

REFERENCE RANGE VALUES OF HAEMATOLOGICAL PARAMETERS IN HEALTHY PAKISTANI ADULTS

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Objectives: This study has been designed and conducted to establish the normal values of various haematological parameters for healthy adult Pakistani males and females, and to compare these values with those obtained for other populations in both western and tropical countries. **Methods:** This study was under taken in reference adult Pakistani Populations in the area of Multan, Pakistan. A total 302 healthy volunteers whose ages ranged between 20–45 years, were investigated. All laboratory analysis was conducted under standardized conditions at the Haematology Section, Department of Pathology, Bakhtawar Amin Memorial Trust, Hospital (BAMTH) and Multan Institute of Cardiology, (MIC). **Results:** In Males, the mean Haemoglobin concentration (Hb) of 13.04 g/dl and Haematocrit (HCT) ratio of 0.39 l/l were significantly higher than females value of 11.63 g/dl and 0.35 l/l respectively. The mean Red Blood Cell (RBC) count of $5.3 \times 10^{12}/l$ in males was also significantly higher than the corresponding value of $4 \times 10^{12}/l$ in females ($p < 0.05$). The value of Mean Corpuscular Volume (MCV) in males (76.30 fl) was significantly higher than in females (73.84 fl), ($p < 0.05$). Similarly the Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were significantly higher in males than corresponding values in females ($p < 0.05$). On the other hand, the mean White Blood Cell count (WBC) of $8.25 \times 10^9/l$ in males was lower than mean value of $8.42 \times 10^9/l$ in females ($p < 0.05$). Similarly the values for Platelet count of $255 \times 10^9/l$ in males were also significantly lower than corresponding values of $255 \times 10^9/l$ in females ($p < 0.05$). **Conclusions:** This study has established baseline values for haematological parameters in healthy Pakistani adults of Multan and surrounding areas. The sex difference of measured levels of all of these parameters has attained statistical significance. When the observed values of this study were compared with those quoted for the methods in use and those drawn from different populations, significant differences were revealed. Such differences are of accurate clinical interpretation of haematological investigation of patients.

Key words: Reference Range, Normal Values, Haematological Parameters

INTRODUCTION

It is well documented that haematological baseline values vary in different population groups and in different geographical areas.¹ The variations are usually due to age, sex, attitude²⁻⁴ and environmental factors and social differences.⁵⁻⁸

Therefore, there has always been a need to establish baseline haematological values of indigenous populations of the world, indeed. These values have long been well established in many parts of world. In the Pakistan, we rely on normal standards of western countries for the interpretation of laboratory results. This is due to the paucity of baseline normal values of haematological parameters of healthy Pakistani population.

Environmental conditions in Pakistan are different from western countries in terms of climate and dietary habits of people. In the light of above and due to lack of knowledge on baseline normal haematological values of healthy adult male and female Pakistanis, this study was carried out.

MATERIAL AND METHODS

The data presented in this study is based on blood samples collected from a total of 302 healthy Pakistani adults. They consisted of 183 males and 119 females, living in Multan region, in the Punjab province of Pakistan. They were selected from employees of Bakhtawar Amin Memorial Trust Hospital, Northern Bypass Multan (BAMTH), Multan Institute of Cardiology (MIC), and volunteers from general public from different area populations.

Selection was based on apparently healthy people who fulfilled the following criteria:

- age between 20–40 year
- no history of drug usage (including vitamins, iron, 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. The blood was drawn at in the morning between 8:00 and 11:00 AM. Before starting collection of blood, the

volunteer relaxed sitting down for a few minutes while giving information on age, sex, medical history, drug usage, smoking history and phase of menstrual cycle. While in upright position, the tourniquet was applied for a few seconds and venous blood was drawn by means of venipuncture.

The usual precaution of selecting an easily accessible vein in the antecubital fossa and applying the minimum of venous stasis was observed. Four millilitre venous blood was drawn into (Vacutainer, BD Vacutainer® K₂EDTA 7.2 mg Ref 367861) or 3 ml into (Vacutainer Vacutte® K₃EDTA greiner bio-one) subsequent mixing of blood with anticoagulant was followed and tubes were kept on mixer prior to processing.

Fresh whole blood was used to measure Haemoglobin (Hb) concentration, Haematocrit (HCT) ratio, Red Blood Cell (RBC) count, Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin

Concentration (MCHC), Platelet count and White Blood Cells (WBC) count.

Measurement of haematological parameters was carried out within 2 hours of sample collection using SYSMEX & Medonic fully automated haematology analysers. The haematology analysers were calibrated by standardized commercially prepared calibrators. The manufacturer's stabilized whole blood controls were used to monitor the analysers' performance. The analysis was conducted at Department of Pathology and Laboratory Medicine at BAMTH and MIC, Multan.

RESULTS

Sixteen females who had low haemoglobin, low haematocrit and low MCV, MCH and MCHC were excluded from the study. Further studies on this subgroup excluded from statistical analysis revealed iron deficiency anaemia. Mean, Standard Deviation (SD) and baseline values for the various haematological parameters are presented in Table-1.

