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Original Research Article

Normal range of white blood cells and differential count of Sudanese in Khartoum state

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ABSTRACT

Background: The normal physiological range for white blood cells and differential count are essential for diagnosis, treatment, follow up and screening. This study aimed at establishing the reference ranges of WBCs and differential count in Sudanese people.
Methods: The present study included 444 healthy adult Sudanese from both sexes with age range of 20 – 60 years. Blood samples were obtained from brachial veins and drawn in EDTA tubes. WBCs and differential count were analyzed using Sysmex KX-21 automated hematology analyzer. Full clinical examination was performed, weight and height were measured, and BMI was calculated.
Results: The mean WBC count was 5.1±1.5×103/ µl with a range of 3.6 ×103/µl to 6.6 ×103/µl. The mean WBCs count for males and females were 4.969×103/µl and 5.138×103/µl respectively. Neutrophils count was 2.430×103/µl (47%) and mean for lymphocyte count was 2.116×103/µl (41.1%).
Conclusions: WBCs count was directly proportional to BMI. The WBCs count of Sudanese people was lower than that of Caucasians and similar to reports from other African countries.

Keywords: BMI, Differential count, WBCs

INTRODUCTION

Appropriate local reference values for hematological parameters are important for diagnosis, treatment, follow up and screening. The reference values of hematological markers currently used in Asia and Africa have been obtained from researches on populations in developing countries and may not be applicable in most regional settings.[1] The lack of appropriate hematological reference range may cause unnecessary follow up investigations, treatment and mismanagement of patients.[2] In addition, many different factors such as age, gender, ethnicity, geographical and environmental factors have an impact on the hematological parameters in different population.[3] Recently studies conducted in Asian and African countries demonstrated lower hematological parameters compared with those from populations in industrial countries.[4,5]

Recent studies demonstrated significant differences in the hematological reference ranges by sex and between studied groups. They also showed that there were

considerable differences in the reference values from western population compared with those from the local population.[4] White blood cells (WBCs) count in obese subjects were found significantly higher than in non-obese subjects.[6] A study done by A.A Abbas and others in Gezira State revealed that there was no significant difference in WBCs count between Sudanese people and international reference values. In another study conducted in Khartoum state reported that WBCs count showed the same result when compared with international reference values.[7,8] In contrast to these results, WBCs count and differential count showed significant variation in Sudanese young adults healthy males in comparison with the reference ranges of African and American.[9] It is necessary to conduct a study involving a large sample size for more accurate determination of WBCs and differential count in Sudanese. Therefore, we have conducted this study to establish the reference ranges of WBCs and differential counts in Sudanese people and to correlate them with age, sex and BMI.

METHODS

This was a cross sectional descriptive study approved ethically by Sudan Federal Ministry of Health and the National Ribat University. This initial study was conducted in Khartoum state from December 2016 to April 2017. The participants were healthy Sudanese males and females between 20-60 years old and residence for at least one year in Khartoum. Participant with Chronic diseases (Hypertension, diabetes mellitus, liver diseases, renal diseases, cardiac diseases, TB, asthma, thyroid disorders), hematological disorders, recent acute diseases (malaria, typhoid fever) surgery, pregnancy and lactation, splenectomy and history of schistosomiasis were excluded.

Each of the participants provided a written informal consent after fully explaining to them the project. A questionnaire was filled by each participant individually. Blood sample was drawn from the brachial vein by the standard procedure with a Vacutainer into tubes containing K3E-EDTA (Anticoagulant) and gently mixed by inverting the tube five to six times immediately after drawing. WBCs and differential count were measured using Sysmex KX-21 automated hematology analyzer. Weight and height were measured with standard techniques. BMI was calculated as weight (kg)/height $(m)^2$. Complete clinical examination was performed. Data was collected in data collection sheet excel. Results obtained were analyzed by Statistical Package for the Social Sciences (SPSS) software version 23 (SPSS Inc., Chicago, IL). The mean and standard deviation were calculated for each parameter. Student test was used for normally distributed data and to compare between two groups. One Way ANOVA was used to compare between different groups. P ≤0.05 was considered statistically significant.

RESULTS

A total of 444 healthy adults were included, 353 (79.5 %) were females and 91 (20.5 %) were males, with age range of 20-60 years.

The mean±SD of WBCs count for Sudanese in Khartoum state was $5.1\pm1.5\times10^3$/ µl compared to international value of 7.5×103/ µl, but comparable to African countries (Table 1). The mean differential count±SD is presented in (Table 2).

