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Reference Range of Platelets count in Healthy Adult Sudanese

Elmutaz Hussien Taha[1*], Mohammed Elshiekh[1], Mohamed Ali Alzain[2], Elnagi Y. Hajo[3], Abdelmohisen Hussein[4], Kamal M. Awad[4], Ibrahim A. Ali[5], Omer A. Musa[5]
[1]Department of Physiology, Faculty of Medicine, Dongola University, Sudan
[2]Department of Community Medicine, Faculty of Medicine, Dongola University, Sudan
[3]Department of Physiology, Faculty of Medicine, The National University, Sudan
[4]Department of Physiology, Faculty of Medicine, Gadarif University, Sudan
[5]Department of Physiology, Faculty of Medicine, National Ribat University, Sudan

Original Research Article

***Corresponding author**
Elmutaz Hussien Taha

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Abstract: The hematological reference values used in Sudan were usually from those of Caucasian populations. It has previously been shown that the white blood cells count in Sudanese is different from international values. The objectives of this study were to establish the reference ranges of platelet count and indices in healthy Sudanese adults. The study included 1076 healthy Sudanese adults from five states and both sexes, with age range of 20 – 60 years. Clinical examination was performed, weight and height were measured, and BMI was calculated. 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. SPSS version 25 statistical software was used for data analysis, P value $\leq$ 0.05 was considered significant and 95% CI was accepted. The mean age of participants was 25.23±9.64 years. The median of platelets count was 280×10^3/µL with reference range of (124-465× 10^3/µL)., for platelet distribution width (PDW) was14.6 ٪ with reference range of (9.1-17.1), and for the mean platelet volume (MPV) was 9.8 and the reference range was (8-13.2FL). Female had a significantly higher platelet count (295× 103/µL) than male (245× 103/µL). The platelets count was significantly higher in Red sea state and small age group (20-29), and also. The Sudanese platelets count is higher than many African Countries but lower than the international reference values, and higher in females than males with regional differences.
Keywords: hematological reference, Sudanese adults, platelet.

INTRODUCTION

Platelets are the second most numerous circulating cells in the blood, after erythrocytes [1]. Megakaryocytes are stimulated to release these small non nucleated cytoplasmic fragments, the platelets, into the circulation by throm bopoietin [2]. Platelets contain a complex network of specialized cell surface receptors and specialized internal structures that enable them to respond to environmental stimuli and participate in hemostasis, coagulation, and the maintenance of vascular integrity. Stimulation of platelets results in platelet adhesion; activation, aggregation, and secretion of granules.[3] Platelets contain three main types of storage granules; dense, alpha, and lysosomal granules [4].

The platelet count is globally lower among black people than in Caucasians [5]. Platelet count, which is usually performed on whole blood using automated hematology analyzers in clinical laboratories, is essential for the diagnosis and management of hemostasis /abnormalities [6].

Platelet volume indices (PVI) have been studied as an easy to obtain and significant parameter in coronary artery disease (CAD). The mean platelet volume (MPV) co-relates with the pre-thrombotic state in acute ischemic episodes and that larger platelets may play significant role in infarction [7]. WBC count and platelet distribution width (PDW) were increased in subjects with ST- segment elevation in acute myocardial infarction (MI) [8].

Sudan, one of the largest countries in the Central East of Africa, has about 40 million individuals. Until now; hematological reference values have not been established. The values usually used are those of Caucasian populations.

Accordingly, we decided to establish hematological reference values in Sudan by studying

healthy Sudanese adults and this study aims to establish reference ranges for Sudanese platelets count and indices.

METHODS

A cross-sectional study was conducted in five states of Sudan, representing the central, northern, western and eastern areas, from December 2016 to April 2018. Khartoum and Gezira states represent the central area with multi ethnicities. The Red sea state, near Eretria and Ethiopia, represent the eastern areas, North Darfur is near Chad and Central Africa and represent the western areas, while the Northern state, near Egypt and Libya represents the northern areas. Ethical approval was obtained from the research ethical committees of the Federal Ministry of Health and the National Ribat University, Sudan. Each participant provided a written informed consent after fully explaining to them the project. A total of 1076 healthy adult Sudanese aged between 20-60 years old and resident for at least one year in their state were included. A questionnaire was filled by each participant. Any subject with; chronic diseases (cardiac diseases, TB, asthma, thyroid disorders, diabetes mellitus, hypertension, renal failure, liver diseases …. etc.); recent acute diseases (malaria, typhoid fever, …); recent surgery; drug abuse; pregnancy; lactation and heavy smokers were excluded. Clinical examination was performed, weight and height were measured, and BMI was calculated as weight (kg)/height (m^2).

