

Normal Reference Values of Complete Blood Count in Healthy Adult Population of Pakistan; A Multicentre Study

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ABSTRACT

Aim: To establish the reference values of hematological parameters in blood donors of all the four provinces of Pakistan as a general population.

Methods: This was a multicenter cross-sectional study conducted from Jan 2017-Oct 2017 in the blood bank and the Dept. of Haematology, The CH&ICH, Lahore, Fatimid Foundation, Karachi, Bolan medical college, Quetta, Armed Forces Institute of Transfusion, Rawalpindi & Ayub medical college, Abbottabad, KPK.

Blood samples of 1060 male and female blood donors were collected from the blood banks of all the centers mentioned above. CBC and differential were performed using an automated hematology analyzer in the respective departments.

Results: The mean and 95% reference values (2.5th-97.5th) for males WBC $7.752 \pm 4.506 \times 10^9$ cells/L, RBC 4.958 ± 1.331 , HB 14.258 ± 3.423 g/dl, HCT 41.967 ± 16.345 , MCV 84.584 ± 15.933 , PLT 219.485 ± 197.331 , LYM 3.346 ± 10.112 , NEUT 6.843 ± 23.557 , MONO 0.811 ± 3.601 , EO 0.327 ± 0.995 . For females WBC 7.174 ± 3.037 , RBC 4.567 ± 1.086 , HB 12.972 ± 2.752 , HCT 39.647 ± 48.186 , PLT 264.07 ± 175.079 , LYM 2.537 ± 5.005 , NEUT 4.769 ± 11.314 , MONO 0.460 ± 0.909 , EO 0.188 ± 0.39

Conclusion: The hematological profile of the population in all four provinces of Pakistan differed from the reports of other countries and the standard reference ranges described in the textbook. So, our own hematological parameters must be followed. More studies must be carried out on other age groups and even on adults to strengthen our results.

Keywords: Normal reference values, Complete blood count, Healthy adults of Pakistan.

INTRODUCTION

The CBC-Complete blood count and differential are among the most common tests routinely ordered clinical tests from the diagnostic laboratory in all ages^{1,2,3}. The hemoglobin, red cell indices, white blood cell count platelet count altogether comprise the CBC. If information about the specific numbers of the different WBC's and their specific percentages is required, then the CBC may be ordered with a differential count⁴. It is mandatory to have reference values that are specific to a certain population since there are ethnic, geographical, and racial differences in complete blood count (CBC) reference intervals (RIs.)⁵ Ralph Grasbeck and Nils-Erik Saris first introduced the term "reference value" in 1969⁶. Clinicians require Reference intervals(RIs) to interpret results; hence they assist in improved decision making⁷. However, variable sources such as age, race, body mass index (BMI), gender, and ethnicity influence and lead to a variation in RIs^{8,9}.

Incorrect reference values can result in misinterpretation of laboratory results and subsequently lead to the mismanagement of patients that can prove disastrous¹⁰. Therefore, the inference drawn from the clinical laboratory data is an important process for which reference values are required for all tests run in the laboratory¹¹. Hence the recommendation that laboratories have reference values that are suited to the population they cater to or at least cross-check any proposed RIs¹².

In Pakistan, the hematology parameters are interpreted as normal or abnormal based on the reference ranges obtained from the international database¹³. This is because of the lack of baseline normal values of the healthy Pakistani population.¹³ Attempts to establish more accurate reference ranges for clinical and hematological assessments of specific populations have been made in several countries^{14,15}.

One of the main variables influencing a reference interval is population. Additionally, manufacturers' reference intervals may not take into consideration variations due to lifestyle, race, and diet¹⁶.

Environmental conditions in Pakistan are different from western countries in terms of climate. In the light of the above, and due to lack of knowledge on baseline normal hematological values of healthy adult Pakistani males and females, this study is carried out.

Thus, the purpose of this study is to establish a set of standard reference ranges and mean for the hematological assessment of the population of different age groups and to offer a recommendation to the local hospitals and community laboratories in Pakistan.

MATERIALS AND METHODS

A multicenter cross-sectional study conducted from Jan 2017-Oct 2017 in the Blood bank and the Haematology, The CH&ICH, Lahore, Fatimid Foundation, Karachi, Bolan medical college, Quetta, Armed Forces Institute of Transfusion, Rawalpindi & Ayub medical college, Abbottabad, KPK.

