

Complete blood count of blood donors in Antananarivo Madagascar

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Abstract

Objective: This study was conducted to determine the values of the blood count of blood donors in Antananarivo.

Methodology: This is a descriptive and cross-sectional study from September 20th to November 09th, 2017 at the National Center for Blood Transfusion and the laboratory of Befelatanana University Hospital Antananarivo. The blood counts of all blood donors who met the inclusion and exclusion criteria were measured. Normal values were defined by values between 2.5 and 97.5 percentiles.

Results: Among the 249 blood donors selected, 126 were men and 123 were women. For erythrocyte parameters, the values of hemoglobin are between 129 g/l -181g/l in men and 116 g/l -161g/l in women. Regarding leukocyte parameters, the values of leukocytes are between 3.8G/l-10.2G/l in men and 4.0G/l - 9.9G/l in women. The numbers of platelets are between 148G/l- 425G/l in men and between 155G/l-482G/l in women.

Conclusion: Blood count values of blood donors in Antananarivo showed variations by age and sex and showed differences from those of the Caucasian population. Thus, Madagascar should establish its own reference values to ensure proper management of the health of the Malagasy population.

Keywords: blood count, erythrocytes, blood donors.

1. Introduction

The blood count is a biological analysis that determines the erythrocyte, leukocyte and platelet values [1]. It is prescribed almost systematically in the event of disruption of the functioning of the organism in particular in case of suspicion of anemia, general deterioration, bleeding, thrombosis, persistent infection or cancer [2]. Thus, it is important to know the reference values of the blood count to be able to detect any qualitative and quantitative anomalies of these blood cells. This study was conducted to update the only study of normal values for the blood count of Antananarivo in 2000 [3].

Our study has brought about a methodological improvement in terms of sampling and the choice of the source population. It is also part of the current trend of establishing organic standards in African countries [4-5]. Indeed, the reference values of Caucasian populations, usually used in laboratories, differ from those of black subjects, including Malagasy people. So, each country should establish its own organic standards to avoid misinterpretation of blood count results. Thus, the objective of this study is to determine the blood count values of blood donors in Antananarivo.

2. Material and Methods

This is a descriptive and cross-sectional study from September 20th to November 09th, 2017 at the National Center for Blood Transfusion (CNTS) and the

laboratory of Befelatanana University Hospital Antananarivo. The study population was constituted by volunteers or replacement blood donors.

Table 1: Inclusion and exclusion criteria

Inclusion criteria (eligible blood donors)[6-7]	Exclusion criteria
<ul style="list-style-type: none"> • Volunteer or replacement blood donor. • Age > 18 years and <60 years. • Weight > 45kg. • Sleep time more than 6 hours the day before. • Woman who is neither pregnant nor breastfeeding nor in menstrual period. • Absence of risky sexual behavior. • Do not belong to a transfusion risk group: human immunodeficiency virus (HIV), syphilis, hepatitis B virus, hepatitis C virus. • Absence of tattoo, piercing, acupuncture treatment and recent blood donation. • No fever in the last 15 days. • No history of jaundice, hepatitis, skin diseases, heart disease, diabetes, high blood pressure, respiratory diseases, lymphadenopathy, joint pain and allergies. • Absence of malaria, extraction or dental care, injection or vaccination • Do not be on antidiabetic or antihypertensive therapy 	<ul style="list-style-type: none"> • Taking medication in the two weeks preceding the blood count to eliminate medications that could transiently modify blood count such as NSAIDs*, ribavirin, methotrexate, penicillins, cephalosporins and cyclins, nitrofurantoin, rasburicase, methylene blue, primaquine® and Dapsone®[8]. • Personal and family history of hematologic, haemorrhagic and thrombotic diseases. • Toxic habits (alcohol, tobacco, drugs). • Intestinal parasitosis • Decreased serum iron (male <10.7 μmol / l, female <9.0 μmol / l) responsible for anemia or microcytosis. • Compliance of the blood sample: haemolysed, coagulated, icteric or insufficient quantity.

