

## Original Article

### Hematological Reference Values for Healthy Males in the Central Part of Iran

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#### ABSTRACT

**Background and Objectives:** Laboratory reference values are an important tool for clinical management of patients. Reference values being used in most laboratories in Iran have been provided from the established reference values from developed countries. However, several variables can affect on these laboratory parameters. Therefore, this study was carried out to establish the reference values of hematological parameters in the blood donors of central province of Iran as a general population.

**Methods:** Blood samples of 1100 male blood donors were collected consecutively from Blood Transfusion Organization. Complete blood cell (CBC) count in 2012 and differential was performed using an automated hematology analyzer.

**Results:** The median and 95% reference values (2.5<sup>th</sup>-97.5<sup>th</sup>) for Hb and platelet counts were 15.5 g/dl (14.1-17.7) and  $209 \times 10^9$  cells/L (151-322) respectively. The median for total WBC count, neutrophil, lymphocyte, monocyte and eosinophil were  $6.7 \times 10^9$  cells/L (4.3-11.2), %58 (%50-%70), 40% (30-49%), 0% (0-2) and %1 (0-3%), respectively.

**Conclusion:** The hematological profile of the population in central province of Iran was different from the reports of other countries and also the standards reference ranges described in textbook. So, further nationwide study should be carried out to establish the hematological reference values of the Iranian population as a whole.

**Key words:** Hematology; Reference Value; Male; Iran

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## Introduction

Appropriate local reference values for hematological parameters are essential for screening, follow up, interpreting laboratory data and detecting hematological abnormalities (1). The reference values of hematological indices currently used in Asia and Africa have been derived from studies on populations in industrialized countries and may not be applicable in most local settings (1). In addition, some variables including age, gender (2), ethnicity (3), geography and environmental factors such as climate, altitude (4) can influence on the hematological profiles in different populations (4, 5). The International Federation for Clinical Chemistry (IFCC) (6) and the Clinical and Laboratory Standards Institute (CLSI) (7) recommended that reference ranges should be established for each region. The inappropriate reference range can cause unnecessary follow up investigations, treatment and mismanagement of patients (8, 9). Some studies conducted in Asian and African countries indicated lower values compared with those from populations in developed countries (9-13). For example, a study conducted in Malaysia showed remarkable differences in the reference ranges by sex and between studied groups in healthy Malaysian population (10). Moreover, another study in Africa showed lower white blood cell (WBC), neutrophil counts and hemoglobin (Hb) values in healthy adults (14). As mentioned above several factors may influence on hematological profiles suggesting that the development of reference values together with clarification of the range of distribution for local population has practical importance for health care. Such valuable information is scarce in the Iranian population. Therefore, this study was carried out to establish the reference values of commonly used hematological parameters in the blood donors of Arak, central province of Iran as a general population.

## Patients and Methods

### *Study population*

In this cross-sectional study, blood samples of 1100 male volunteer blood donors residing in Arak city (rural and urban areas), central province of Iran were collected consecutively from Blood Transfusion Organization from October to December 2012. This project was approved by the Arak University of Medical Sciences Ethics Committee and signed informed consent was gathered from all patients before study initiation.

Enrollment to the survey was according to willingness of the participants and their good health condition (based on past medical history, physical examination taken by a single physician and laboratory findings including human immunodeficiency virus antibody (anti-HIV), Hepatitis B surface antigen (HBsAg), hepatitis C antibody (anti-HCV) and syphilis serology). Participants with evidence of fever, history of drug abuse, alcohol consumption, drug and food hypersensitivity, smoking and chronic diseases such as diabetes mellitus, were excluded from the study.

Then, blood sample was collected. Complete blood cell (CBC) count and differential was performed using an automated hematology analyzer (Sysmex K-1000 Corporation, France). All instruments were operated and quality controlled according to the manufacturers' instructions and standard quality control protocols. The hematological values including hemoglobin, platelet count, WBC count and differential were analyzed.