Samples were withdrawn from the blood of 1060 male and female blood donors from the blood banks of all the centers mentioned above. CBC and differential count were performed using an automated hematology analyzer in the respective departments.

CBC's with WBC differential were collected from various institutions across Pakistan to include all four provinces of Pakistan. The CBC's were of healthy blood donors of different ages in the adult population and included both genders. The mean and standard deviation was calculated for all the parameters of the CBC from all the centers.

RESULTS

CBCs of healthy blood donors from different centers showing the mean, and standard deviations (Tables I and II).

Table-I. CBC data from KPK, Sindh, Balochistan.

PARAMETER	BMC, Quetta (Balochistan)				Fatimid Foundation, Karachi, Sindh				Ayub Medical College, Abbotabad, KPK			
	MALE		FEMALE		MALE		FEMALE		MALE		FEMALE	
	MEAN	2SD	MEAN	2SD	MEAN	2SD	MEAN	2SD	MEAN	2SD	MEAN	2SD
Age	27.819	12.089	27.118	11.421	25.533	8.514	24.500	1.414	27.760	13.184	27.917	12.747
WBC	6.505	3.817	5.986	3.614	5.193	3.746	7.065	9.970	7.630	3.544	7.217	2.643
RBC	4.873	1.758	4.626	1.855	5.118	1.314	4.065	3.012	5.138	0.975	4.562	1.004
HB	13.731	2.823	13.476	2.586	13.933	3.875	12.000	8.202	15.074	3.007	12.960	2.606
HCT	40.625	27.835	38.940	14.280	42.460	8.215	35.580	13.803	44.022	7.050	37.890	9.616

MCV	82.196	19.929	85.112	21.827	84.007	14.916	90.150	31.537	86.036	13.569	84.097	11.918
MCH	27.856	5.113	28.965	4.826	27.740	6.476	29.500	1.414	29.598	6.581	28.540	5.070
MCHC	33.285	9.446	33.882	9.875	32.693	2.985	33.150	10.041	34.188	2.566	33.900	2.180
Platelets	257.916	143.778	258.412	81.179	260.067	125.595	218.000	22.627	245.680	122.307	280.817	122.479
Lymphocytes	2.167	4.234	2.069	1.642	1.899	1.552	1.310	0.594	2.413	1.592	2.404	1.386
Neutrophils	4.389	13.365	3.313	2.503	2.679	1.507	4.830	9.192	4.590	3.360	4.204	2.178
Monocyte	0.671	4.689	0.454	0.254	0.457	0.465	0.155	0.325	0.435	0.351	0.422	0.424
Eosinophil	0.297	1.352	0.176	0.208	0.268	0.438	0.245	0.325	0.175	0.369	0.163	0.339

Table-II CBC data from Punjab.

PARAMETER	The CH&ICH, Lahore, (Punjab)				AFIT, Rawalpindi, Punjab			
	MALE		FEMALE		MALE		FEMALE	
	MEAN	2SD	MEAN	2SD	MEAN	2SD	MEAN	2SD
AGE	28.043	11.509	27.486	5.670	30.112	12.352	32.500	3.500
WBC	9.112	4.903	8.586	3.004	8.530	3.574	9.875	1.735
RBC	4.916	1.664	4.466	0.564	4.944	1.110	4.390	0.163
HB	14.131	2.362	12.965	0.867	14.556	2.344	12.750	0.563
HCT	42.706	5.929	42.329	2.627	42.039	7.249	37.575	2.310
MCV	87.163	15.621	84.605	3.579	85.419	13.405	85.525	3.858
MCH	29.751	3.758	29.614	1.131	29.691	5.490	29.050	0.813
MCHC	33.207	2.922	33.311	1.473	34.693	2.491	34.050	0.661
PLT	247.206	130.276	261.837	55.980	243.406	132.777	311.500	46.385
LYM	2.563	1.743	2.414	0.818	2.989	1.793	4.000	0.708
NEUT	5.769	4.792	5.541	2.682	4.607	2.436	4.750	1.073
MONO	0.530	0.414	0.429	0.174	0.596	0.418	0.588	0.097
EO	0.251	0.370	0.202	0.213	0.336	0.256	0.488	0.148

