Ferritin and haematological values in healthy elderly Nigerians

Nkiru N. ODUNUKWE[1], Ifeoma O. IMONUGO[2], Akanmu S. AKANMU[2], Obiageli E. NNODU[3], Charles C. OKANY[2], Ibironke AKINSETE[2], Omowunmi A. AHMED[1], Chinyere EFIENEMOKWU[1]

[1] Nigerian Institute of Medical Research P.M.B. 2013 Yaba,
[2] Department of Haematology and Blood Transfusion, College of Medicine of the University of Lagos, IDI- Araba, P.M.B. 12003,
[3] National Orthopaedic Hospital Igbobi, Lagos, NIGERIA.

Turk J Haematol 2004;21(2): 71-77

Received: *24.09.2003* ***Accepted:*** *27.02.2004*

ABSTRACT

Two-hundred Nigerians (65 years and above) were studied and compared with control (18-50 years). Haematocrit, haemoglobin, mean corpuscular haemoglobin concentration, mean corpuscular haemoglobin, mean corpuscular volume, platelets and ferritin were analyzed.

Mean ferritin levels were 105 ± 30 µg/L and 72 ± 10 µg/L (males and females respectively). Mean MCV, MCH and MCHC were 94.6 ± 9.0 fl, 93.6 ± 9.0 fl, 31.5 ± 3.0 pg, 31.4 ± 4.4 pg, 348 ± 30 g/L, and 347 ± 42 g/L. Mean haematocrits were 37 ± 4%, 36 ± 4%, while mean haemoglobins levels were 132 ± 24 g/L and 129 ± 1 g/L. RBC counts were 4.1 ± 0.8 x 10^{12}/L, and 4.0 ± 0.5 x 10^{12}/L. Mean total WBC counts were 6.4 ± 1.5 x 10^{9}/L and 6.3 ± 0.7 x 10^{9}/L; mean platelets were 170 ± 60 x 10^{9}/L, 184 ± 5 x 10^{9}/L. All haematological parameters were similar in both aged males and females, except ferritin, haematocrit, RBC and haemoglobin, which were significantly higher in males ($p< 0.05$). Significant sex differences exist in all the parameters, of control except MCV and total WBC count. There were significant differences in all the haematological parameters between the controls and the aged ($p< 0.05$), and between the aged (65-84 years) and the very aged (85-105 years) ($p< 0.05$).

Reference haematological range needs to be established for the elderly Nigerians.

Key Words: Ferritin, Haematological tests, Aged, Nigerians.

ÖZET

Sağlıklı görünen yaşlı Nijeryalılar'da ferritin ve diğer hematolojik değerler

Altmışbeş yaş üzeri 200 Nijeryalı, hematolojik değerleri açısından kontrol grubu (18-50 yaş) ile karşılaştırıldı. Hematokrit, hemoglobin, MCV, MCH, MCHC trombosit sayıları ve ferritin düzeyleri saptandı. Ortalama fer-

ritin düzeyleri kadın ve erkekler için sırası ile 105 ± 30 µg/L ve 72 ± 10 µg/L bulundu. Ortalama MCV, MCH ve MCHC ise 94.6 ± 9.0 fl, 93.6 ± 9.0 fl, 31.5 ± 3.0 pg, 31.4 ± 4.4 pg, 348 ± 30 g/L ve 347 ± 42 g/L bulundu. Ortalama hematokrit ise %37 ± 4, %36 ± 4, ortalama hemoglobin 132 ± 24 g/L ve 129 ± 1 g/L, alyuvar sayımları 4.1 ± 0.8 x 10^{12}/L ve 4.0 ± 0.5 x 10^{12} L, ortalama lökosit sayıları 6.4 ± 1.5 x 10^{9}/L ve 6.3 ± 0.7 x 10^{9}/L ortalama trombosit 170 ± 60 x 10^{9}/L, 184 ± 5 x 10^{9}/L olarak bulundu. Erkeklerde ferritin, hematokrit, RBC ve hemoglobin yüksek bulunurken ($p< 0.05$), diğer parametreler kadın ve erkeklerde aynı bulundu. MCV ve lökosit sayısı dışında diğer tüm parametreler kontrol grubundaki cinsiyetlerden farklı bulundu. Kontrol grubu ile yaşlılar arasında tüm hematolojik parametrelerde farklılık bulundu ($p< 0.05$). Aynı zamanda yaşlılar (65-84) ile çok yaşlılar arasında (85-108) da anlamlı fark bulundu ($p< 0.05$).