There is no significant difference between males and females in the WBCs count, 4.969/ µl and 5.138/ µl respectively, but the count for the age group 30-39 was 5.465±1.22 and for the age group above 50 was 4.843±2.08. There was statistically significant difference between underweight and obese for WBCs count (P ≤0.05). WBCs count was directly proportionate with-BMI (Table 3).

Table 1: Comparison of WBCs values of Sudanese with International values from Caucasians.

Parameter	Mean for Sudanese	Mean for International
WBCs count	5.103/µl	7.500/µl
Male WBCs count	4.969/µl	7.500/µl
Female WBCs count	5.138/µl	7.500/µl

The mean for the WBC count was found to be 4.969 x 10^3/µl for men, with a higher mean of 5.138 x10^3/µl for women. The difference was not significant; but when we compare the mean of WBCs count in Khartoum state (Sudan) to the International values it is found to be significantly low (5.103 x10^3/µl and 7.500x10^3/µl respectively). The WBCs count in Sudanese is similar as those from African countries, but sigificant lower than the International values.

Table 2: Mean values of WBCs differential in Sudanese.

Variables (thousand/ µl)	Mean	Std. deviation %	% of Sudanese mean	% of international mean
Lymphocyte count	2.116	0.9	41.1% (45% male 40% female)	20-40%
Neutrophils count	2.430	1.5	47% (40% male 45% female)	45-75%
(monocytes, basophils and eosinophils) count	0.678	0.4	11.7	3-13%

The mean of total WBCs count was 5.103×10^3/µl and the absolute neutrophil counts was 2.43×10^3/µl. The mean lymphocyte counts in males and females were, respectively, 2.1×109/L and 2.2×109/L.

Neutrophil and lymphocyte counts were also significantly higher in females compared to males.

Table 3: Comparison WBCs count between BMI categories.

BMI classification	N (%)	Mean±SD
Under weight	102	4.802±1.504**
Acceptable	223	5.078±1.474
Over weight	82	5.333±1.493
Obese	36	5.589±2.034**

**P ≤0.05 underweight versus obese

The WBCs count in Sudanese was directly proportion to the BMI.

Underweight subjects had lower WBCs count than obese subjects and the difference was statistically significant P ≤0.05. WBCs count significant increased by increasing BMI.

DISCUSSION

The goal of this study was to establish the reference ranges of WBCs and differential count in Sudanese and correlate them with age, sex and BMI. The WBCs count is globally lower among black people than in Caucasians.[6,10,11] In present study we have demonstrated that WBCs count in Sudanese healthy adult was significantly lower than International reference values. In addition, our results are similar to many African countries such as Central Africa, Uganda and Tanzania and lower than South Africa and Ethiopia.[12-16] The cause of these differences is unclear, although dietary, environmental and genetic factors have been reported.[13,17]

Neutrophils count was reported lower in all black African and American population.[18,19] Present study revealed that neutrophils count in Sudanese people is similar to black African population. Mechanisms by which black African people have neutropenia is still not explained. Furthermore, lymphocyte count in Sudanese people was similar to those reported from African studies.[5,13]

In this study a slight insignificant difference of mean WBCs count was observed between males and females in Sudanese people. In consistence with our result previous studies have documented minor differences of mean WBCs count from different parts of the world.[4,20-22] In contrast, Rukia and his colleagues demonstrated statistically significant differences in WBCs and differential count by gender in Kenya, where males had lower values than females (Table 1).[23] This study demonstrates that mean WBCs count was markedly lower in underweight Sudanese people compared with obese one and directly proportion with BMI (Figure 2). The mean WBCs and differential count was higher in obese compared to non-obese women.[24] Shimakawa et al reported that the mean WBCs count is positively associated with components of metabolic syndrome, such as BMI and WHR.[25] In obese subjects Adipose tissue produces and releases a variety of inflammatory factors and adipokines as well as cytokines such as IL-6 and IL-8.[26] WBCs count was increased by cytokines, especially IL-6.[27] IL-6 by itself further increases the production of C Reactive Protein (CRP) in obesity. This elevated amount of CRP is taken up by WBC, promotes migration of WBC into arterial wall.[28]

CONCLUSION

In conclusion, authors demonstrated that the WBCs count of Sudanese people was similar to reports from other African countries and lower than Caucasians. In addition, the WBCs count was directly proportional with BMI.

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