*Non Steroid Anti-inflammatory Drugs

During the study period, 297 donors were initially included. After taking into account the different exclusion criteria, 249 donors were finally selected, composed of 126 men and 123 women (Figure 1).

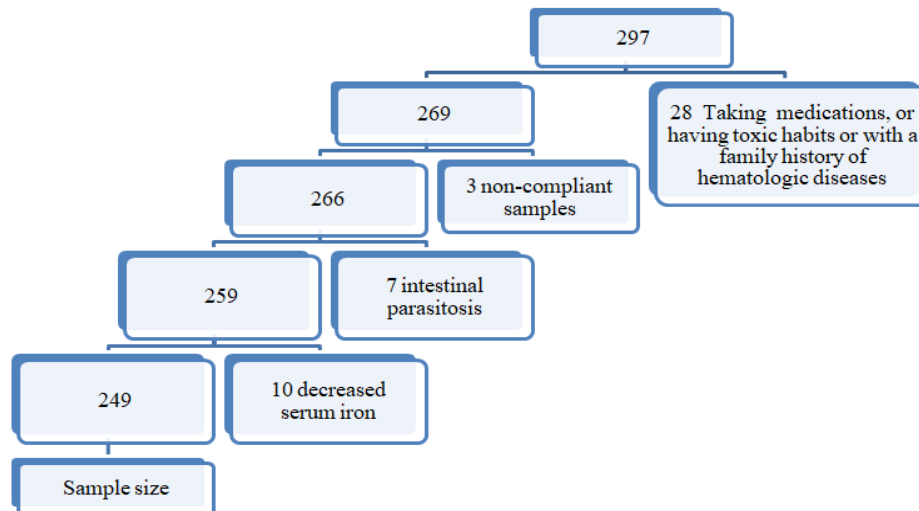


Figure 1: Final study population

These 249 selected donors correspond to the number required by the current recommendation of the Clinical and Laboratory Standards Institute (CLSI) and the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC-LM) that require a sufficient number of reference individuals ≥ 120 [9]. The study parameters were age, sex and blood count results.. The blood count was performed on the ABX Pentra 60 hematology analyzer. The validity of the measurements was guaranteed by the passage of 3 levels of CBC-3D control provided by Euro Cell Diagnostics composed of Low Control, Normal Control and High Control. For the [IJBAR \(2018\) 09 \(05\)](#)

exclusion criteria, the serum iron assay was performed on the BS 300 (Mindray) biochemistry automaton. The validity of the measurements was guaranteed by the passage of control before analysis. Stool examination was performed using the MIF technique (Merthiolate-Iodine-Formol). Data entry and processing was performed on the Epi-info 3.5.2 software. The blood count variables were described by the central trend parameters and their dispersion index. The 2.5th and 97.5th percentiles were used to limit the normal values. The statistical significance threshold used was $p = 0.05$. This study respected the notion of volunteering, anonymity and confidentiality. It was implemented after the

acceptance of the protocol by the ethics committee of the National Institute for Public and Community Health of Antananarivo (INSPC) according to the decision n^o 002/2017-CEER / INSPC.

3. Results

The present study shows the results of blood count of 249 blood donors consisting of 126 men and 123 women with a sex ratio of 1.02. The average age is 35.66 ± 11.39 years old with extremes of 18 to 64 years old.

Table 2: Sociodemographic characteristics of the study population

Sociodemographic characteristics		n	%
Gender	Male	126	50.6
	Female	123	49.4
Age range	≤ 29	88	35.3
	30 - 49	123	49.4
	≥ 50	38	15.3
Marital status	Single	73	29.3
	Divorced	8	3.2
	Married	161	64.7
	Widowed	7	2.8
Study level	Primary	42	16.9
	Secondary	106	42.6
	University	97	39.0
	Without instruction	4	1.6
Daily physical activity*	Light	68	27.3
	Moderate	141	56.6
	Vigorous	40	16.1
Ethnicity	Merina	197	79.1
	Betsileo	25	10.0
	Other ethnic groups	27	10.8

* The level of MET (Metabolic Equivalent Task): Mild intensity <3 METs, moderate intensity between 3 to 6 METs, vigorous intensity >6 METs [10].

