

Reference Value Profile for Healthy Individuals From the Aljouf region of Saudi Arabia

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Abstract

Background: Many factors influence hematological values such as sex, age, ethnic origin, geographic location, season, and genetic disease. The aim of this study was to detect the hematological reference value profile for healthy adults from the Aljouf region of Saudi Arabia.

Methods: The project was carried out on 2,040 healthy individuals, 1,152 males and 888 females, with ages ranging from 17 to 28 years. A group of participants were recruited from the higher secondary schools, university students and premarital centers of Aljouf cities. Hematological reference value profile, hemoglobin (Hb) concentration, red blood cell (RBC) count, RBC indices, white blood cell (WBC) count, differential WBC and platelet (Plt) count were measured. Moreover, a peripheral blood film was prepared in order to detect abnormalities of RBC and all samples were examined for liver function tests (LFTs) and renal function test (RFT) performed, along with a lipid profile.

Results: Hb concentration, hematocrit (Hct) and RBCs were found to be significantly higher in males than in females ($P < 0.01$). On the contrary, Plt ranges were significantly lower in male as compared to female ($P < 0.01$). No significant differences in the study population were determined in the other hematological parameters ($P > 0.05$).

Conclusion: Our findings reflect that healthy adults from the Aljouf region have some hematological parameters differing quantitatively from Caucasians. The hematological reference value profile reported here can be used as normal reference values for Saudi people of the Aljouf region to help in diagnosis and consequently treatment of individuals with hematological disorders.

Keywords: Full blood count; Hematological parameters; Aljouf

Introduction

Many factors influence hematological values such as sex, age, ethnic origin, geographic location, season, and genetic disease [1, 2]. Moreover, a major problem in Arab countries is to determine “normal healthy individuals” due to the high prevalence of hemoglobin (Hb) disorders, iron deficiency anemia and viral infections [3-5]. It is important to recognize that reference ranges in your laboratory may be different; when interpreting results from patients in your laboratory, you must use your own local reference ranges. Thus, unsuitable reference values of hematological profile might elevate the risk of either unnecessary further investigations or failure to determine underlying disease [6].

Full blood count can be performed either manually or on an automated hematology analyzer, using well mixed anticoagulated (normally EDTA) whole blood. The latter was preferred to be used here, as it is rapid, precise and accurate [7]. This will obviously assist to establish hematological reference values in a proper way.

There are no studies published to date investigating the reference values of hematological profile for healthy individuals in Arab populations in Saudi Arabia. The Saudi Arabs are a distinctive lineage and they live in a particular environment. Also, they have a characteristic lifestyle [8] and they might not be the same as the other population. Therefore, the aim of this study was to detect the hematological reference value profile for healthy adults from the Aljouf region of Saudi Arabia.

Studies of this type are essential to establish hematological reference values which may serve Arabic countries particularly the Aljouf region of Saudi Arabia for interpretation of laboratory results. This will improve and help in diagnosis and treatment of individuals with hematological disorders. The hematological reference values from Aljouf may also serve as a pattern for other Arabic regions, better than the commonly used Caucasian values.

Materials and Methods

Hematological parameters and blood morphology, two enzymes (aspartate aminotransferase (AST) and alanine aminotransferase (ALT)) for liver function tests (LFTs), urea and creatinine for renal function test (RFT), along with a lipid profile (total cholesterol and triglyceride), were performed on

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Table 1. Hematological Reference Value Profile for Normal Adults of Aljouf Region Expressed as a Mean \pm SD (95% Range)

Hemoglobin concentration, g/dL	
Male	15.2 \pm 2.3 ^a
Female	13.7 \pm 1.8
Red blood cell count, $\times 10^6/\text{mm}^3$	
Male	4.8 \pm 0.4 ^a
Female	4.1 \pm 0.5
Hematocrit (Hct) packed cell volume (PCV)	
Male	0.43 \pm 0.03 ^a
Female	0.39 \pm 0.05
Mean corpuscular volume (MCV), fL	
Male	83.8 \pm 5.6 ^b
Female	84.1 \pm 5.7
Mean corpuscular hemoglobin (MCH), pg	
Male	29.8 \pm 2.0 ^b
Female	28.9 \pm 2.6
Mean corpuscular hemoglobin concentration (MCHC), g/dL	
Male	36.3 \pm 0.4 ^b
Female	35.9 \pm 1.8
Red cell distribution width (RDW), %	
Male	13.2 \pm 0.8 ^b
Female	12.9 \pm 0.7
Platelet count (Plt), $\times 10^3/\text{mm}^3$	
Male	252.1 \pm 84.9 ^a
Female	294.7 \pm 114.9
White blood cell count (WBC), $\times 10^3/\text{mm}^3$	
Male	6.2 \pm 2.4 ^b
Female	6.5 \pm 2.6
Differential white blood cell count	
Neutrophils, %	58.2 \pm 14.2 ^b
	59.1 \pm 13.4
Lymphocytes, %	33.7 \pm 10.7 ^b
	34.7 \pm 11.2
Monocytes, %	7.2 \pm 2.6 ^b
	7.7 \pm 2.4 ^b
Eosinophils, %	3.3 \pm 2.2 ^b
	3.1 \pm 1.9
Basophils, %	0.5 \pm 0.49 ^b
	0.6 \pm 0.46

