HAEMATOLOGICAL PARAMETERS IN DIFFERENT AFRICAN POPULATIONS: AN EXPERIENCE FROM UNITED NATIONS LEVEL 3 HOSPITAL

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ABSTRACT

Objective: To evaluate hematological parameters in African population to estimate normal reference intervals for these tests.

Study Design: Cross sectional observational study.

Place and Duration of Study: Department of Pathology, United Nations level 3 hospital, Nyala, Darfur from 1st Mar to 30th Dec 2014.

***Material and Methods*:** There were 396 healthy African male and female volunteers selected between 18-65 years of age, belonging to different countries. Fresh whole blood was used to measure haemoglobin (Hb) concentration, haematocrit (Hct), total red blood cell (TRBC) count, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), platelet count, total leucocyte count (TLC) and differential white blood cells count. Data were analysed using SPSS version 19.

Results: Mean Hb of study group was 13.81 ± 1.99 g/dl. Mean TLC was 5.50 ± 1.96 x 10^3/ul. Mean lymphocyte count was 2.58 ± 0.95. Mean platelet count was 234 ± 92 x10^3 /ul. Mean values for Hb Concentration, TRBC, Hct Ratio, MCV, MCH and MCHC were all higher for African Males than Females; this difference was statistically significant (p<0.05).

Conclusion: This multi-national African population based study confirms the variations in haematological parameters previously described in single nation African studies. The commonly observed variations in normal adults are low RBC indices, relative neutropenia and lymphocytosis.

Keywords: Africa, Hematology, Reference values, United Nations

INTRODUCTION

The primary role of any clinical laboratory is to provide quality diagnosis services/ test results to clinicians to reach a diagnosis and institute evidence broad/rational treatment of patients. This is done by comparing results with established normal reference values. Laboratory reference intervals may be variable depending on age, gender, race, geographical distribution. The complete blood count and differential leukocyte count are widely used in clinical practice and appropriate reference intervals are essential for the interpretation of patients' test results[1]. The reference interval is defined as the interval between and including two numbers, an upper and lower reference limit, which are estimated for a specified percentage (usually 95%) of the values for a population from which the reference subjects have been drawn[2]. For most analytes, the lower and upper reference limits are assumed to demarcate the estimated 2.5th and 97.5th percentiles of the underlying distribution of values, respectively. A number of studies have been done demonstrating that TLC and neutrophil count are lower in African population as compared to Caucasians[3,4]. This observation is validated by studies performed on population from Uganada, Zambia, Togo, Central African Republic, Ghana, Nigeria, South African Bantus, Black Americans and Afrocaribbeans residents in Britain. However these were all individual studies and recruited people of specific ethnic background.

Most of these studies were done in African population of a particular country and however data incorporating hematological parameters

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from multinational African population lacking. United Nations level 3 hospital located in Darfur, Sudan provided an opportunity to carry out hematological investigations on African populations of different countries making it possible to evaluate hematological parameters in multinational African population.

MATERIAL AND METHODS

It was a cross-sectional observational study carried out at department of pathology, United Nations level 3 hospital, Nyala, Darfur, from 1st Mar 2014 to 30th December 2014. It was approved by hospital ethical committee. The study population comprised of 396 consecutive healthy African male and female volunteers between 18-65 years belonging to different countries reporting at department of pathology during this period. Sample size was calculated using Raosoft sample size size calculator taking confidence interval of 95% and response distribution of 50%. The study group included 270 male and 126 female soldiers and civilians enrolled by consecutive sampling. They were natives of Sudan, Nigeria, Egypt, Kenya, Ethiopia, Sierra Leone and Rwanda. Inclusion criteria included the following; age between 18–65years, asymptomatic at time of blood sampling, no infection or illness in past 2 weeks, no history of drug usage (including vitamins, iron supplements, antibiotics), no recent history of blood loss, not received any blood transfusions in last 12 months. Additional criteria were included for females as, not being pregnant, not lactating and not menstruating at the time of blood collection.

Individuals with positive HIV serology, HBsAg, anti HCV antibody, positive VDRL, current or past smoking history, those with evidence of acute or chronic respiratory, cardiovascular, gastrointestinal, hepatic or genitourinary conditions, history of blood donation/ transfusion within the immediate past three months, hospitalisation within the immediate past one month, or any other findings that in the opinion of the examining clinician may compromise on the assessment of the laboratory parameters of interest in this study were excluded. HBsAg, Anti HCV antibodies and Anti-HIV antibody testing of all participants was done by ELISA and those with positive results were excluded from the study.

At time of enrolment in study, all the demographic information and detailed medical history were collected. A thorough physical examination was performed, and blood samples were collected. The timing of blood sampling was in the morning between 9:00 and 12:00 AM. The volunteers were asked to sit down on a chair, tourniquet was applied for a few seconds, skin was cleaned with alcohol swab, left to air dry and venous blood was drawn by means of venipuncture.