Table 3: The values of erythrocyte parameters according to age and gender of blood donors at Antananarivo defined by values between the 2.5th and 97.5th percentiles

Erythrocyte parameters	Age (years)	Men		Female	
		Median	Percentiles	Median	Percentiles
			2,5 – 97,5		2,5 – 97,5
Erythrocytes (T/l)	All ages	5.26	4.54-6.08	4.68	3.94-5.37
	≤ 29	5.26	4.58-6.02	4.64	4.05-5.52
	30 à 49	5.26	4.54-6.25	4.71	3.84-5.42
	≥ 50	5.15	4.57-5.81	4.71	3.94-5.98
Hematocrit (%)	All ages	47.7	40.4-53.9	42	34.7-46.5
	≤ 29	47.6	41-53.3	41.5	34.5-46.4
	30 à 49	47.7	39.2-53.3	42	34.9-46.6
	≥ 50	47.7	43.8-53.1	42.2	34.7-49.2
Hemoglobin (g/l)	All ages	162	129-181	141	116-161
	≤ 29	161	138-181	139	122-164
	30 à 49	163	125-181	141	115-160
	≥ 50	164	140-176	141	122-163
MCV* (fl)	All ages	91	80-99	90	75-95
	≤ 29	89	82-97	90	74-96
	30 à 49	92	80-99	90	75-95
	≥ 50	92	82-99	89	74-96
MCH** (pg)	All ages	30.5	25.4-34.4	30.2	24.7-33.5
	≤ 29	30.3	26.2-34.3	30.5	24.5-33.5
	30 à 49	31.0	25.0-35.4	30.2	24.5-33.7
	≥ 50	32.1	26.2-33.6	29.8	23.2-33.1
MCHC*** (g/l)	All ages	336	320-358	335	319-359
	≤ 29	334	320-357	340	320-359
	30 à 49	337	322-359	334	319-358
	≥ 50	337	320-357	335	320-359

* Mean corpuscular volume** Mean corpuscular hemoglobin *** Mean corpuscular hemoglobin concentration

Table 4: The values of leukocyte count and platelet count according to age and gender of blood donors at Antananarivo defined by values between the 2.5th and 97.5th percentiles

Leukocyte and platelet count	Age (years)	Men		Female	
		Median	Percentiles	Median	Percentiles
			2,5 – 97,5		2,5 – 97,5
WBC* (G/l)	All ages	6.1	3.8-10.2	6.6	4.0-9.9
	≤ 29	6.6	3.9-10.2	7.3	3.8-10.6
	30 à 49	5.5	3.6-10.2	6.6	3.7-9.9
	≥ 50	5.8	4.9-9.9	5.9	4.2-8.8
Neutrophils(G/l)	All ages	3.25	1.67-6.35	3.52	1.64-5.89
	≤ 29	3.69	1.63-6.08	3.90	1.50-6.76
	30 à 49	2.86	1.64-6.36	3.40	1.73-5.85
	≥ 50	3.34	2.30-6.52	3.453	1.60-5.41
Eosinophils(G/l)	All ages	0.000	0.000-0.486	0.000	0.000-0.375
	≤ 29	0.000	0.000-0.486	0.000	0.000-0.408
	30 à 49	0.000	0.000-0.486	0.000	0.000-0.340
	≥ 50	0.080	0.000-0.340	0.077	0.000-0.245
Basophils(G/l)	All ages	0.000	0.000-0.070	0.000	0.000-0.049
	≤ 29	0.000	0.000-0.098	0.000	0.000-0.091
	30 à 49	0.000	0.000-0.099	0.000	0.000-0.091
	≥ 50	0.000	0.000-0.064	0.000	0.000-0.049
Lymphocytes (G/l)	All ages	2.59	1.18-4.20	2.58	1.39-4.33
	≤ 29	2.66	1.15-3.87	2.56	1.21-4.28
	30 à 49	2.55	1.15-3.92	2.75	1.36-4.33
	≥ 50	2.56	1.45-4.23	2.40	1.39-4.65
Monocytes (G/l)	All ages	0.166	0.045-0.472	0.172	0.04-0.54
	≤ 29	0.198	0.039-0.545	0.156	0.03-0.61
	30 à 49	0.153	0.042-0.385	0.197	0.04-0.53
	≥ 50	0.162	0.050-0.330	0.210	0.05-0.49
Platelets (G/l)	All ages	286	148-425	326	155-482
	≤ 29	289	134-398	348	133-500
	30 à 49	282	148-427	324	134-482
	≥ 50	291	147-396	306	175-434

