Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
an open access publisher
http://ansinet.com

OPEN ACCESS Journal of Applied Sciences

ISSN 1812-5654
DOI: 10.3923/jas.2019.682.689

Research Article
Some Haematological and Iron-related Parameters of Elderly People in Calabar South LGA of Cross River State, Nigeria

Okpokam Dorathy Chioma and Ndemateh Winifred Okon

Department of Medical Laboratory Science, Faculty of Allied Medical Sciences, College of Medicine, University of Calabar, Calabar, Cross River State, Nigeria

Abstract

Background and Objective: Anaemia is common in the elderly and its prevalence increases with age. This work aimed to estimate the haemoglobin concentration, packed cell volume and some iron related parameters (SI, TIBC and TS) of people in Calabar South Local Government Area (LGA) of Cross River state, Nigeria. **Materials and Methods:** Haemoglobin estimation and packed cell volume were done using the cyanmethaemoglobin method and microhaematocrit method, respectively, while the iron related parameters were measured using the colorimetric method. Forty control subjects comprising of 21 males (52.5%) and 19 females (47.5%) with 47 elderly people made up of 18 males (38.3%) and 29 females (61.7%) with age range of 65-78 years, mean age of 68±4.5 were used for this study. **Results:** Packed cell volume (PCV), haemoglobin concentration (Hb), Mean cell haemoglobin concentration (MCHC), serum iron (SI) and transferrin saturation (TS) showed a significant decrease in elderly people (0.35±0.33 L L^{-1}, 111±11.1 g L^{-1}, 31.9±0.63%, 66±15.4 μg dL^{-1} and 24±8.07%) and slight increase in total iron binding capacity (TIBC) (296±79.9 μg dL^{-1}) when compared to the control subjects. There was a strong positive significance correlation between Hb and PCV ($r = 0.982$, $p<0.05$), while mild significant positive correlation was seen between TS and Hb ($r = 0.329$, $p<0.05$) of the elderly people which are pointers to iron deficiency. **Conclusion:** This study revealed that haemoglobin, PCV and iron related parameters are reduced in elderly people in Calabar South LGA, Calabar. Caregivers should be made to understand the basic requirement of the elderly, which is adequate diet, mineral and iron supplement to avoid anaemia in them.

Key words: Elderly people, serum iron, transferrin saturation, Calabar South, haemoglobin concentration, anaemia

Citation: Okpokam Dorathy Chioma and Ndemateh Winifred Okon, 2019. Some haematological and iron-related parameters of elderly people in Calabar south LGA of cross river state, Nigeria. J. Applied Sci., 19: 682-689.

Corresponding Author: Okpokam Dorathy Chioma, Department of Medical Laboratory Science, Faculty of Allied Medical Sciences, College of Medicine, University of Calabar, Calabar, Cross River State, Nigeria Tel: +234 806 889 6860

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Iron (Fe) is an essential metal ion for living beings; although it is the fourth most abundant mineral in the Earth's crust, it is the most prevalent nutritional deficiency worldwide[1]. It participated in a variety of vital physiological processes such as; oxygen transportation, energy production in the brain by cytochrome oxidase, enzymatic cofactor in the synthesis of neurotransmitters and myelin[2,3]. The main consequence of iron deficiency is the generation of anaemia which allows us to estimate its prevalence in a given population indirectly of red blood cell counting. The worldwide prevalence of iron deficiency is approximately 30%, resulting in close to 2 billion people with anaemia of this cause[4,5]. Elderly has been defined as a chronological age of 65 years old or older[6]. There is no epidemiological iron deficiency data available in the elderly, but they are expected to have a higher prevalence of anaemia than in the general population, since longevity is associated with a variety of physiological dysfunctions, chronic and inflammatory diseases and occasionally inadequate diet that lower reserves and unavailability of iron. Clinical manifestations of anaemia in the elderly add to changes in sensory organs, increasing the risk of falls, with a decline in mobility and loss of autonomy[7] that results in an increase in health expenses. A cause is found in approximately 80% of elderly patients. The most common causes of anaemia in the elderly are chronic disease and iron deficiency. Vitamin B12 deficiency, folate deficiency, gastrointestinal bleeding and myelodysplastic syndrome are among other causes of anaemia in the elderly[8].