SD: standard deviation. Statistical significance is shown in superscript parenthesis and determined by comparison of male group with female indices. ^aP < 0.01. ^bP > 0.05.

1,152 male and 888 female healthy individuals of the Aljouf region, 2,040 in total with ages ranging from 17 to 28 years. Exclusions included those already on medications for anemia and other diseases, smokers and pregnant or lactating individuals.

Participants were recruited from the higher secondary

schools, university students and premarital centers of Aljouf cities during the period from January 2015 to June 2016. Ethical approval for the study protocol was obtained from the Faculty of Medical Applied Science, University of Aljouf. Informed consent was obtained individually from all subjects.

Hematological reference value profile, Hb concentra-

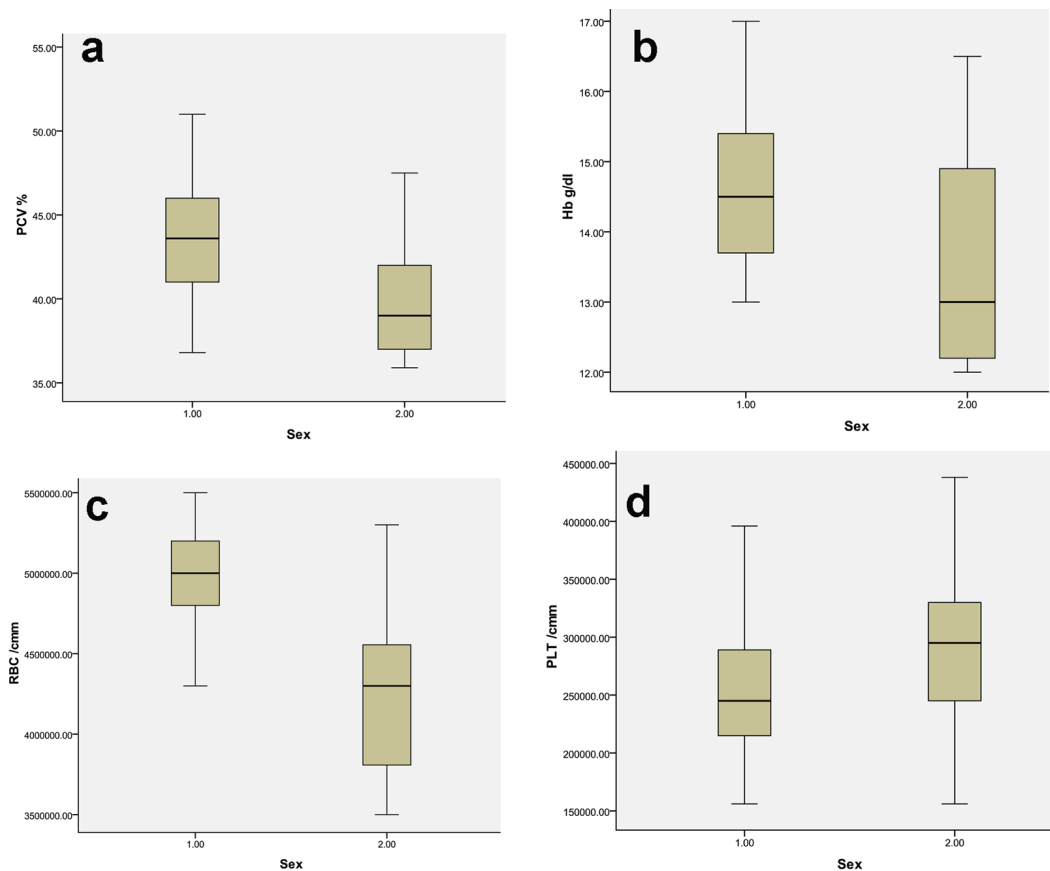


Figure 1. Hematological parameters with significant variation between male and female. PCV: packed cell volume; Hb: hemoglobin; RBC: red blood cell; 1: male; 2: female.

