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Original Article

Reference Range Values of Haematological Parameters of Healthy Adults in Western Rajasthan

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ABSTRACT

Objectives: This study was done to establish the normal values of various haematological parameters for healthy adult of Western Rajasthan (males and females) and to compare these values with those obtained for other population in both India and tropical countries. **Methods:** This study was under taken in reference adult Western Rajasthan Population in the area of Jodhpur, India. A total 1000 healthy volunteers whose ages ranged between 20–50 years, were investigated. All laboratory analysis was conducted under standardized conditions at L.N. Memorial Hospital & Research Centre, Jodhpur. **Results:** In Males, the mean Haemoglobin concentration (Hb) of 14.03 g/dl and Haematocrit (HCT) ratio of 44% were significantly higher than female value of 12.50 g/dl and 40% respectively. The mean Red Blood Cell (RBC) count of $4.90 \times 10^6/\mu\text{L}$ in males was also significantly higher than the corresponding value of $4.50 \times 10^6/\mu\text{L}$ in females ($p < 0.05$). The value of Mean Corpuscular Volume (MCV) in males (88.12 fL) was significantly higher than in females (86.32 fL), ($p < 0.05$). Similarly the Mean Corpuscular Haemoglobin (MCH) was significantly higher in males than corresponding values in females ($p < 0.05$). Mean Corpuscular Haemoglobin Concentration (MCHC) was significantly higher in females than corresponding values in males ($p < 0.05$). On the other hand, the mean White Blood Cell count (WBC) of $7.76 \times 10^3/\mu\text{L}$ in males was lower than mean value of $7.95 \times 10^3/\mu\text{L}$ in females ($p < 0.05$). Similarly the values for Platelet count of $211 \times 10^3/\mu\text{L}$ in males were also significantly lower than corresponding values of $278 \times 10^3/\mu\text{L}$ in females ($p < 0.05$). **Conclusions:** This study has established baseline values for haematological parameters in healthy Western Rajasthan adults 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.

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1. Introduction

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

Therefore, there has always been a need to establish baseline

haematological values of indigenous population of the world, indeed. These values have long been well established in many parts of the world. In India, 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 Western Rajasthan population.

Environmental conditions in Western Rajasthan 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 Western Rajasthan, this study was carried out.

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2. MATERIAL AND METHODS

The data presented in this study is based on blood samples collected from a total of 1000 healthy Western Rajasthan adults. They consisted of 500 males and 500 females, living in Jodhpur region, in the Rajasthan province of India.

They were selected from employees of L.N. Memorial Hospital & Research Centre, Jodhpur and volunteers from general public from different area population. Selection was based on apparently healthy people who fulfilled the following criteria:

Age between 20–50 years.

Volunteers from general public from rural and urban people.

No recent history of blood loss.

Not received any blood transfusions recently.

Not received any haematinics recently.

Additional criteria were included for females as, not being pregnant, not lactating and not menstruating at the time of blood collection. The blood sample was drawn in the morning. Before starting collection of blood, the volunteer relaxed sitting down for a few minutes while giving information on age, sex, habitat and dietary habits. While in upright position, the tourniquet was applied for a few seconds and venous blood was drawn by means of venipuncture. 2.5 ml of blood was collected from anticubital vein by venipuncture and put in an anticoagulant (EDTA vial) subsequent mixing of blood with anticoagulant was done and vial 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 NIHON KOHDEN automated haematology analyzer. The haematology analyzer was calibrated by standardized commercially prepared calibrators. The manufacturer's stabilized whole blood controls were used to monitor the analyzer's performance. The information were noted into a specially designed Performa followed by laboratory investigations were done by automated haematology analyzer, standardized in L.N. Memorial Hospital & Research Centre, Jodhpur.

3. OBSERVATIONS

Table-1 shows comparative Haematological values for Western Rajasthan males and females. Hb, RBC Count, PCV, MCV and MCH were significantly raised in male population than Western Rajasthan females ($p < 0.01$). Three parameters that is WBC count, Platelet counts and Mean Corpuscular Haemoglobin Concentration were found raised significantly in Western Rajasthan females on compared to Western Rajasthan males ($p < 0.01$).