Nijeryalılar için referans hematolojik değerlerin belirlenmesi gereklidir.

Anahtar Kelimeler: Ferritin, Hematolojik testler, Yaş, Nijerya.

INTRODUCTION

The life expectancy in Nigeria has increased tremendously from 47.3 years in 1900 to 71.3 years in 1973[1]. Chances of survival have increased with improvement in quality of life. This has shown that aging is not synonymous with disease and that a healthy old age is certainly possible[2].

A number of factors affect haematological parameters in healthy state; such as age, sex, race, and environment, particularly altitude[1]. Haematopoietic (red) marrow occupies the entire capacity of the bones at birth. In old age there is increased replacement with fatty marrow[2]. This may affect the haematological parameters and result in different reference range for different age groups.

The haematological reports in Nigerians are centered on neonates, children and young adult while little or nothing is known about our aged subjects[3-5].

Many workers in this environment have documented significant differences in the values obtained in Nigerians compared with the Caucasian values. From the work done on haematocrit values on 338 singleton normal Nigerian neonates, the mean obtained for cord blood of Nigerian neonates is higher than that obtained for the white population 60.8% and 51% respectively[6]. From four weeks onward, the haematocrit in Caucasians is higher than that in Nigerians[6]. Another worker reported a difference between the Caucasians and Nigerians in a study of 704 children aged 1 to 10 years[7]. A report from the work on individuals aged 10-19 years revealed that the lower limit of parameters studied were significantly lower than the lower limit in the Caucasians[8]. Other workers revealed that the lower limit of the haemoglobin and haematocrit were markedly lower than that found in the Caucasian adults[5].

Although there is no evidence yet that the effects of aging on marrow proliferative capacity, or ultimately on steady-state blood counts, are clinically significant within existing life-span, magnetic resonance imaging and histological sections estimations have confirmed a significant decrease in marrow cellularity with age[9-11]. In this context it is desirable to establish what can be regarded as a reference haematological values for the aged. It may be tempting to assume that blood counts may be low in the elderly because of the established fatty changes in the marrow with age, there is need to prove that this is truly so. Otherwise a small drop in haematocrit or haemoglobin which may be an early pointer to an occult neoplasm in the aged may be missed. The present communication is an effort to bridge the gap in our knowledge as regards reference values of some haematological parameters in elderly Nigerians.

MATERIALS and METHODS

Two-hundred healthy persons (100 male and 100 females) aged 65-105 years who we-

re attending the NISWREP (Nigeria Society for the Welfare of Retired and Elderly Persons) out-patient clinic at Gbaja Health center in Surulere, Lagos were studied. A hundred healthy young adults blood donors (60 males 40 females) aged 18-50 years from National Orthopaedic Hospital, Igbobi and Lagos University Teaching Hospital, Idi-araba were included as control group. Informed consent was obtained from all the subjects and none was clinically ill at the time of study. Physical examination was done to eliminate those who were ill. Those with peptic ulceration and haemorrhoids were excluded. Those included were those who had no symptoms or signs of disease. Stool microscopy was performed and those with worm infestation were excluded.

Blood film for malaria parasite was used to exclude those with malaria.

8 mL of blood (5 mL in EDTA bottle and 3 mL in plain bottles) were collected from each subject. Haematocrit, hemoglobin concentration, MCHC, MCH, MCV, WBC and platelet count were determined using coulter counter ACT 8. The sera stored at -20°C were analyzed in batches for ferritin using DAKO sandwich ELISA method[12]. Blood films were stained and examined for malaria parasites by a single microscopist using x 100-oil immersion lens x 7 eyepieces. One hundred fields were examined before a slide was declared negative[13]. Erythrocyte sedimentation rate was determined by westergren methods[14].