### **Serological testing**

HBsAg was tested by enzyme-linked immunosorbent assay (ELISA) using commercial Kit (Hepanostika, bioMerieux, Boxtel, Netherlands). All samples were also checked for anti-HCV using ELISA kit (Bio-Rad Laboratories, Segrate, Italy). Anti-HIV status was also assessed by ELISA (MP Biomedicals, Illkirch, France).

### Statistical Analysis

The Chi-square test used along with the SPSS 16 Package program for statistical analysis (Chicago, IL, USA). Data are presented as absolute counts, medians (95 percentile range) and means and proportions (standard deviation or 95% binomial exact confidence intervals [CI]) where indicated. *P* values <0.05 were considered statistically significant.

### Results

A total of 1100 male blood donor with mean age of  $35.07 \pm 10.73$  years (range 18-66 years) were enrolled in the study. The median and 95% reference values (2.5<sup>th</sup>-97.5<sup>th</sup>) for Hb and platelet

count were 15.5 g/dl (14.1-17.7) and  $209 \times 10^9$  cells/L (151-322) respectively. The median for total WBC count, neutrophil, lymphocyte, monocyte and eosinophil was  $6.7 \times 10^9$  cells/L (4.3-11.2), %58 (%50-%70), 40% (30-49%), 0% (0-2) and %1 (0-3%) respectively. The total mean value of Hb, platelet count, WBC count and differential was similar with median.

The mean value and median with 95 percentile range of WBC, differential count, Hb and platelet count in different age groups were shown in Table 1 and 2. Table 3 shows hematological reference values established for Central province of Iran in comparison with values provided from textbook references and some other studies.

**Table 1-** Distribution mean value with 95% CI and median with 95 percentile range of Hb and platelet

Age group (yr)	No.	Hemoglobin (g/dl)		Platelet ( $\times 10^9$ cells/L)	
		Mean (95%CI)	Median (95 percentile range)	Mean (95%CI)	Median (95 percentile range)
18-25	212	15.5 (15.4-15.6)	15.6 (14.1-17.5)	218 (211.7-224.2)	208 (153.3-328)
26-35	439	15.5(15.4-15.6)	15.4 (14.1-17.6)	214 (209.6-218.5)	205 (150-331)
36-45	234	15.6 (15.5-15.8)	15.6 (14.1-17.7)	214.5 (208.7-220.3)	206 (150-321.1)
46-55	164	15.7 (15.6-15.8)	15.6 (14.2-18)	220.6 (213.7-227.6)	218 (150.1-328)
56-66	51	15.6 (15.3-15.8)	15.6 (14-18)	219.6 (206-233.3)	214 (150.3-354.7)

**Table 2-** Distribution mean value with 95% CI and median with 95 percentile range of WBC count and differential count

Age group (yr)	No.	WBC* count ( $\times 10^9$ cells/L)		Neutrophil (%)		Lymphocyte (%)	
		Mean (95%CI)	Median (95 percentile range)	Mean (95%CI)	Median (95 percentile range)	Mean (95%CI)	Median (95 percentile range)
18-25	212	6.8 (6.6-7)	6.6 (4.4-9.7)	59 (58.2-59.6)	59(50-69)	40.1 (39.5-40.8)	40 (30-50)
26-35	439	6.8 (6.7-7)	6.6 (4- 11.6)	58.9 (58.4-59.4)	58 (50-71)	40 (39.5-40.5)	41 (28-49)
36-45	234	6.9 (6.7-7)	6.7 (4.5-10.4)	58.3 (57.7-59)	58(49.9-69.1)	40.6 (40-41.3)	41 (30-49)
46-55	164	7.2(6.9-7.4)	6.8 (4.6-11.4)	59.4 (58.6-60.2)	59(50-70)	39.6 (38.8-40.4)	40 (30-48)
56-66	51	6.9 (6.4-7.3)	6.6 (4.2-10.08)	59 (57.4-60.6)	58(45.6-70)	39.9 (38.3-41.5)	41(29.3-53.7)