tion, red blood cell (RBC), RBC indices (packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and red cell distribution width (RDW)), white blood cell (WBC), differential WBC (neutrophil, lymphocyte, monocyte, eosinophil and basophil) and platelet (Plt) count were measured, using a hematology analyzer, BS-320. Moreover, a peripheral blood film was prepared in order to detect abnormalities of RBC, using Leishman's stain and all samples were examined for ALT and AST as LFT, urea and creatinine as RFT performed, along with total cholesterol and triglyceride as a lipid profile, using chemistry analyzer BS-200.

Results

The complete hemogram of the normal adults of Aljouf region is summarized in Table 1. This table also shows comparative statistics between genders. Hb concentration, hematocrit (Hct) and RBCs were found to be significantly higher in males than in females ($P < 0.01$), as shown in Figure 1a, b and c, respectively. On the contrary, Plt ranges were significantly lower in male as compared to female ($P < 0.01$) as summarized in Figure 1d.

No significant differences in the study population were

determined in the other hematological parameters, RBC indices, WBC and differential WBC count (neutrophil, lymphocyte, monocyte, eosinophil and basophil) ($P > 0.05$) (Fig. 2). In contrast, our findings reflect that healthy adults from the Aljouf region have some hematological parameters differing quantitatively from Caucasians, as observed in the results of WBC and MCV, while other hematological parameters have reference value profiles which are similar.

The findings in healthy individuals for AST, ALT, urea, creatinine, total cholesterol and triglyceride were within the published normal ranges of 21 ($5 \pm SD$) and 30 ($7 \pm SD$), respectively.

Discussion

This is a prospective cross-sectional study to assess the hematological reference value profile, which included differentially counting blood cell types, blood cell morphology and RBC indices. The results incorporate RBC, WBC and Plt counts. The RBC indices contain parameters such as Hb concentration, PCV, MCV, MCH, MCHC and RDW [9]. All these were done in the current study for healthy individuals from the Aljouf region of Saudi Arabia.