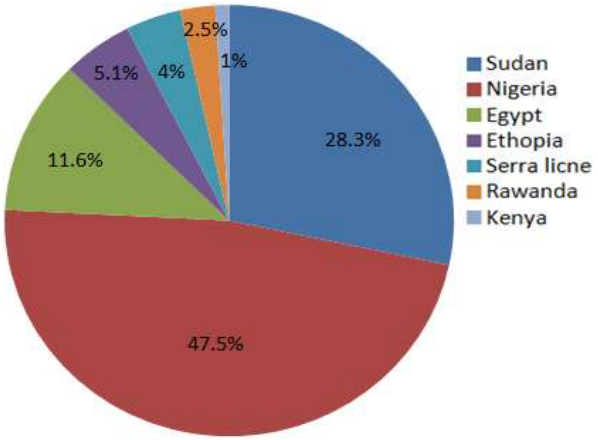

Figure: Pie chart showing the percentage of the study population of different countries.

Sample tubes were purchased from Becton Dickinson (Plymouth, United Kingdom) containing K2 EDTA as anticoagulant. Fresh whole blood was used to measure Hb concentration, Hct ratio, TRBC count, MCV, MCH, MCHC, Platelet count and white blood cells (WBC) count. Measurement of haematological parameters was carried out within 2 hours of sample collection using SYSMEX KX-21(Sysmex Corporation, Japan) automated haematology analyzers. The haematology analyzers were calibrated by standardized commercially prepared calibrators. The manufacturer's stabilized whole blood

controls were used to monitor the analyzer's performance. Blood smears were prepared from fresh blood and air dried. The red cell morphology was assessed after appropriate staining. The results were verified by pathologist. All data were entered in a predesigned proforma. The data were compiled for statistical analysis using statistical package for Social Sciences rogramme (SPSS) version 19.0. The mean, median, and standard deviation (SD) values were calculated for all haematological parameters such as Hb, TLC, Platelets, MCV, MCH, MCHC and total count of neutrophils, lymphocytes, monocytes, eosinophils and basophils. Gender was presented as frequency and percentage.

Independent student's t-test was used to compare means of these parameters between gender groups. Differences were statistically significant when p was <0.05. Data were directly recorded on case report forms. The clinical and laboratory standards institute (CLSI) terms and guidelines for defining reference intervals were followed. The reference intervals were determined as 95% confidence intervals of the population, by striking the top and bottom 2.5% of samples for each parameter.

RESULTS

Study population included 270 (68.2%) males and 126 (31.8%) females. Mean age of study population was 34.14 ± 9.25 years. The bulk of the study population comprised of individuals from the countries of Nigeria, Sudan and Egypt (fig-1). Mean Hb of study group was 13.81 ± 0.99 g/dl (Mean ± SD). Mean TLC was 5.50 ± 0.98 x 109/L. Mean platelet count was 234 ± 46 x109 /L (table-I). Mean Hb in females was 12.5g/dl while in males it was 14.4 g/dl and difference was statistically significant (p<0.001). Similarly gender differences in TRBC, PCV, MCV, MCH, MCHC, platelets count, TLC, lymphocyte and neutrophil count were also significant statistically however non-significant difference was observed with respect to absolute counts of eosinophils and monocytes (table-II). Similarly when data was analyzed to differentiate hematological parameters on basis of native countries of origin, no statistically significant difference was observed.

Table-I: Descriptive Statistics of the study group (n=396).

	Minimum	Maximum	Mean	SD	Reference interval
Hb (g/dl)	7.4	17.0	13.81	0.995	12.82-14.81
TRBC (10^{12}/L)	3.40	6.60	4.72	0.28	4.44-5.00
PCV (L/L)	0.27	0.53	0.41	0.021	0.39-0.43
MCV (fl)	67.0	101.9	86.5	2.93	83.57-89.43
MCH (pg)	23	36	29.6	0.8	28.80-30.40
MCHC (g/dl)	27.0	37.6	33.62	0.74	32.88-34.36
Platelet count (10^9/L)	80	544	234	46	188-280
TLC (10^9/L)	2.5	10.4	5.50	0.98	4.52-6.48
Neutrophil count (10^9/L)	0.7	6.8	3.14	0.665	2.48-3.81
Lymphocyte count (10^9/L)	0.8	4.5	2.58	0.475	2.11-3.06
Monocyte count (10^9/L)	0.1	1.0	0.40	0.125	0.28-0.53
Eosinophil count (10^9/L)	0.03	0.46	0.23	0.085	0.15-0.32
Neutrophils (%)	22.0	73.0	48.53	5.425	43.11-53.96
Lymphocytes (%)	5	65	43.04	5.31	37.73-48.35
Monocytes (%)	1	16	4.30	0.92	3.38-5.22
Eosinophils (%)	1	14	.68	0.795	2.89-4.48