Table-1: Comparative Haematological values for Pakistani Males with Pakistani Females

Parameters	Male		Female		p-Value
	Mean	SD	Mean	SD	
Hb	13.04 g/dl	2.90	11.63 g/dl	2.33	0.00004
RBC Count	5.39×10 ¹² /l	2.23	4.79×10 ¹² /l	0.65	0.00019
WBC Count	8.25×10 ⁹ /l	2.61	8.42×10 ⁹ /l	2.26	0.00208
Platelets	255×10 ⁹ /l	97.10	279×10 ⁹ /l	93.54	0.00308
HCT (PCV)	0.39 l/l	2.49	0.35 l/l	2.56	0.00510
MCV	76.30 fl	2.49	73.84 fl	2.48	0.00430
MCH	25.54 pg	2.64	24.42 pg	0.16	0.04440
MCHC	32.27 g/dl	2.06	37.72 g/dl	2.73	0.00201

Mean values for Haemoglobin Concentration, Red Blood Cell Count, Haematocrit Ratio, Mean Cell Volume, Mean Cell Haemoglobin and Mean Cell Haemoglobin Concentration were all higher for Pakistani Males than females; this difference is statistically significant ($p < 0.05$), where the lowest single value of any of the variables is always in females, and the highest one is always in males.

Mean values for these parameters are clearly related to each other. This indicates that the distribution of Haemoglobin concentration, Red Blood Cells count, Haematocrit Ratio, Mean Cell Volume, Mean Cell Haemoglobin and Mean Cell Haemoglobin Concentration follows the "Gaussian Distribution". However, mean and baseline values for platelets are higher in Pakistani females than males the difference is statistically significant ($p < 0.05$).

We have calculated the mean haematological parameters obtained in this study for both sexes separately in order to test the difference between our sample mean and Western mean. The comparative values for males and females (Western Vs Pakistani) are presented in Table-2 and 3 respectively.

Table-2: Comparative Haematological values for Pakistani Males with Western Values

Parameters	Sample Mean for Pakistan	Sample Mean for Western
Hb	13.04 g/dl	15.50 g/dl
RBC Count	5.39×10 ¹² /l	5.50×10 ¹² /l
WBC Count	8.25×10 ⁹ /l	7.50×10 ⁹ /l
Platelets (Range)	175–370×10 ⁹ /l	150–400×10 ⁹ /l
HCT (PCV)	0.39 l/l	0.47 l/l
MCV	76.30 fl	86.0 fl
MCH	25.54 pg	29.50 pg
MCHC	32.27 g/dl	32.50 g/dl

Table-3: Comparative Haematological values for Pakistani Females with Western Values

Parameters	Sample Mean for Pakistan	Sample Mean for Western
Hb	11.63 g/dl	14.0 g/dl
RBC Count	4.79×10 ¹² /l	4.82×10 ¹² /l
WBC Count	8.46×10 ⁹ /l	7.50×10 ⁹ /l
Platelets (Range)	200–390×10 ⁹ /l	150–400×10 ⁹ /l
HCT (PCV)	0.35 l/l	0.42 l/l
MCV	73.84 fl	86.0 fl
MCH	24.42 pg	29.50 pg
MCHC	37.72 g/dl	32.50 g/dl

There is significant difference between Pakistani males in Haemoglobin Concentration, Red Blood Cells Count, and Haematocrit values with higher values recorded for western males. Also comparison of these parameters between Pakistani females and females shows a significant difference; this difference is higher than the difference in the male group.

The mean values of White Blood Cell count recorded for Pakistani males and females are higher than mean values in Western males and females.

DISCUSSION

The observed values of haematological parameters were different from standard reference values from western studies. Similar differences were observed in African adult population compared with western adult populations.¹⁰⁻¹² When the values of haematological parameters observed in the present study were compared to values from western populations, significant differences were observed.¹³ The differences are more obvious between the female groups, where Pakistani females showed a marked lower Haemoglobin concentration, Haematocrit ratio, and Mean Corpuscular Volume than the western females.

The difference in findings of this study and those reported elsewhere¹⁴⁻¹⁷ could be due to many possibilities. It could be due to a bias in selection of the study subjects. For example, the groups studied by Viteri's *et al* were highly selected subjects who were hookworm free, had adequate serum iron values; transferrin saturation fraction, serum folate and serum vitamin B₁₂, and thus lower values were obtained in both sex groups than others.¹⁵⁻¹⁷ On the other hand, Kelly and Munan¹⁸ from Canada reported lower values in their randomly selected population. In the present study, subjects were selected according to certain criteria, which excluded those with abnormal conditions. Another possibility might be due to the standardization of conditions under which measurements were made. Factors such as altitude, posture and diurnal variations have been reported to fluctuate the Haemoglobin Concentration, Red Blood Cells count, and Haematocrit Ratio^{15, 19, 20}.

In comparison with other published data, our data is compared to the values obtained by Bain²¹, where the mean Platelet counts were 288 and 262×10⁹/l in the Caucasian females and males respectively. However our values in both sex groups are slightly higher than values for Afro-Caribbean and Africans included in the same study. Low Platelet counts found in Africans, in addition to low White Blood Cell counts could be a reflection of true genetic differences.

The corresponding mean values obtained in males in this study are in agreement with values obtained in all ethnic groups, with exception of Africans, who had a significantly lower value. However the influence of environmental factors such as diet is likely to explain part of differences, for example, Essien *et al*²² observed higher count in educated Nigerians than in peasant farmers, and attributed the low platelet count in Nigerians to high prevalence of malarial parasitemia, which was more common among rural farmers.

CONCLUSIONS

This study has established baseline values for haematological parameters in healthy Pakistani adults from Multan and surrounding areas. The sex difference of measured levels of all of these parameters has attained statistical significance. Furthermore, when the observed values of this study were compared with those quoted for the methods in use and those drawn from different populations, significant difference emerged. Such differences are of accurate clinical interpretation of haematological investigation of patients.

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