Anaemia is common in the elderly and its prevalence increases with age using World Health Organization criteria for anaemia (haemoglobin of less than 12.0 g dL^{-1} (120 g L^{-1}) in women and less than 13.0 g dL^{-1} (130 g L^{-1}) in men. The prevalence of anaemia in the elderly has been found to range from 8-44% with the higher prevalence in men 85 years and older. The increased incidence of anaemia with aging has led to speculation that lower haemoglobin levels may be a normal consequence of aging[9].

Serum ferritin is a reliable and sensitive parameter for the assessment of iron stores in healthy subjects[10-12] and is widely used in clinical practice and population screening. Serum ferritin levels below 12 µg L^{-1} are highly specific for iron deficiency and denote complete exhaustion of iron stores in adults[13]. In apparently healthy population groups, serum ferritin have been reported to vary significantly from one country to another[14]. However, its interpretation in the elderly is complicated by its tendency to rise with age[15], chronic sepsis and maglignancy[16]. In iron deficiency, the decreased serum iron concentration leads to an increase in total capacity of iron binding (TIBC) and a decreased saturation of the iron transporter transferrin (Tsat). Ferritin (Ferr) and transferrin (Tf) have the disadvantage of being acute phase reactants with limited value in the differential diagnosis of anaemia of chronic disease (ACD) from iron deficiency anaemia (IDA)[17]. One problem of elderly people is inability to eat, especially food rich in iron which will result in anaemia. The aim therefore, was to provide information on the packed cell volume, haemoglobin concentration and some iron-related parameters among elderly people in Calabar South LGA.

MATERIALS AND METHODS

Study design and area: The research was conducted using cross-sectional study design at the University of Calabar Teaching Hospital (UCTH), Haematology Laboratory and samples were gotten from elderly people visiting the hospital and those residing in an Old People's Home both situated in Calabar South LGA of Cross River state, Nigeria.

Subject selection: Forty-seven elderly men and women aged 65 years and above were recruited into the study. Ethical approval was gotten from the Health Research Ethical Committee (HREC) State Ministry of Health with approval number CRS/MH/HREC/017/Vol vi/045. This study was carried out from March-August, 2017. After due and appropriate explanations, the elderly people willing to participate in the study gave their consent by appending their signature or thumb print to the informed consent form before any study related procedures are done.

Sample collection: Five millimeters of blood was collected by venepuncture from each subject. Two millimeters of blood was dispersed into K^2EDTA container in the concentration of 2 mg mL^{-1} of blood for packed cell volume and haemoglobin estimation while the remaining 3 mL of blood was dispensed into a plain container to obtain serum for the estimation of serum iron and total iron binding capacity. The serum was kept at -20°C until ready for analysis.

Inclusion and exclusion criteria: Inclusion criteria were elderly people of age range of 65 and above while adults below 65 years of age and critically ill elderly people were excluded.

Estimation of haemoglobin concentration (Hb): Cyanmethaemoglobin method was used. The diluent used is Drabkin's fluid as described by Lewis *et al.*[18].

The principle of this test is based on the fact that Hb in the presence of potassium ferricyanide is converted to methaemoglobin. The methaemoglobin is then converted into cyanmethaemoglobin by the action of potassium cyanide. The colour intensity of the cyanmethaemoglobin is directly proportional to the concentration of Hb in the blood and this is measured spectrophotometrically at wavelength of 540 nm.

Packed cell volume (PCV): This was assessed using the microhaematocrit method. The principle of this method is based on the fact that blood separates into cellular and non-cellular components by centrifugal force and the volume occupied by red cells is expressed as a percentage of whole blood and also as described by Lewis *et al.*[18].

Mean cell haemoglobin concentration (MCHC): This was derived by dividing Hb (g dL^{-1}) by PCV (%) and multiplying by 100:

$$\text{MCHC (\%)} = \frac{\text{Hb (g dL}^{-1})}{\text{PCV (\%)}} \times 100$$

Serum iron (SI) and total iron binding capacity (TIBC): Serum iron was determined using Teco Diagnostics kit (photometric colorimetric test) for iron with lipid clearing factor-Chromeazurol B (CAB) method[19]. The principle of this method is based on the development of a coloured ternary complex when the iron (III) released from transferrin by reduction in pH of the serum (sodium acetate buffer pH 4.7) reacts with chromeazurol B (CAB) and cetyltrimethylammonium bromide (CTMA). The intensity of the colour is read spectrophotometrically at a wavelength of 623 nm:

$$\text{Concentration of iron} = 17.9 \times \frac{\text{A sample } (\mu\text{mol L}^{-1})}{\text{A standard}}$$

$$\text{TIBC} = \text{C (iron)} \times 3$$

Where:

