Haematological Reference Ranges for Adults in Zimbabwe

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Haematological reference ranges are affected by several variables such as sex, race, altitude (in case of red blood cell parameters), etc. The reference ranges that are currently in use in Zimbabwe were adopted from other countries and refer mainly to Caucasian subjects. Reporting such reference ranges might be misleading because of differences based on the above variables. This study attempts to establish haematological reference ranges for an adult Zimbabwean population. Haematological tests were carried out in the haematology laboratory at Parirenyatwa hospital on 220 samples from regular blood donors (146 males and 74 females), using automated hematology analyzer SF-3000 (Sysmex Corporation, Japan).

Zimbabweans exhibited a low white blood cell count compared to reference ranges established in Europe using automated hematology analyzer XT-2000i/XT-1800i (Sysmex Corporation, Japan). All red cell and platelet parameters appeared lower than Caucasian values. The mean values in this study compared relatively well with an earlier study on elderly Zimbabweans. There were notable differences between Zimbabwean and European reference ranges and similarities between Zimbabwean and reference ranges from other African studies. To improve the interpretation and reporting of results, Zimbabwe needs to establish its own haematological reference ranges.

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INTRODUCTION

In Zimbabwe, haematology results are reported as normal or abnormal using reference ranges that were obtained elsewhere and are usually of Caucasian origin. It is important to improve the quality of laboratory reporting by establishing indigenous reference ranges. Haematological parameters are affected by variables that include sex, geographic location, and ethnic origin. This might cause a misinterpretation of laboratory results leading to misdiagnosis. The problem can be avoided by establishing reference ranges for a Zimbabwean population. A number of countries with different populations have done studies on their haematology parameters and report on this basis for more accurate clinical haematological assessments[1-5].

It has been suggested that every laboratory must establish its own set of reference ranges by selecting subjects from a healthy population. The interpretation of any clinical laboratory test involves an important concept, comparing the patient's result to the reference range[1-3,6-8]. A study done in Zimbabwe for healthy elderly blacks residing in Harare showed notable differences from those adopted from Caucasian subjects[9]. Ethnic factors have shown to significantly contribute to some blood cell parameters with Caucasian values being higher than those of Africans and Afro-Carribeans[10-14]. An "African neutropenia" has been known to exist. These differences are thought to be due to genetically determined characteristics of the indigenous Africans and environmental challenges[15-17].

Considering the influences of the above factors on haematological reference ranges, it is important that Zimbabwe has its own reference ranges. The purpose of this study was primarily to achieve this outcome and to recommend the use of these reference ranges in local hospitals.

Abbreviations: Hb: haemoglobin, Hct: haematocrit, PDW: platelet distribution width, RBC: red blood cells, RDW: red cell distribution width, SD: standard deviation, WBC: white blood cells.

MATERIALS AND METHODS

A prospective cross-sectional study was carried out in Harare on 220 (146 males and 74 females) to establish reference haematological ranges for adult Zimbabweans. The Zauber and Zauber method was used for sample size determination[20].

Tri-potassium ethylenediamine tetra-acetic acid (K_3-EDTA) blood samples were collected from the cubital vein of healthy regular blood donors at National Blood Service of Zimbabwe (NBSZ). Regular blood donors represented a healthy population because they underwent a rigorous pre-donation screening. This was achieved by conducting thorough pre-donation interviews and haemoglobin screening using the copper sulphate technique. It is important to note that this method does not detect other haematological disorders that may render individuals not suitable as donors. Donors were also tested for HIV and other transfusion transmitted infections. Samples and controls (SF CHECK, Sysmex Corporarion Japan) were analysed in duplicate using the SF-3000 (Sysmex Corporation Japan) soon after collection to reduce storage variables. Results were recorded and statistically analysed using a statistical package for social scientists (SPSS; SPSS Inc. Chicago, Illinois) for the summary statistics. This statistical package checked for normal distributions of the major haematological parameters and calculated their means and standard deviations (+/- 2 SD) to establish the reference ranges.