The statistical analysis was by student's t-test and level of significance taken as $p< 0.05$. For the purpose of data analysis the elderly were divided into two groups viz:-

(i) The aged (65-84 years) and,

(ii) The very aged (85-105 years).

RESULTS

Three hundred samples were collected but only 285 were fully analysed. Others were either lysed or clotted.

The mean ages of the aged subjects studied were 74 ± 8 and 73 ± 8 years for males and females respectively. The results of the ferritin and haematological parameters are shown in Table 1. The mean haemoglobin values were 132 ± 20 g/L for males and 128 ± 10 g/L for females, and mean haematocrit was 37 ± 4% and 36 ± 4% for males and females respectively.

All the other haematological parameters were similar in both males and females elderly subjects except ferritin, haematocrit, haemoglobin and RBC count. Values for males were significantly higher than that for the females ($p< 0.05$) (Table 1).

There was significant difference between the male control group and male aged population in all the parameters compared except MCH, which was similar for both groups. There was significant difference between the female control group and female aged population in all the parameters compared except haemoglobin, MCH, MCHC and RBC which were similar for both groups (Table 2). There was a significant difference between all the parameters except MCV and MCH, WBC and MCV in females of the aged (65-84 years) and the very aged (85-105 years) ($p< 0.05$). There was also a significant difference between all the parameters in males of the aged (65-84 years) and the very aged (85-105 years) ($p< 0.05$) (Table 3).

DISCUSSION

This study confirmed that there is significant difference in the haematological parameters between the aged and the young adults and also between the aged and the very aged as has been observed in earlier reports[15].

From birth there is an initial rise in these parameters from days one to three followed by a gradual drop till three to six months. Again there is gradual rise between six months and two years till young adulthood, the lowest values are observed mainly in the oldest subject[15].

Table 1. A comparison of ferritin and haematological parameters in the aged male & females

	Male	Female	
Parameters	**Mean ± SD**	**Mean ± SD**	**Difference**
Haematocrit %	37 ± 4%	36 ± 4%	**p< 0.05**
Haemoglobin (g/L)	132 ± 20	128 ± 10	**p< 0.05**
RBC (x 10^{12})	4.1 ± 0.6	4.0 ± 0.5	**p< 0.05**
MCV (fl)	94.8 ± 8.1	93.6 ± 9.0	p> 0.05
MCH (pg)	31.5 ± 3.4	31.4 ± 4.4	p> 0.05
MCHC (g/L)	348 ± 30	347 ± 42	p> 0.05
WBC (x 10^9)	6.4 ± 1.5	6.3 ± 1.7	p> 0.05
Ferritin (µg/L)	105 ± 30	72 ± 10	**p< 0.05**
Platelets (x 10^9)	170 ± 60	184 ± 52	p> 0.05
Age (years)	74 ± 8	73 ± 8	p> 0.05
ESR (mm/hr)	45 ± 2.7	43 ± 2.5	p> 0.05

Table 2. Comparison of ferritin and haematological parameters between the aged and control (young adult)

	Male Mean ± SD		Female Mean ± SD		
Parameters	**Control**	**Aged**	**Control**	**Aged**	**Difference**
Age (years)	31 ± 6	74 ± 8	29 ± 6	73 ± 8	0.00
Haematocrit %	44 ± 4	37 ± .4.4	3.8 ± 3	36 ± 4	0.02
Hb (g/L)	151 ± 17	132 ± 25*	128 ± 12	126 ± 18	**0.35**
RBC (x 10^{12})	5 ± 0.5	4.1 ± 0.6	4.2 ± 0.5	4.0 ± 0.8	**0.08**
MCV (fl)	101 ± 8	94 ± 8	100.4 ± 2.9	98.4 ± .4	0.00
MCH (pg)	30 ± 2	32 ± 3	30.4 ± 3	31.4 ± 4.4	**0.20**
MCHC (g/L)	338 ± 15	348 ± 30	334 ± 14	347 ± 42	**0.10**
WBC (x 10^9)	7.3 ± 1.7	6.3 ± 1.5	7.4 ± 1.4	6.3 ± 1.7	0.00
Platelets (x 10^9)	240 ± 76	120 ± 60	220 ± 70	184 ± 52.0	0.00
ESR (mm/hr)	6 ± 3	44 ± 2.7	11 ± 4	43 ± 2.5	0.00
Ferritin (µg/L)	97.8 ± 46	105 ± 30	66.5 ± 21	72 ± 10	p< 0.05