3 = Dilution factor

Transferrin saturation: This was derived by dividing the serum iron concentration by the TIBC value and multiplying by 100 (expressing as percentage):

$$\text{Transferrin saturation (TS\%)} = \frac{\text{Serum iron concentration}}{\text{TIBC 1}} \times 100$$

Statistical analysis: Obtained results were presented in Tables as mean±SD while the associated/relationship was presented as bar charts and Pearson's correlation coefficient. It was analyzed using Student's T-test one-way analysis of variance (ANOVA). Significant will be expressed using $p<0.05$.

RESULTS

Comparison of some haematological and iron-related parameters of control subject and elderly people: Table 1 showed some haematological and iron-related parameters of control subject and elderly people. The result shows significant decrease in PCV, Hb, MCHC, SI and TS (0.35 L L^{-1}, 111 g L^{-1}, 31.9%, 66 µg dL^{-1} and 24%) of the elderly subject ($p<0.05$) when compared to the control subject (0.44 L L^{-1}, 149 g L^{-1}, 34.5%, 106 µg dL^{-1} and 37%). However, the TIBC value shows no significant change in elderly subject (296 µg dL^{-1}) when compared to control subject (290 µg dL^{-1}).

Comparison of some haematological and iron-related parameters of elderly male and female subjects: The data in Table 2 showed some haematological and iron-related parameters of elderly male and female subjects. The result shows significant decrease in PCV, Hb, SI and TIBC of the elderly female (0.33 L L^{-1}, 106 g L^{-1}, 61 µg dL^{-1} and 280 µg dL^{-1}) subjects ($p<0.05$) when compared to the elderly male subjects (0.37 L L^{-1}, 119 g L^{-1}, 73 µg dL^{-1} and 321 µg dL^{-1}). However, the MCHC and TS value show no significant change in elderly male and female subjects.

Comparison of some haematological and iron-related parameters of control male and elderly male: The findings in Table 3 demonstrated some haematological and iron-related

Table 1: Some haematological and iron parameters of control subjects and elderly people

Parameters	Control (n = 40)	Elderly people (n = 47)	p-value	Remarks
Age	25.00±5.5	68.00±4.5	p<0.05	S
PCV (L L^{-1})	0.44±0.32	0.35±0.33	p<0.05	S
Hb (g L^{-1})	149.00±11.7	111.00±11.1	p<0.05	S
MCHC (%)	34.50±2.41	31.90±0.63	p<0.05	S
SI (µg dL^{-1})	106.00±22.9	66.00±15.4	p<0.05	S
TIBC (µg dL^{-1})	290.00±36.1	296.00±79.9	p>0.05	NS
TS (%)	37.00±9.07	24.00±8.07	p<0.05	S

S: Significant, NS: Non-significant, PCV: Packed cell volume, Hb: haemoglobin concentration, MCHC: Mean cell haemoglobin concentration, SI: Serum iron, TIBC: Total iron binding capacity, TS: Transferrin saturation

Table 2: Some haematological and iron parameters of elderly male and female subjects

Parameters	Male (n = 18)	Female (n = 29)	p-value	Remarks
Age	70.00±4.51	69.00±4.61	p>0.05	NS
PCV (L L^{-1})	0.37±0.02	0.33±0.30	p<0.05	S
Hb (g L^{-1})	119.00±6.74	106.00±10.39	p<0.05	S
MCHC (%)	31.90±0.59	31.90±0.66	p>0.05	NS
SI (µg dL^{-1})	73.00±14.5	61.00±14.5	p<0.05	S
TIBC (µg dL^{-1})	321.00±58.2	280.00±88.3	p<0.05	S
TS (%)	24.00±8.16	24.00±3.15	p>0.05	NS

S: Significant, NS: Non-significant

Table 3: Some haematological and iron parameters of control male and elderly male subjects