Table-1: Comparative Haematological values for Western Rajasthan Males and Females

Haematological Parameters	Males		Females		p-value
	Mean	S.D.	Mean	S.D.	
Hb	14.03 g/dl	0.93	12.50 g/dl	0.72	<0.0001**
RBC Count	4.9 x 10 ⁶ /μL	0.38	4.5 x 10 ⁶ /μL	0.35	<0.0001**
WBC Count	7.76 x 10 ³ /μL	1.37	7.95 x 10 ³ /μL	1.56	0.0479*
Platelets	211 x 10 ³ /μL	33.98	278 x 10 ³ /μL	35.88	<0.0001**
HCT (PCV)	44%	2.60	40%	2.17	<0.0001**
MCV	88.12 fL	3.96	86.32 fL	3.45	<0.0001**
MCH	28.34 pg	1.33	27.94 pg	1.12	<0.0001**
MCHC	32.00 g/dl	0.62	32.09 g/dl	0.79	0.0453*

P values were calculated with t test for comparison of mean for male and female subjects.

** Highly Significant

* Significant

Table-2 shows comparative Haematological values for Western Rajasthan males with Indian males. On comparing the data's of Western Rajasthan males to Indian males, it is evident that except WBC count, PCV, MCV and all other parameters were significantly found better in males, while WBC, PCV and MCV found better in Western Rajasthan males.

Table-2: Comparative Haematological values for Western Rajasthan Males with Indian Males

Haematological Parameters	Sample Mean for Western Rajasthan Males		Sample Mean for Indian Males		p-value
	Mean	S.D.	Mean	S.D.	
Hb	14.03 g/dl	0.93	14.69 g/dl	0.72	<0.0001**
RBC Count	4.9 x 10 ⁶ /μL	0.38	5.05 x 10 ⁶ /μL	0.35	<0.0001**
WBC Count	7.76 x 10 ³ /μL	1.37	6.75 x 10 ³ /μL	1.56	0.0479*
Platelets	211 x 10 ³ /μL	33.98	248 x 10 ³ /μL	35.88	<0.0001**
HCT (PCV)	44%	2.60	43%	2.17	<0.0001**
MCV	88.12 fL	3.96	87.50 fL	3.45	<0.0001**
MCH	28.34 pg	1.33	29.50 pg	1.12	<0.0001**
MCHC	32.00 g/dl	0.62	33.5 g/dl	0.79	0.0453*

P values were calculated with t test for comparison of mean for male subjects.

** Highly Significant

* Significant

Table-3 shows comparative Haematological values for Western Rajasthan females with Indian females. Western Rajasthan females showing all parameters better than sample mean for Indian females ($p < 0.01$).

Table-3: Comparative Haematological values for Western Rajasthan Females with Indian Females

Haematological Parameters	Sample Mean for Western Rajasthan Females		Sample Mean for Indian Females		p-value
	Mean	S.D.	Mean	S.D.	
Hb	12.50 g/dl	0.72	12.17 g/dl	1.29	<0.0001**
RBC Count	$4.5 \times 10^6 / \mu\text{L}$	0.35	$4.37 \times 10^6 / \mu\text{L}$	0.50	<0.0001**
WBC Count	$7.95 \times 10^3 / \mu\text{L}$	1.56	$6.92 \times 10^3 / \mu\text{L}$	1.80	<0.0001**
Platelets	$278 \times 10^3 / \mu\text{L}$	35.88	$257 \times 10^3 / \mu\text{L}$	81.73	<0.0001**
HCT (PCV)	40%	2.17	37%	3.53	<0.0001**
MCV	86.32 fL	3.45	84.00 fL	3.65	<0.0001**
MCH	27.94 pg	1.12	27.5 pg	1.76	<0.0001**
MCHC	32.59 g/dl	0.79	32.50 g/dl	0.90	<0.0001**

P values were calculated with t test for comparison of mean for female subjects.

** Highly Significant

Table-4 shows different age-groups comparison between Western Rajasthan males and Indian females. Age-groups (20-30, 30-40 and 40-50) females are having better WBC count and platelet counts. Rest other parameters are better in Western Rajasthan males.

Table-4: Age & Sex wise Haematological values for Western Rajasthan Males and Females