RESULTS

The reference ranges for WBC, RBC, Hb, Hct, red cell indices, and platelet count were low (***Table 1***). There

Table 1 *Haematological mean and reference ranges at +/- 2SD based on sex using the SF-3000*

	FEMALES	MALES
	Mean (2SD) Reference Range (n=74)	Mean (2SD) Reference Range (n=146)
WBC [x $10^3/\mu L$]	5.9 (3.5) 2.4 - 9.4	5.0 (2.9) 2.1 - 7.9
Neutrophils [%]	55.7 (17.0) 38.7 - 72.7	54.5 (18.9) 35.6 - 73.4
Neutrophils [x $10^3/\mu L$]	3.4 (2.6) 0.8 - 6.0	2.9 (2.6) 0.3 - 5.4
Lymphocytes [%]	35.3 (16.8) 18.5 - 52.1	34.1(16.6) 17.5 - 50.7
Lymphocytes [x $10^3/\mu L$]	1.9 (1.2) 0.7 - 3.1	1.7 (0.8) 0.9 - 2.5
Monocytes [%]	7.2 (3.3) 3.9 - 10.5	8.5 (3.8) 4.7 - 12.3
Monocytes [x $10^3/\mu L$]	0.4 (0.3) 0.1 - 0.7	0.4 (0.3) 0.1 - 0.7
Eosinophils [%]	2.1 (1.4) 0.7 - 3.5	1.6 (0.8) 0.8 - 2.2
Eosinophils [x $10^3/\mu L$]	0.3 (0.3) 0.0 - 0.6	0.3 (0.1) 0.2 - 0.4
Basophils [%]	0.6 (0.6) 0.0 - 1.2	0.5 (0.4) 0.1 - 0.9
Basophils [x $10^3/\mu L$]	0.04 (0.04) 0 - 0.08	0.03 (0.04) 0.00 - 0.07
RBC [x $10^6/\mu L$]	4.4 (0.9) 3.5 - 5.3	4.7 (1.0) 3.7 - 5.7
Hb [g/dL]	12.3 (2.4) 9.9 - 14.7	14.2 (2.6) 11.6- 16.8
Hct [%]	37.8 (7.2) 30.6 - 45.0	42.1 (7.9) 34.2 - 50.0
MCV [fL]	85.9 (13.8) 72.1- 99.7	89.6 (12.6) 77.0 - 102.2
MCH [pg]	29.8 (4.2) 25.6 - 34.0	30.9 (5.6) 25.3 - 36.5
MCHC [%]	33.1 (2.7) 30.4 - 35.8	33.8 (3.9) 29.9 - 37.7
RDW [%]	15.2 (2.8) 12.4 - 18.0	15.7 (2.5) 13.2 - 18.2
Platelets [x $10^3/\mu L$]	247.8 (121.3) 126.5 - 369.1	249.4 (142.1) 107.3 - 391.5
PDW [fL]	12.1 (1.9) 10.2 - 14.0	12.6 (3.4) 9.2 - 16.0

Table 2 *Comparison of means for the current study and the normal elderly Zimbabwe population*

	Hb [g/dL]	Hct [%]	MCV [fL]	MCHC [%]	RBC [x 10^6/μL]	WBC [x 10^3/μL]	Platelets [x 10^3/μL]
Current study:							
Females	12.3	37.8	85.9	33.1	4.4	5.9	247.8
Males	14.2	42.1	89.6	33.8	4.7	5.0	249.4
Elderly Zimbabweans[9]:							
Females	13.4	37.7	84.2	35.6	4.5	5.7	251.0
Males	14.5	40.5	86.2	35.8	4.8	5.8	226.0

Table 3 *Comparison of reference ranges of the main haematological parameters for the current study with other studies*