Parameters	Control male (n = 21)	Elderly male (n = 18)	p-value	Remarks
Age	26.00±6.06	70.00±4.51	p<0.05	S
PCV (L L^{-1})	0.46±0.27	0.37±0.02	p<0.05	S
Hb (g L^{-1})	155.00±11.3	119.00±6.74	p<0.05	S
MCHC (%)	34.00±2.29	31.90±0.59	p<0.05	S
SI (µg dL^{-1})	105.00±25.3	73.00±14.5	p<0.05	S
TIBC (µg dL^{-1})	289.00±27.3	321.00±58.2	p<0.05	S
TS (%)	36.00±8.94	24.00±8.16	p<0.05	S

S: Significant

Table 4: Some haematological and iron parameters of control female and elderly female subjects

Parameters	Control (n = 19)	Elderly female (n = 29)	p-value	Remarks
Age	25.00±4.76	69.00±4.59	p<0.05	S
PCV (L L^{-1})	0.41±0.02	0.33±0.03	p<0.05	S
Hb (g L^{-1})	143.00±8.64	106.00±10.4	p<0.05	S
MCHC (%)	35.10±2.47	31.90±0.66	p<0.05	S
SI (µg dL^{-1})	106.00±20.4	61.00±14.6	p<0.05	S
TIBC (µg dL^{-1})	291.00±44.6	280.00±88.3	p>0.05	NS
TS (%)	37.00±9.43	24.10±8.15	p<0.05	S

S: Significant, NS: Non-significant

Table 5: Some haematological and iron-related parameters of elderly people based on age

Parameters	65-69 (n = 29)	70-74 (n = 8)	≥80 (n = 10)	p-value	Remarks
PCV (L L^{-1})	0.35±0.03	0.36±0.03	0.34±0.05	p>0.05	NS
Hb (g L^{-1})	111.00±8.89	112.00±8.91	108.00±17.5	p>0.05	NS
MCHC (%)	31.90±0.58	31.60±0.74	32.10±0.67	p>0.05	NS
SI (µg dL^{-1})	68.00±16.4	60.00±8.48	63.00±15.9	p>0.05	NS
TIBC(µg dL^{-1})	284.00±73.6	301.00±87.6	324.00±92.1	p>0.05	NS
TS (%)	25.00±8.14	22.00±7.32	21.00±8.09	p>0.05	NS

NS: Non-significant

parameters of control male and elderly male subjects. The result shows significant decrease in PCV, Hb, MCHC, SI, TIBC and TS of the elderly male (0.37 L L^{-1}, 119 g L^{-1}, 31.9%, 73 µg dL^{-1} and 24.1%) subjects ($p<0.05$), when compared to the control male subjects (0.46 L L^{-1}, 155 g L^{-1}, 34.0%, 105 µg dL^{-1} and 36%). The TIBC was found to be increase in male elderly people (321 µg dL^{-1}) than the control subjects (289 µg dL^{-1}) ($p<0.05$).

Comparison of some haematological and iron-related parameters of control female and elderly female: The results in Table 4 illustrated some haematological and iron-related parameters of control female and elderly female subjects. The result shows significant decrease in PCV, Hb, MCHC, SI and TS of the elderly female subjects (0.33 L L^{-1}, 106 g L^{-1}, 31.9%, 61 µg dL^{-1} and 24%) ($p<0.05$) when compared to the control female subjects (0.41 L L^{-1}, 143 g L^{-1}, 35.1%, 106 µg dL^{-1} and 37%). The TIBC value shows no significant change in the elderly female subjects when compared to the control female subjects.

Comparison of some haematological and iron-related parameters of elderly people based on age: Table 5 showed some haematological and iron-related parameters of elderly people based on age. There was no significant different in some haematological and iron-related parameters among the elderly people base on age.