This observation may be as a result of the replacement of the red marrow by fatty tissue (yellow marrow)[2]. Increasing replacement of red marrow by fatty tissue with increasing age has been reported[2]. It has been reported that the cellularity of the marrow decreases with increase in age with subsequent decrease in the haematological parameters. Significantly higher values have been recorded for myeloid clusters and colonies of erythroid progenitor cells in young adults when compared with the elderly subjects[16].

However, apart from replacement of the red marrow with fatty marrow being the reason for decrease haematological parame-

Table 3. Effects of increasing age on heamatological parameters

	Male			Female		
	Aged 65-84 yrs n= 100	Very aged 85-105 yrs n= 52		Aged 65-84 yrs n= 29	Very aged 84-105 yrs n= 19	
Parameters	**Mean ± SD**		**Difference**	**Mean ± SD**		**Difference**
Age (years)	70 ± 2	94 ± 8	p< 0.05	68 ± 6	90 ± 8	p< 0.05
Haematocrit %	38 ± 4	33 ± 1.2	p< 0.05	33 ± 3	30 ± 4	p< 0.05
Hb (g/L)	132 ± 17	116 ± 25	p< 0.05	120 ± 12	112 ± 18	p< 0.05
RBC (x 10^{12})	4.2 ± 0.5	3.9 ± 0.4	p< 0.05	4.0 ± 0.3	3.6 ± 0.7	p< 0.05
MCV (fl)	94 ± 5	95 ± 8	p< 0.05	96 ± 2	94 ± 4	p< 0.05
MCH (pg)	32 ± 4	31 ± 3	p< 0.05	30.4 ± 3	31 ± 4.2	p< 0.05
MCHC (g/L)	353 ± 5	340 ± 30	p< 0.05	334 ± 14	347 ± 4.2	p< 0.05
WBC (x 10^9)	6.6 ± 1.7	6.3 ± 1.5	p< 0.05	6.4 ± 1.4	6.3 ± 1.7	p< 0.05
Platelets (x 10^9)	176 ± 76	160 ± 20	p< 0.05	184 ± 70	166 ± 72.0	p< 0.05
ESR (mm/hr)	40 ± 3	48 ± 27	p< 0.05	51 ± 4	62 ± 5	p< 0.05
Ferritin (µg/L)	99.8 ± 9	115 ± 2.0	p< 0.05	68.5 ± 2	72 ± 10	p< 0.05

ters, low intake of micronutrients and calories may contribute to decrease haematopoiesis[17].

The mean MCV was significantly higher in the young control group when compared with the aged. This is contrary to what was reported for Caucasian population, where there was significant increase in MCV as age increases[18]. The explanation given for the Caucasian population was that it could be as a result of habitual cigarette smoking by the aged Caucasian[18]. We think that the reversal of the ratio of MCV in our study could be perhaps, that the elderly has increased tendency to vasculopathy with attendant roughness of vascular endothelia surfaces. This may cause microangiopathic lesions with loss of red cell membrane and reduce MCV of the elderly red cells and the observed increase in fractions of dense red cells in the aged may be a consequence of this phenomenon[19]. Because of reduced surface area of dense cells, MCH may be high and osmotic fragility may increase[20]. Although the mean MCV value in the aged was 14 fl lower than that found in young adult, this lower value is still higher than the values obtained for aged Caucasians. The high MCV (101 fl) in young adult Nigerians found in this study has not been documented previously. Previously unreported values was 84 ± 7 fl. Of recent however, an unpublished MCV value was said to be about 100 fl. Perhaps difference in methods of determination may be held responsible. The recent report were determined by electronic means while previous by manual method. It is also possible that the general increase in MCV observed in this study may be related to asymptomatic malaria parasiteamia that is common in Nigeria and in most malaria endemic areas. This may result in low grade haemolysis and this supports our earlier report[21,22]. It is known that in haemolytic anaemia MCV is usually high. Also it could mean that the general population both young and old have low serum folate or low serum vitamin B_{12}. The former may be more likely knowing that folate is not heat stable and that most Nigerians tended to eat overcooked meals.