*White blood count

Table 5: Comparison of mean blood count values between men and women

Parameters	Male (n=126)	Female (n=123)	p-value
	Mean ± sd*	Mean ± sd	
Erythrocytes (T/l)	5.27 ± 0.41	4.70 ± 0.37	10 ⁻⁴
Hematocrit (%)	47.89 ± 3.28	41.72 ± 3.01	10 ⁻⁴
Hemoglobin (g/l)	161 ± 12.52	141 ± 11.75	10 ⁻⁴
MCV (fl)	90.89 ± 5.14	88.84 ± 5.42	0.0024
MCH (pg)	30.6 ± 2.33	29.9 ± 2.18	0.01
MCHC (g/l)	337.21 ± 12.45	338.21 ± 11.71	0.51 (NS)
WBC (G/l)	6.398 ± 1.840	6.654 ± 1.708	0.25 (NS)
Neutrophils (G/l)	3.494 ± 1.393	3.617 ± 1.279	0.46 (NS)
Eosinophils (G/l)	0.108 ± 0.167	0.084 ± 0.121	0.18 (NS)
Basophils (G/l)	0.0076 ± 0.029	0.0028 ± 0.014	0.1 (NS)
Lymphocytes (G/l)	2.576 ± 0.828	2.725 ± 0.784	0.14 (NS)
Monocytes (G/l)	0.192 ± 0.122	0.220 ± 0.147	0.11 (NS)
Platelets (G/l)	293.71 ± 71.93	331.01 ± 83.04	0.0002

*Standard deviation

Table 6: Comparison of blood count values between this study and other countries defined by values between 2.5th and 97.5th percentiles