Correlation between some haematological and iron-related parameters of elderly people: Figure 1 showed strong positive significance correlation between Hb and PCV ($r = 0.982$, $p<0.05$). Meanwhile, there was a mild negative significant correlation between TIBC and SI ($r = 0.115$, $p<0.05$, Fig. 2) while correlation between TIBC and Hb ($r = 0.059$,

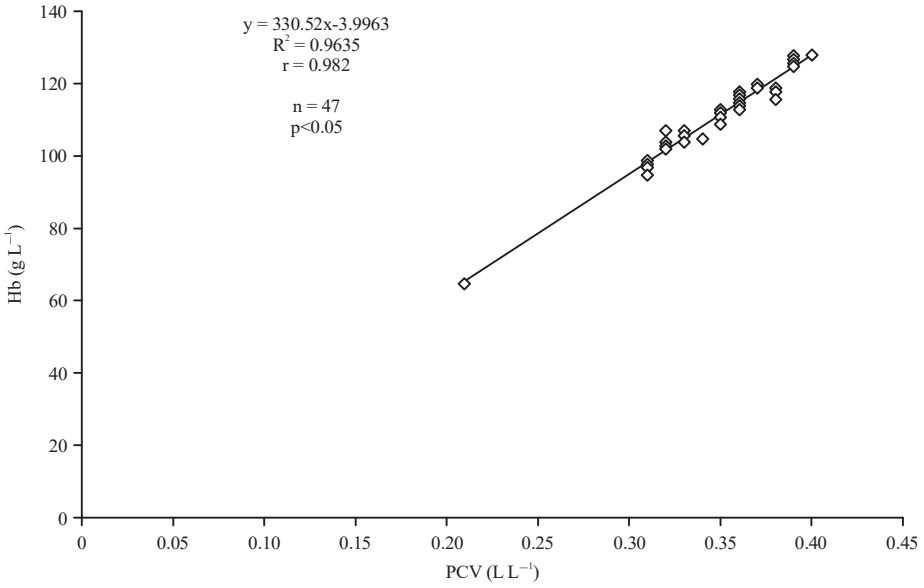

Fig. 1: Correlation graph between Hb and PCV of elderly people

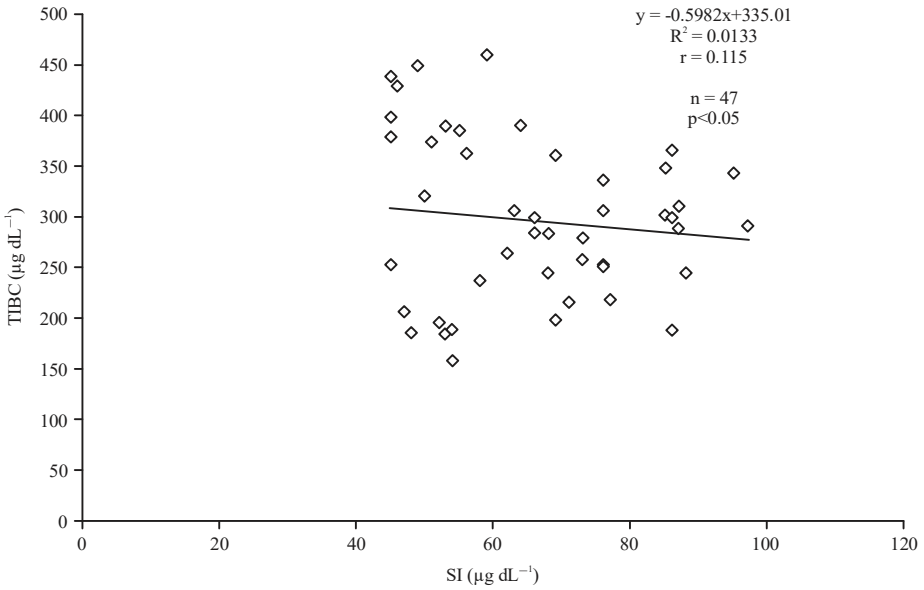

Fig. 2: Correlation graph between TIBC and SI of elderly people

p<0.05, Fig. 3) show no significant association in the elderly people. Figure 4 showed moderate significant positive correlation between TS and Hb (r = 0.329, p<0.05) of the elderly people.

DISCUSSION

In this study, it was observed that Hb, PCV, MCHC, SI and TS were significantly decrease in elderly people when it compared to the control groups (apparently healthy subjects). This could be attributed to the fact that the elderly people lack the care and pamper to encourage them eat a proper balanced meal, take their iron (haematinic) drug and other supplement needed for their health. The bone marrow, according to Merritt[20] failed to produce adequate volume of blood leading to anaemia and Davis[21] also recorded this same result in a separate study. These above reports agreed with this research work which has shown that PCV is reduced in elderly people. By implication, the haemoglobin level was also reduced because it is present in reduced quantity in the available red cells.