The mean and 95% reference values (2.5th-97.5th) for all adult males showed WBC $7.752 \pm 4.506 \times 10^9$ cells/L, RBC 4.958 ± 1.331 , HB 14.258 ± 3.423 g/dl, HCT 41.967 ± 16.345 , MCV 84.584 ± 15.933 , MCH 29.131 ± 7.127 , MCHC 34.154 ± 5.664 , PLT 219.485 ± 197.331 , LYM 3.346 ± 10.112 , NEUT 6.843 ± 23.557 , MONO 0.811 ± 3.601 , EO 0.327 ± 0.995 . For females WBC 7.174 ± 3.037 , RBC 4.567 ± 1.086 , HB 12.972 ± 2.752 , HCT 39.647 ± 48.186 , MCV 84.185 ± 12.944 , MCH 28.554 ± 5.109 , MCHC 33.915 ± 3.494 , PLT 264.07 ± 175.079 , LYM 2.537 ± 5.005 , NEUT 4.769 ± 11.314 , MONO 0.460 ± 0.909 , EO 0.188 ± 0.39

DISCUSSION

In accordance with IFCC/CLSI Document C28-A3,¹⁷ it is essential for each diagnostic laboratory to derive RIs. A laboratory may check with the reference values provided by manufacturers or establish its own RIs. The reference values given by the manufacturers are based on European/American populations. It is crucial to determine RIs based on the country's own population. A large sample size is needed statistically to determine RIs in a manner that is also easily reproducible. This is usually beyond the efforts of a single laboratory to achieve. A relatively more convenient way is to conduct a multicenter study¹⁸ as we have done.

In a multicenter study conducted in Turkey, using a panel from whole blood RIs for RDW, MPV, MCHC & Basophil % were derived. There were observed differences in reference values among the seven different regions of Turkey. This was probably because of environmental factors or nutritional ones as well as differences in altitudes¹⁹.

For methodological reasons, our study only included adult subjects. Pediatric normal values have been studied in other studies²⁰. A study conducted on healthy newborns in Karachi, Pakistan demonstrated the need for local RIs in the pediatric population as well²¹. A similar study on CBC conducted in Kenya showed that consistency with other such studies from the African region, the neutrophil counts and Hb values were lower as compared to those from white populations. Their finding of lower eosinophil counts and higher Hb values in contrast to the other such studies conducted in Kenya is probably a result of the strictness implemented in recruitment and a healthier reference population after excluding those who were likely to have sub-clinical diseases⁵.

Another study conducted in Saudi Arabia emphasized ethnic variations.²² The effect of ethnic variations on reference values are required to rule out these variations when specific procedures are required is a major concern. If detailed data is collected, it will become apparent that different reference intervals are needed

based on analysis following standard procedures, and so does sample handling²⁷ the ethnic variations²³.

Beutler et al. highlighted that the African population in America had lower values of, Hct, Hemoglobin, WBC, and absolute granulocyte count and higher values of the total lymphocyte count compared to European-American populations²⁴. Karita et al. conducted a study to derive reference values RIs for common hematology tests in Uganda, Rwanda, Zambia, and Kenya. This study demonstrated lower Hb, Hct, WBC, and neutrophil counts but higher eosinophil counts compared to RIs from America²⁵. Another study in Kericho, Kenya, showed RIs for males and females were $8.3-11.3$ g/dL and $5.9-10.0$ g/dL respectively. Many study participants demonstrated relatively low MCH and MCV values consistent with iron deficiency, especially in women of childbearing age. Higher eosinophil counts & lower neutrophil counts in comparison to white populations were also demonstrated²⁶. The establishment of local normal values for coagulation factors needs to be established²⁷. These examples highlight the need to establish reference values that are suited to a specific population. The establishment of RIs should follow strict criteria of identifying reference individuals, ensuring sample handling and analysis^{28,29}.

CONCLUSION

Despite all efforts to only include healthy individuals in a study, this is not entirely possible because of subclinical diseases in seemingly healthy individuals. Reference individuals are also extremely diverse that we cannot unify health status²⁸. Despite all these limitations, it is evident that there is a major need to establish local reference values, as highlighted by our study due to marked variations in different populations.

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