DISCUSSION

Blood CP which includes the hematological parameters is one of the baseline and most commonly ordered laboratory test[5]. These

parameters are helpful in guiding towards a diagnosis in various diseases. Blood indices show variability depending upon various factors including the ethnicity, gender, age, nutrition and environmental conditions[6]. The reference ranges of these indices have been standardized mostly using the data of western based studies. There have been a number of studies to determine the reference ranges in African population, but all these studies have been carried out in a particular country or region and encompass a particular nationality[7]. Being in a United Nations field hospital located in Nyala, Darfur, Africa and having access to multiple African populations provided an ideal platform for a broad based Pan African study. The study population included various nationalities mainly Sudanese, Nigerian, Egyptian, Kenyan, Ethiopian, Sierra Leone and Rwandan.

Various studies done in the past have concluded that the normal reference ranges in hematological parameters in normal adult African population are significantly different from similar studies done in the American, European and Caucasian ethnicity[8]. This study was conducted to determine and confirm the differences between reference intervals of various haematological parameters, when a broader multinational African population was considered.

ong the red blood cell indices, Hb, TRBC, MCV, MCH, MCHC and Hct were considered. Reference intervals for either sex documented in textbooks for MCV, MCH and MCHC were found to be comparable in our study population of healthy Africans, however statistically significant difference was observed when gender was added as a factor. Mean Hb was found to be 13.81 ± 0.99 and was 14.4 ± 0.65 for males and 12.5 ± 0.7 for females. These values were lower as compared to western studies[9]. Various factors have been postulated for such differences such as nutritional deficiency of iron, hookworm infestations, genetic factors, chronic malaria and menstrual blood loss[10].

In the granulocytic lineage, TLC was found to be significantly lower in our population as confirmed by similar studies. Similarly the neutrophil counts were found lower than the

Table-II: Gender wise distribution of haematological parameters.

	Male (n=270)			Female (n=126)			*p*-value
	Mean	SD	Reference interval	Mean	SD	Reference interval	
Hb (g/dl)	14.4	0.65	13.75-15.05	12.5	0.7	11.8-13.2	<0.001
TRBC (10^{12}/L)	4.94	0.3	4.64-5.24	4.25	0.225	4.025-4.48	<0.001
PCV (L/L)	0.42	0.025	0.395-0.445	0.37	0.02	0.35-0.39	<0.001
MCV (fl)	86.5	2.75	83.75-89.25	83.5	3.25	80.25-86.75	<0.001
MCHC (g/dl)	33.9	0.7	33.2-34.6	33.2	0.75	32.45-33.95	<0.001
MCH (pg)	30.6	0.65	29.95-31.25	29.9	0.9	29-30.8	<0.001
Platelet count (10^9/L)	214	40	174-254	244	33.5	210.5-277.5	<0.001
TLC (10^9/L)	5.0	0.85	4.15-5.85	5.5	0.95	4.55-6.45	<0.001
Neutrophil count (10^9/L)	2.8	0.7	2.1-3.5	3.0	0.75	2.25-3.75	0.01
Lymphocyte coun(10^9/L)	2.3	0.5	1.8-2.8	2.5	0.55	1.95-3.05	0.0004
Eosinophil count (10^9/L)	0.23	0.075	0.155-0.305	0.22	0.07	0.15-0.29	0.21
Monocyte count (10^9/L)	0.42	0.125	0.295-0.545	0.40	0.125	0.275-0.525	0.139
Neutrophil (%)	48.2	5.35	42.85-53.55	50.2	5.55	44.65-55.75	0.0007
Lymphocytes (%)	41	5	36-46	43	5.5	37.5-48.5	0.0004
Eosinophils (%)	4	1	3-5	3	0.75	2.25 -3.75	<0.001
Monocytes (%)	5	0.65	3-7	4.5	2	2.5-6.5	0.002

reference ranges. In white blood cells another interesting feature was relative lymphocytosis. This observation is also confirmed by similar studies done in African populations[11]. No significant difference was observed in the platelet counts.

Generally the results of this study confirmed the significant difference from standardized western based studies and were similar to individual studies done in African population as in Ethiopia[12], Central African Republic[13] and Uganda[14]

CONCLUSION

This multi national African population based study confirms the variations in haematological parameters previously described in single nation African studies. The commonly observed variations in normal adults are low RBC indices, relative Neutropenia and Lymphocytosis.

RECOMMENDATION

Clinicians should bear in mind various variables while managing patients of African origin. This will help in correct interpretation of the haematological indices as well as help in avoiding unnecessary investigations.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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