\*: White Blood Cell

**Table 3-** Comparison of hematological reference values established for Central province of Iran with values from textbook references and some other studies

Analyte	Current study	Textbook references (15)	USA (17)	Ghana (8)	Southwest Ethiopia (1)	Tanzania (13)
Hemoglobin (g/dl)	14.1-17.1	13.3-16.2	13.5-17.5	13.5-16.5	8.4-17	13.7-17.7
Platelets ( $\times 10^9$ cells/L)	151-322	165-415	150-350	145-355	91-429	147-356
WBC*, total( $\times 10^9$ cells/L)	4.3-11.2	3.54-9.06	4.5-11	4.7-9.6	3.1-10.5	2.8-7.9
Neutrophil (%)	50-70	40-70	40-70	49-74	48.1-49.8	31.7-69.3
Lymphocyte (%)	30-49	20-50	22-44	23-47	35.1-36.4	20.8-57.3
Monocyte (%)	0-2	4-8	4-11	3-6	NA**	NA
Eosinophil (%)	0-3	0-6	0-8	NA	NA	NA

\*: White Blood Cell

\*\*:Not Available

## Discussion

In this study, we aimed to establish the reference values for commonly used hematological parameters in the blood donors of a central province of Iran as a general population. This survey showed that the Hb value, WBC count and differential in our study were higher and the platelet count was lower than the reference ranges described in the textbook (15). Additionally this study showed that the mean and median of Hb value, WBC, differential and platelet counts were similar in different age groups.

Limited studies are available for Asian countries due to hematological reference ranges (5, 10, 16) and also such data are scanty in Iranian population. Reference values being used in most laboratories in Iran have been provided from the textbook reference ranges or based on the manual of the hematology analyzer used. Therefore, such differences were expected for populations in different geographical areas and indicate the need to develop reference values that are appropriate for the relevant population (8, 9).

When the values obtained from this survey compared with those provided from other popula-

tions, differences will be revealed. Our values regarding Hb and total WBC count was similar to USA (17) but higher than African countries (1, 8, 12). In comparison to our neighbor countries, we had similar Hb values to Turkey but higher compared with the values in a survey in Pakistan (5, 16).

The proportion of neutrophil in current study was similar to the values reported by Kratz *et al.* (17) in the US but higher compared to African countries (1, 8, 12, 13). In contrast, our lymphocyte count was higher than US population (17) but was almost similar to other countries (8, 12, 13). The monocytes and eosinophil percentile reported in current study were lower than other areas (8, 12, 17). The reason for these differences is not clear, however dietary, environmental and genetic factors may have a role (11, 18, 19).

Although platelet counts is low in African countries in comparison to developed countries but it is of interest to show that this value obtained from our study were slightly lower than those of African countries.

Our data showed some similarities with industrialized countries and differences particularly with

African countries. Lower values in areas such as Africa may be associated with factors such as genetic factors, red blood cell disorders, poor nutritional status, socio-economic conditions, chronic blood loss due to hookworm infestation, schistosomiasis, malaria infection or a combination of several factors (8, 14, 20). We cannot justify the high reference ranges obtained from our study, although, it can be due to genetic factors (18). Besides, Arak is the capital of central province of Iran with an estimated population over 500,000. It was located 260 km from Tehran City. Arak is an industrial city with several factories and very high levels of air pollution. However there is scarce data regarding association of hematological parameters and air pollution.

### Conclusion

The hematological indices of the population in central province of Iran were different from the reports of other countries and also the standard reference ranges described in the textbook. Moreover, this study provided region-specific reference values which can be used to guide patient management and interpretation of laboratory findings and potentially improve the quality of health care. So, these data can be used as a baseline data, and further nationwide study should be carried out to determine the hematological reference values of the Iranian population as a whole.

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