The higher ferritin values we have documented in the elderly is unlikely to be associated with increased iron store. It is also unlikely that the observed raised MCH values is related to increased ferritin values because serum iron in the elderly actually falls despite a definite rise in serum ferritin levels[19]. Thus the raised ferritin levels may indicate an acute phase reactants protein in the elderly.

White blood cell count was significantly higher in the young adult when compared with the aged ($p< 0.05$). This observation is different from what was reported earlier by Zaino[23]. Nevertheless there is no significant difference when compared between sexes for both groups ($p> 0.05$). This observation is similar to the report of Ukaejiofor et al[24].

Lower WBC count observed in the aged could be as a result of decreased cellularity of the marrow as age advances[10,25].

There is no significant difference between the platelet counts of the aged males and females ($p> 0.05$). However there is a significant difference between the platelet counts of the aged when compared with the control group ($p< 0.05$). The mean platelet counts of the aged (120×10^9/L) being lower than that of the young adult (240×10^9/L). This again may be as a result of the decreased cellularity of the marrow with advance in age[10,25].

The sex disparity in serum ferritin levels supports earlier reports. Serum ferritin levels rise from a median of 25 μg/L to 94 μg/L in males in the third decade, and increases slowly thereafter to a median of 124 μg/L above 45 years. In females the levels remain low until middle age and increase from 25 μg/L to 89 μg/L at menopause[26].

Significant higher ESR observed in the aged, might be as a result of multiple factors that are common with increase in age. The rate of fall of the red cells (ESR) is influenced by a number of factors. Relative decrease in PCV and Hb as age increases may create a wider gap in RBC/plasma ratio, which will augments rapid sedimentation.

Rouleaux formation augments rapid sedimentation of red cells. Rouleaux formation is common with increase in fibrinogen and other acute phase proteins. Fibrinogen and acute phase proteins (haptoglobin, ceruloplasmin, reactive protein etc) are reported to increase with age, as a result of inflammatory responses of tissues in the ageing process[26].

It is evident that haematological parameters in the aged are different from that of the younger subjects. However the reference Haematological values available now in Nigeria does not have any reference for the aged. Judging from above observations one can confidently conclude that there is need for a separate reference haematological values for the aged in Nigeria. The higher MCV and WBC count observed in the younger group may support our hypothesis that the general higher MCV compared with Caucasian report may be as a result of frequent malaria attacks in our environment or asymptomatic malaria parasiteamia. It is also important for further studies to be done to ascertain the actual causes of the high MCV observed in this study.

Acknowledgements

The authors are grateful to, Segun Adesesan and M.A. Junaid of Haematology laboratory, Nigerian Institute of Medical Research, for assisting in the laboratory works. The secretarial support of Mrs. E.O Onwudimegwu is appreciated. We are also grateful to ROCHE Foundation for the coulter counter donated to NIMR, which was used for this work. The Federal Ministry of Science and Technology funded this work.