Moreover, prior to selecting our participants for hemato-

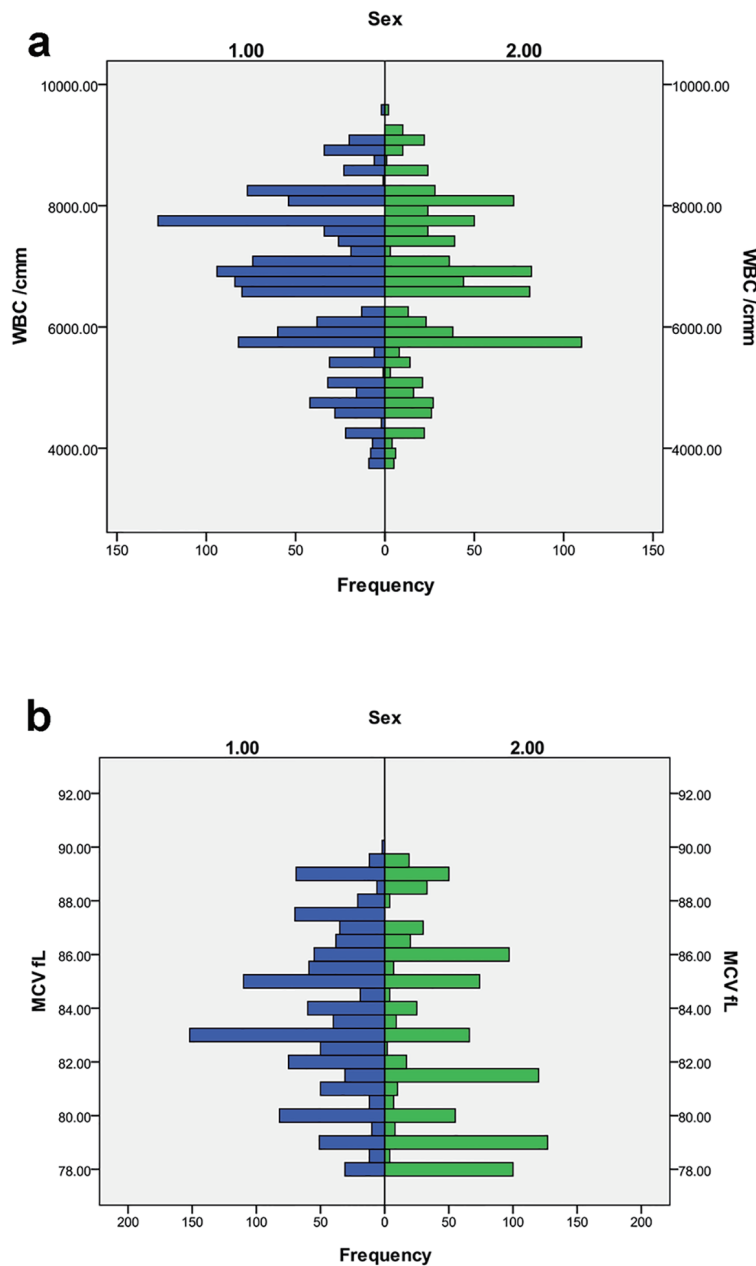


Figure 2. Hematological parameters which do not show significant variation between male and female. WBC: white blood cell; MCV: mean cell volume; 1: male; 2: female.

logical reference value profile, an interview and questionnaire was applied to collect demographics: nationality, age, sex, geographical area, family history and clinical data from each participant, because they have a clear role in changing hematological parameters [2]. Other biochemical parameters and risk factors were also considered in selecting healthy individuals for this study. For example, ALT, AST, urea and creatinine were measured to check the function of liver and kidney (Table 2), as these organs are the main sites in producing hemopoietic growth factors such as erythropoietin and thrombopoietin [10, 11]. Total cholesterol and triglyceride were also investigated,

because IDA is associated by alteration in these parameters, which responds to iron treatment [12] and other anemia as well [13, 14]. Participants who were diabetic, smoking, pregnant or lactating were also excluded from the study, as they cause alteration in hematological parameters [15-18].

Table 1 shows the normal values of each parameter in adults (male and female) and demonstrated significant variations in males versus females as reported in the previous studies [19, 20]. Our results showed that Hb concentration, Hct and RBCs were found to be significantly higher in males than in females ($P < 0.01$). This is expected to be found among the study

Table 2. Clinical Chemistry Parameters for Normal Adults of Aljouf Region Expressed as a Mean \pm SD (95% Range)

Parameter	AST (μ /L)	ALT (μ /L)	T. chol (mmol/L)	Trig (mmol/L)	Urea (mg/dL)	Creatinine (mg/dL)
Mean \pm SD	28.1 \pm 14	26.4 \pm 12.8	133.2 \pm 38.7	92.8 \pm 39.4	19 \pm 7	0.9 \pm 0.5
Reference range	16.0 - 44.4	13.2 - 42.5	173 - 63	45 - 134	12 - 26	0.4 - 1.4

AST: aspartate aminotransferase; ALT: alanine aminotransferase; T. chol: total cholesterol; Trig: triglyceride.

population, which is similar to the studies carried out in the developed countries, Arab countries [21], Asian countries [22, 23] and also comparable to documentation from Africa [19, 23].

On the contrary, Plt ranges were significantly lower in male as compared to female, which is in agreement with the other reported studies [19, 20, 22]. This may be as a result of the differences in hormone types and concentrations in the different sexes and the consequence of thrombopoietin release in response to regular menstruation cross-stimulating thrombopoiesis. In fact, the main cause for these lower values is still unknown and therefore further research is essential. However, other studies documented that these lower values might be due to the diet, genetic factors or other environmental factors [24].

In contrast, the Plt counts and MCV values are lower in comparison with the Caucasians, USA values and other African studies [19, 20]. Our findings reflect that healthy adults from the Aljouf region have also some hematological parameters differing quantitatively from Arab [19, 21], Caucasians [25, 26], Asian [23, 27] and African [20, 28, 29], while other hematological parameters have reference value profiles which are similar to these ethnic groups [18, 20, 21, 23, 26, 27, 29].

It is of interest to report also that the reference values of MCV and WBC from the current study were on most occasions far lower than those of other European countries [25]. Similar results of MCV, WBC, Hb, PCV and RBC with varying degrees have been made in studies carried out in other ethnic groups such as Palestine [21], Tanzania [19], Sudan [28], Kenya [29], Nigeria, and Turkey [30].

Conclusion

Our findings reflect that healthy adults from the Aljouf region have some hematological parameters differing quantitatively from Caucasians, while other hematological parameters have reference value profiles which are similar to Caucasians. Therefore, hematological reference value profile reported in this study can be used as normal reference values for Saudi people of the Aljouf region to improve and help in diagnosis and treatment of individuals with hematological disorders.

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