Blood samples were drawn from the brachial veins by the standard procedure with a Vacutainer into tubes containing K3E-EDTA and gently mixed by inverting the tube five to six times immediately after drawing. The samples were then placed in ice-box, transported to the laboratory and processed within two hours. A Sysmex KX-21 automated hematology analyzer was used for measuring Platelet count and indices. Normality of continuous variable was determined by using the Shapiro-Wilk test. The non-parametric continuous (Platelet count and indices) was presented as a median (interquartile range). Normal reference range was determined by 2.5^{th} and 97.5^{th} percentile for Platelet count and indices according to CLSI [9]. To determine differences between groups for continuous non-normally distributed variables, the medians were compared using the Mann-Whitney U test. All statistical tests were two sided, and $p \leq 0.05$ was considered statistically significant. All statistical analyses were carried out using IBM SPSS Statistics software (version 25.0 from Armonk, NY: IBM Corp, USA).

RESULTS

The sample was selected from five states, namely Khartoum 437 subjects (40.6%), Northern 203 (18.9%), Red sea 174 (16.2%), North Darfur 171 (15.9%), and Gezira state 91 (8.5%). The age group 20-29 years represented 81.8%, 30-39 years was 7.3%. While 40-49 years was 5.8% and 50-60 was5.1%.

The reference range of Platelets count in adult Sudanese was (124- 465) × 103/µL with a median of 280× 103/µL. as indicated in table1.The median of PDW was found to be 14.6 ٪ with reference range of (9.1- 17.1). While the median of MPV was 9.8FL with reference range of (8-13.2). There was a significant difference in platelet count and indices between age groups; age group between 20-29 years had a significantly higher platelet count than other age groups. While the MPV significantly decrease with increase age.

The median of platelet count was significantly higher in females [295 × 103/µL (range: 243- 347× 103/µL)] than males [245× 103 /µL (range: 200- 291× 103/µL)] ($p < 0.001$) as shown in table 2 and Figure 1. The same result was found regarding MPV. In contrast PDW was found significantly higher in males (p. value<0.05) as shown in table 1 and Figure 1. There was significant increase in the platelet count and PDW in subjects with higher educational level, as shown in table 2. Our results showed that there was statistically significant (p. value<0.05) increase in Platelets count and MPV in the Red sea state (East of Sudan) compared to the other states as shown in (figure2).

Table-1: Reference ranges and the median of platelet count and indices

Parameter	Median(IQR)	Reference range (2.5^{th}-97.5^{th})
Platelet(10^3/µL)	280(232-340)	(124-465)
PDW. ٪	14.6(9.1-15.3)	(9.1-17.1)
MPV. FL	9.8(9.1-10.6)	(8.0-13.2)

Table-2: Demographical characteristics of the study population with Platelet count and in

Variables	n(%)	Platelet Median(IQR)	P. value	PDW Median(IQR)	P. value	MPV Median(IQR)	P. value
Age group							
20-29 years	848(81.8)	285(239-341)	0.002	14.7(12.3-15.4)	0.269	9.9(9.2-10.7)	0.035
30-39 years	76(7.3)	248.5(212.5-319.3)		14.6(12.2-15.1)		9.85(9.3-10.6)	
40-49 years	60(5.8)	248.5(207.3-346)		14(10.3-14.8)		9.65(8.9-10.3)	
50-60 years	53(5.1)	242(197-327.5)		14.8(13.5-15.4)		9.5(8.8-10.2)	
Sex							
Male	261(24.6)	245(200-291)	<0.001	14.9(12.3-15.3)	<0.001	9.6(8.8-10.4)	0.01
Female	802(75.4)	295(243-347)		14.6(12.1-15.6)		9.9(9.3-10.7)	
Education							
Illiterate	19(1.8)	268(233-337)	0.006	10.5(9.4-14.6)	<0.001	8.9(8.4-9.8)	0.231
Preprimary	19(1.8)	257(231-242)		11.8(10.1-14.6)		10(9.15-10.5)	
Primary	34(3.2)	254.5(218.5-307.3)		12.3(9.7-14.9)		10.6(9.8-11.1)	
Secondary	80(7.4)	255(202.8-317.8)		14(10.7-14.8)		9.8(9.1-10.4)	
University	844(78.4)	285(236.3-242)		14.7(12.5-15.4)		10.1(9.2-11.3)	
P. graduate	22(2.0)	271(222.8-300)		14.1(12.15-14.8)		9.9(9.2-10.6)	
States							
Khartoum	437(40.6)	271(236-331.5)	<0.001	13.1(11.1-15.3)	<0.001	9.9(9.3-10.6)	<0.001
Red sea	174(16.2)	321(276.8-383.5)		12.9(11.8-14.3)		10.7(9.9-11.2)	
Northern	203(18.9)	245(210-299)		14.8(14.6-15)		9.8(9.3-10.4)	
Gezira	91(8.5)	285(248-350)		13.4(12.1-15.3)		10.4(9.7-11.2)	
N. Darfur	171(15.9)	286(215-347)		15.6(15.3-15.9)		8.7(8.4-9.2)	

Table-3: comparison of platelet counts between study population and African studies

Countries	Median (Reference range)	*p*.value
Our study Ethiopia	280 (124-465) 264(132-423)	0.005
Tanzania	221*	
Malawi	170*	
Uganda	198(100-297)	
Botswana	277(141-494)	
USA	257*	
Togo	239(120-443)	
Central-Africa	228(117-382)	
Kenya	226(120-411)	