	Hb [g/dL]	Hct [%]	MCV [fL]	MCHC [%]	RBC [x 10^6/μL]	WBC [x 10^3/μL]	Platelets [x 10^3/μL]
Current study:							
Females	9.9-14.7	30.6-45	72.1-99.7	30.4-35.8	3.5-5.3	2.4-9.3	126.5-369.1
Males	11.6-16.8	34.2-50	77.0-102.2	29.9-37.7	3.7-5.7	2.1-7.9	107.3-391.5
Elderly Zi'bweans[9]:							
Females	10.2-17	29.4-46	69.8-99	23.8-36	3.6-5.4	3.1-9.1	117-478
Males	11.1-18	31.9-49	72.5-100	25.8-36	3.6-5.8	2.9-9.7	122-395
Basotho[18]:							
Females	11.8-16	35.3-47	80.9-99	27.4-33	4.0-5.2	2.5-8.9	-------
Males	13.7-18	41.4-52	80.9-99	27.4-33	4.6-5.8	2.1-7.7	-------
Cape Peninsula[15]:							
Females	10.2-15	28.8-47	80.9-99	26.1-33	3.2-5.2	3.2-11.2	-------
Males	8.7-17.5	26.9-43	81.6-107	25.8-32	4.2-5.9	2.1-9.8	-------
Parirenyatwa hospital[19]:							
Females	12-16	32-52	80-99	27-32	2.8-6.8	4.8-10.8	130-400
Males	14-18.6	42-52	80-99	27-32	4.7-6.1	4.8-10.8	130-400

were similarities between the means of current and previous studies on an elderly Zimbabwean population (***Table 2***). The reference ranges for Hb and MCV in the current study were similar to those of an elderly Zimbabwean population but lower than in some other African studies (***Table 3***).

DISCUSSION

The reference ranges established in this study indicated a low WBC count. This was expected because Africans in general have a lower leukocyte count than Caucasians[15,16]. It is therefore important to use the local reference ranges for reporting results. For Hb, Hct and the red cell parameters the situation is different. The determination of reference ranges for these parameters is particularly crucial since individuals with iron deficiency and / or anaemia should be excluded from the reference population, e.g. by assuring that the ferritin values of the individuals included in the reference population are normal. In practice, this is hardly possible. Since anaemia, especially anaemia due to iron deficiency, is commonplace in many African countries it is reasonable to assume that the low reference ranges are at least in part due to the fact that the reference population contained a significant number of anaemic individuals. Therefore, it would be advisable to use the reference ranges not for diagnosing or excluding anaemia. Instead, the WHO definition should be used which classifies men with Hb < 13 g/dL and women with Hb < 12 g/dL as anaemic. The reference ranges can only tell whether an individual is perhaps more anaemic than the reference population. The same would apply to the red blood cell indices. This poses a serious challenge in reporting results. A value inside the reference range does not necessarily mean that the value is "normal" or that the individual is healthy. It just means that the individual has values similar to those

in the investigated population. The low haemoglobin and MCV in ***Table 3*** for both females and males could also be due to latent thalassaemic conditions. Prevalence of thalassaemia in Zimbabwe is not yet clearly understood. The different MCV values for males and females could be associated with presence of iron depletion in the female population due to chronic menstrual blood loss. The wide range of the MCV reference ranges could be due to the existence of dual population of cells (microcytic and macrocytic). A previous study on adult Zimbabweans gave similar results[9].

The standard normal platelet count is considered to be equal or greater than 150,000/μL. In Zimbabwe the lower limit of the platelet count was 121,000/μL according to the current study. However, the results obtained were also comparable to those of a previous study on elderly Zimbabweans (45-65 years old), and blacks elsewhere[5,8,9,17]. This would strengthen the need to establish local reference ranges.

It can be concluded that reference ranges for important haematological parameters (WBC, Hb, RBC indices and platelets) in Zimbabwe differ significantly from those adopted elsewhere outside the region. They are comparable with those from other African studies. To improve in the reporting of results, Zimbabwe needs to establish its own haematological reference ranges that can be recommended for use in local laboratories. The criteria for choosing a reference population should include that the selected individuals are healthy and have no nutritional deficiencies. This is sometimes hard to achieve. Therefore, it is difficult to distinguish genetically caused differences in reference ranges from those caused by inclusion of non-healthy or undernourished individuals. As a consequence, doctors and nurses need to be aware that a result within the reference range does not necessarily reflect a healthy status.

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