REFERENCES

1. Federal Office of Statistics and IRD Marco International Inc. 1992. Nigeria Demographic and Health Survey.
2. Lewis SM. Erythropoiesis. In: Hoffbrand AV (ed). Postgraduate Haematology. 3rd ed. London: Caroline Creed and Richard Brling, 1989:1-25.
3. Akinsete FI, Akinla O. Leukocyte count in cord blood of Nigerian neonates. J Trop Paediatr 1986;2:7-9.
4. Araba A. B, a survey of haematological variables in 600 healthy Nigerians. Nig Med Journ 1976;6:49-53.
5. Timiras ML, Brownslein H. Prevalence of anaemia and correlation of haemoglobin with age in a geriatric screening clinic population. J Am Geriatr Soc 1987;35:639.
6. Effiong E, Taiwo O, Odeniyi OO, Mellitus ED. Haematological values in healthy Nigerian full term newborn. Bio Neonates 1976;28:336-46.
7. Akinkugbe FM. Prevalence study of anaemia on a total of 704 children aged 1 to 10 in rural population (Igbo-Ora in Oyo State). Niger Med Journ 1978;8:312-8.
8. Adewoye HO, Kuforiji OO. Haematological and biochemical reference values in. Nigerian secondary school children. W African J Surg 1980;4:44-9.
9. Lajtha LB, Schofield R. Regulation of stem cell renewal and differentiation of possible significance in aging. Adv Geriatol Res 1971;3:131-3.
10. Ricci C, Cora M, Kang YS, et al. Normal age-related patterns of cellular and Fatty bone marrow distribution in the axial skeleton. MR imaging study. Radiology 1962;177:83.
11. Kricum ME. Red-yellow marrow conversion: Its effect on location of some solitary bone lesions. Skeletal Radiol 1985;14:10-3.
12. Revenant MC. Sandwich enzyme Immunoassay for serum ferritin with polypropylene test tubes as solid phase. Clin Chem 1983:29;981-3.
13. WHO; Basic Malaria Microscopy, Part 1: Learner's Guide. 1991 WHO Geneva.
14. Dacie JV, Lewis SM. Estimation of the erythrocyte sedimentation rate (ERS). Practical Haematology. 6th ed. Edinburgh: Churchill Livingston, 1992:420.
15. Dallman PR. In: Rudolph AM (ed). Paediatrics. 16th ed. New York: Appleton Century Crofts, 1980: 177:111.
16. Dixon DO, Neilan B, Jonesse, et al. Effect of age on therapeutic outcome in advanced diffuse histiocytic lymphoma: The Southwest Oncology Group Experience. J Clin Oncol 1986;4:295-305.
17. McGaudy RB, Russell RM, Hatz SC, et al. Nutritional status survey of healthy non-institutionalized elderly. Energy and nutrient intakes from three-day diet records and nutrient supplements. Nutr Research 1986;6:785-98.
18. Helman N, Rubenstein HS. The effects of age, sex and smoking on erythrocytes and leukocytes. Am J Clin Pathol 1975;63:35-44.
19. Pirrie R. The influence of age upon serum iron in the normal subjects. J Clin Pathol 1952;5:10-4.
20. Lipschitz DA, Mitchel CO, Thompson C. The anaemia of senescence. Am J Hematol 1981;11:47-51.
21. Araki K, Rifkind JM. Age dependent changes in osmotic haemolysis of human erythrocyte. J Gerontol 1980;35:499.
22. Odunukwe NN, Salako LA, Okany CC, et al. Serum ferritin and other haematological measurements in apparently healthy adults with malaria parasitaemia in Lagos, Nigeria. TMIH 5.8.2000:583-6.
23. Zaino EC. Blood counts in the nonagenarian. NY State J Med 1981;8:1199.
24. Ukaejiofor EO, Isaacs-Sodeye A. Haematological values in normal adults from Western Nigeria. Nigerian Medical Journal 1974;4:129.
25. Hartsock RJ, Smith EB, Petty CS. Normal various with aging on the amount of haematopoietic tissue in bone marrow from the anterior iliac crest. Am J Clin Pathol 1965;43:326-31.
26. Meade WW, North WRS. Population based distribution of haematostatic variables. Br Med Bull 1977; 33:283-8.

Address for Correspondence:

Nkiru N. ODUNUKWE, MD

Nigerian Institute of Medical Research,
6 Edmund Crescent
(Off Murtala Mohammed Way),
P.M.B. 2013, Yaba,
Lagos, NIGERIA

e-mail: *nodunukwe@yahoo.com*