*Reference range not available

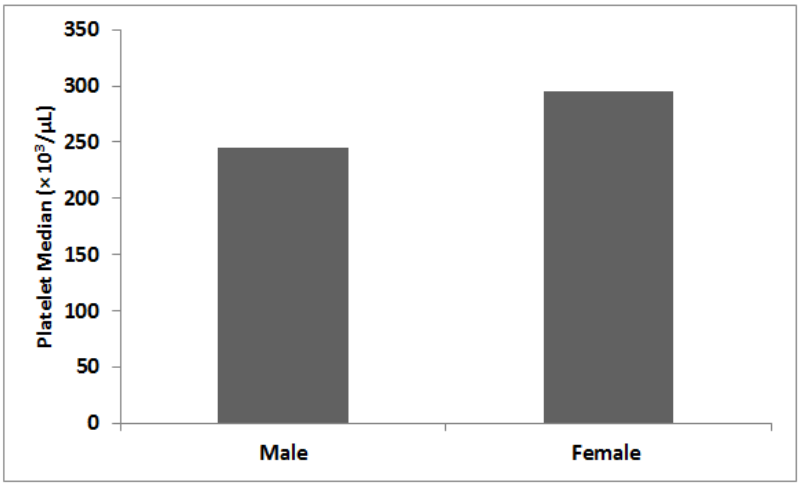

Fig-1: Platelet count in male and female in adult Sudanese

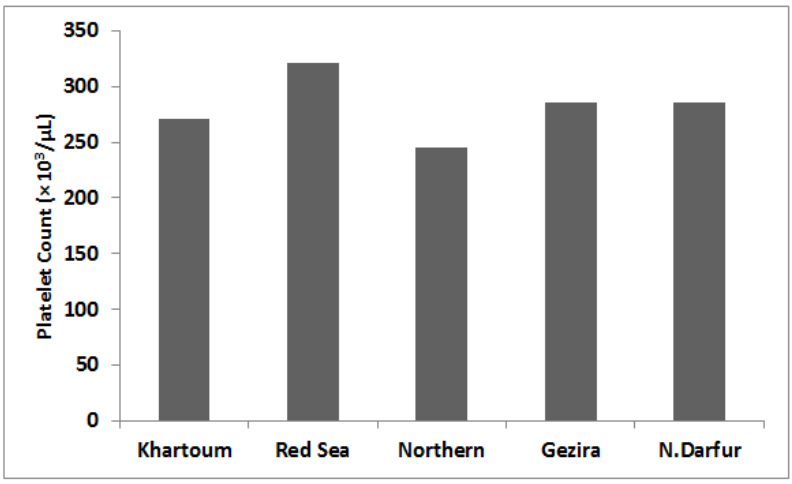

Fig-2: Platelet count in different states in adult Sudanese

DISCUSSION

The aim of our study was to establish the reference range of platelets count in adult Sudanese and identify factors that influence the platelets count values. The reference range of our study was (124-465 × 10^3/µL), and the median was 280, which was significantly higher than several studies done in African countries like Ethiopians (265× 10^3/µL), Ugandans (235× 10^3/µL), Tanzanian (221× 10^3/µL), Malawians (170× 103\$^3$/µL) [10-13] and Togo (239× 10^3/µL) [5], but almost the same count of Botswanains (277× 103/µL) [14]. The reference values of platelets count in adult Sudanese is lower than the international count (200-500× 103/µL) [15]. The higher platelet counts of Sudanese compared with many African countries may be due to the ethnic composition of Sudanese which is a complex mixing between Arab and African nations.

We have found that males had significantly lower platelets count compared with females, and this agreed with many previous studies [16-18]. The higher platelets count observed in females agrees with what has been reported by previous studies which suggested that gender-based differences in platelets count are most likely due to differences in hormone profiles where estradiole has been demonstrated to trigger platelet formation in megakaryocytic cells [19]. Our results showed that the red sea state had higher platelets count compared to the other states. This might be due to environmental or/and genetic factors. There was an increase in platelets count and PDW with higher educational level for unknown reasons.

The median of MPV was (9.8 FL) which was higher compared with an American study (8.4 FL)[13] and lower than a study done in Sudan (10.2 FL)[20]. This might be due to the younger age of the participants compared to our study subject, and we found that younger participant had significantly higher MPV (9.9 FL).

Our study showed that MPV was significantly higher in red sea state; which may be due to certain type of infection and this was matched with study conducted in Sudan which revealed that red sea state had a significant higher WBCs count compare with other states [21].

MPV was reported to have been affected by inflammation, and that it increases significantly in myocardial infarction, sepsis, cerebrovascular diseases, respiratory distress syndrome, chronic pulmonary diseases [22, 23] and acute appendicitis [24].

The present study had some limitations. First, the mean age of participants was younger (25.23±9.64 years) this is because most of elder participant were excluded due to the chronic diseases. Second, many states were not included in the study. Third the number of female was larger compared with male.

In conclusion the reference values of platelets count in adult Sudanese is lower than the international one and higher than many Africant countaries. A larger national scale should be performed to overcome the limitations.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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