Haematological Parameters	Age Groups (Years)								
	20-30 (Yrs.)			30-40 (Yrs.)			40-50 (Yrs.)		
	Male (187) (Mean \pm S.D)	Female (168) (Mean \pm S.D)	p-value	Male (124) (Mean \pm S.D)	Female (112) (Mean \pm S.D)	p-value	Male (189) (Mean \pm S.D)	Female (220) (Mean \pm S.D)	p-value
Hb (g/dl)	14.09 \pm 0.93	12.93 \pm 0.72	<0.001**	14.80 \pm 0.98	12.57 \pm 0.64	<0.001**	13.96 \pm 0.91	12.59 \pm 0.76	<0.001**
RBC Count (106/ μL)	4.97 \pm 0.38	4.51 \pm 0.33	<0.001**	4.97 \pm 0.40	4.55 \pm 0.33	<0.001**	4.95 \pm 0.36	4.57 \pm 0.38	<0.001**
WBC Count (103/ μL)	7.02 \pm 1.61	7.92 \pm 1.32	<0.001**	7.56 \pm 1.66	7.97 \pm 1.33	0.0387*	8.00 \pm 1.67	8.10 \pm 1.46	0.5186 (NS)
Platelets (103/ μL)	214 \pm 36.69	277 \pm 39.52	<0.001**	212 \pm 29.41	277 \pm 41.38	<0.001**	208 \pm 33.92	280 \pm 37.13	<0.001**
HCT/PCV (%)	44.00 \pm 2.51	39.36 \pm 1.97	<0.001**	44.14 \pm 2.81	39.70 \pm 2.03	<0.001**	43.88 \pm 2.56	39.89 \pm 2.40	<0.001**
MCV (fL)	88.22 \pm 4.30	86.20 \pm 3.46	<0.001**	88.12 \pm 3.95	86.45 \pm 2.89	0.0003*	88.08 \pm 3.70	86.30 \pm 3.77	<0.001**
MCH (pg)	28.47 \pm 1.37	28.02 \pm 1.09	0.0008*	28.33 \pm 1.40	27.99 \pm 1.10	0.0406*	28.24 \pm 1.25	27.83 \pm 1.15	0.0006*
MCHC (g/dl)	32.08 \pm 0.66	32.19 \pm 0.79	0.0141*	32.05 \pm 0.64	32.17 \pm 0.74	0.1830	31.94 \pm 0.58	31.95 \pm 0.81	0.8620
						(NS)			(NS)

P values were calculated with t test for comparison of mean for male and female subjects.

** Highly Significant

* Significant

4. DISCUSSION

The aim of our study was to establish hematological reference values which may serve as Western Rajasthan standards for interpretation of laboratory results. Many factors influence the hematological values such as sex, age, ethnic origin, geographic location, season, and genetic disease.⁹⁻¹¹

Significant gender differences were documented for the RBC parameters (haemoglobin, haematocrit and RBC) Western Rajasthan males have higher values for these parameters than Western Rajasthan females. The RBC parameters are influenced by several factors especially the abnormalities of haemoglobin synthesis. Those abnormalities can be constitutional (sickle cell disease, alpha- and beta-thalassemia) or acquired (iron deficiency). Thalassemia and iron deficiency display hypochromia. The reasons for these differences have been attributed to factors such as the influence of the androgen hormone on erythropoiesis and menstrual blood loss in females.¹²⁻¹³

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. On the other hand, Kelly and Munan¹⁸ from Canada reported lower values in their randomly selected population.

White blood cell (WBC) count, platelets and Mean Cell Haemoglobin Concentration were higher in Western Rajasthan females than Western Rajasthan males; this difference is statistically significant ($p < 0.05$). The work of Kadikoylu¹⁹ also observed that platelet counts increase in women with iron deficiency anaemia. Iron saturation is an important factor that affects platelet counts. It is suggested that decreased iron saturation might stimulate megakaryopoiesis. Moreover, iron may have an inhibitor effect on platelet counts. The reason for low platelets could range from, inherent nature of Indians to vitamin B12 deficiency to nutritional deficiencies.²⁰

The observations of the present study also correspond well with the age-related trends demonstrated by Z. Flegar-Mestric²¹ who have presented the haematological profile in healthy urban population with the range of age groups from 8-70 years.

Stevens and Alexander²² showed a highly significant difference in platelets count in premenopausal age group of the order of 40-70 thousands/cu.mm and after menopause count decline in women.

The corresponding mean values obtained in males in this study are in agreement with values obtained in all ethnic groups, 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 al²³ 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.

5. RESULT

The Mean values for Haemoglobin Concentration (Hb), Red Blood Cell Count (RBC), Haematocrit Ratio (HCT), Mean Cell Volume (MCV) and Mean Cell Haemoglobin (MCH) were all higher for Western Rajasthan 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. 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 white blood cell (WBC) count, platelets and Mean Cell Haemoglobin Concentration (MCHC) were higher in Western Rajasthan females than males; this difference is statistically significant ($p < 0.05$).

6. CONCLUSIONS

This study has established baseline values for haematological parameters in healthy Western Rajasthan adults from Rajasthan 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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