Parameters	Gender	Antananarivo	Zimbabwe	Togo	South Africa	China	United State	Germany
Erythrocytes (T/l)	M*	4.54-6.08	4.4-6.7	3.3-6.4	4.0-6.4	4.28-5.81	4.5-5.9	3.94-5.43
	F**	3.94-5.37	3.9-5.9	3.1-6	3.8-5.6	3.81-5.13	4-5.2	3.64-4.93
Hematocrit (%)	Male	40.4-53.9	42-55.1	28-54	35-50.8	40-51	41-53	37-48
	Female	34.7-46.5	33.9-48.7	28-47	29.4-45.4	35-46	36-46	33-43
Hemoglobin (g/l)	Male	129-181	132-183	100-184	122-177	133-175	135-175	125.7-164.4
	Female	116-161	102-159	103-171	95-158	115-152	120-160	112.8-146.6
MCV (fl)	Male	80-99	72.8-102.6	80-99	68-98	82.3-99.2	80-100	NA
	Female	75-95	68.8-100.7	80-95				NA
MCH (pg)	Male	25.4-34.4	22.9-33.5	26-36	NA*	27-33.7	26-34	NA
	Female	24.7-33.5	20.7-32.1	25-37	NA			NA
MCHC (g/l)	Male	320-358	289-354	290-390	NA	316-354	310-370	NA
	Female	319-359	292-343	300-410	NA			NA
WBC (G/l)	Male	3.8-10.2	2.80-8.10	1.9-10.1	3.1-9.1	3.64-9.39	4.5-11	NA
	Female	4-9.90	3.30-8.30	2.2-7.8				NA
Neutrophils (G/l)	Male	1.67-6.35	0.772-3.967	0.5-5.4	1.0-5.3	1.80-6.30	NA	NA
	Female	1.64-5.89	1.112-4.440	0.5-4.4			NA	NA
Eosinophils (G/l)	Male	0.000-0.486	0.019-0.612	0-0.5	0.04-1.53	0.02-0.52	NA	NA
	Female	0.000-0.375	0.018-0.622	0-0.5			NA	NA
Basophils (G/l)	Male	0.000-0.070	0.008-0.053	NA	0.01-0.15	0.00-0.06	NA	NA
	Female	0.000-0.049	0.007-0.051	NA			NA	NA
Lymphocytes (G/l)	Male	1.18-4.20	1.144-3.276	1.1-4.3	1.2-3.7	1.06-3.20	NA	NA
	Female	1.39-4.33	1.339-1.373	1.2-4.3			NA	NA
Monocytes (G/l)	Male	0.045-0.472	0.212-0.795	0.05-0.8	0.20-0.78	0.16-0.62	NA	NA
	Female	0.044-0.544	0.211-0.723	0.05-0.8			NA	NA
Platelets (G/l)	Male	148-425	125-357	120-443	126-438	127-350	150-350	129-327
	Female	155-482	163-431	150-436				

*Non applicable

4. Discussion

This study has estimated normal blood count values in the Antananarivo population. Blood donors are supposed to be pathology-free subjects. Thus, they can be considered normal and can be used as a study population to determine the normal values of the blood count [11]. The significant differences between men and women could be due to the influence of androgens in men [12]. Indeed, testosterone can increase the plasma volume [13]. Similarly, estrogens in women can lead to hemodilution due to menstrual bleeding [4]. Concerning the MCHC, it is the erythrocyte index that most frequently reflects an abnormality of red blood cells number measurement and hemoglobin level measurement [14]. The non-variability of the MCHC in this study confirms the good functioning of the ABX Pentra 60 cellular hematology analyzer used [14]. The elevation of lymphocytes in women [13] is due of the presence of estrogen receptors on B lymphocytes [15] which strengthen the immune system. Thus, women have a stronger immune response than men. Normal values of platelets are higher in women [5, 16] because of hormonal influences. The peak in the number of platelets is found in the middle of the menstrual cycle, but menstrual bleeding also have a role [13]. By comparing our study with other studies, the values of blood count that we have found are essentially the same as those found in several African countries [5,17], except in South Africa [18] where a mixture of Caucasian and African populations live.

However, the results of this study show higher values compared to the study carried out in 2000 in Antananarivo [3].

By comparing our study with other studies conducted in Caucasian and Asian countries, we have found higher normal blood count values, especially erythrocyte and platelet parameters [16, 19-21]. Indeed, genetic and environmental factors may affect reference values in some populations. In addition, The Malagasy population is composed of a mixture of several peoples [22]. In brief, the results of this study are close to those of the African population, especially the Zimbabwean population. Moreover, the geographical situation, the climate and the mode of feeding of Madagascar are close to those of the African population.

5. Conclusion

This study has determined the values of blood count of the blood donors of Antananarivo. These values do not differ from those used in other African countries. By contrast, they are different from those of Caucasians and Asians. Thus, we should no longer use the Caucasian reference values in our country to avoid misinterpretation of results. Further studies that will be conducted in the 6 provinces of Madagascar deserve to be made to have a more diverse study population that can represent the entire Malagasy population.

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