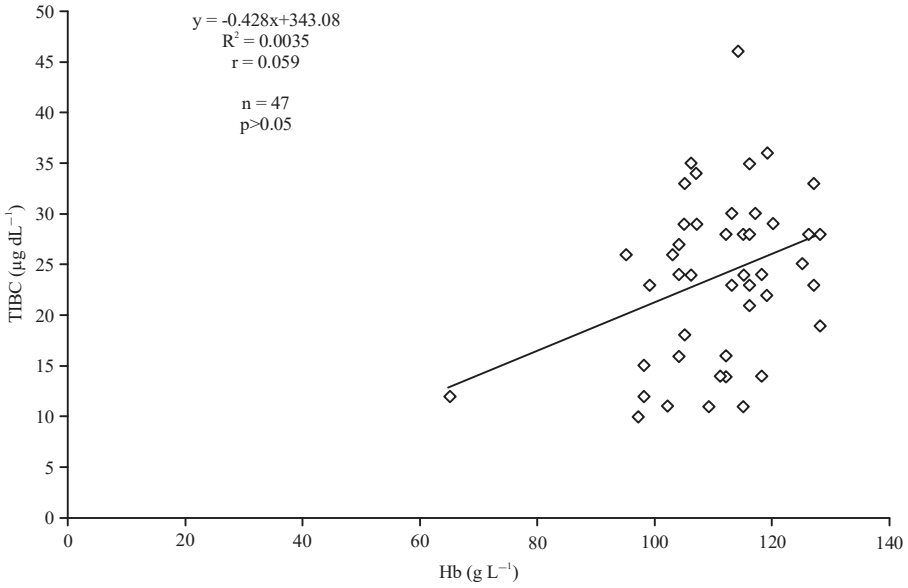

Fig. 3: Correlation graph between TIBC and Hb of elderly people

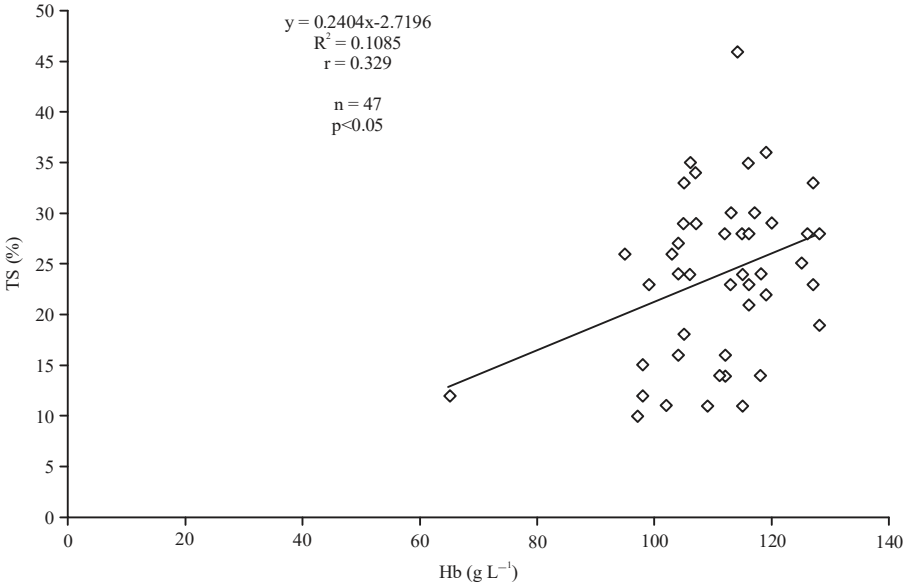

Fig. 4: Correlation graph between Hb and TS of elderly people

The reduction in Hb, PCV, MCHC, SI and TS could also be due majorly to lack of appetite and suggested anaemia in the elderly people which could be due to microcytic hypochromic anaemia and is characteristic of iron deficiency anaemia. It was reported by Joosten *et al.*[22] and Guralnik *et al.*[23] that multiple conditions can lead to anaemia in elderly persons. Moreover, the anaemia may be multifactorial. Nevertheless, in the majority of cases of anaemia in elderly persons, an etiology can be found. The most common causes included iron deficiency (with or without blood loss), chronic disease/inflammation and chronic kidney disease. Identifying iron deficiency anaemia in elderly persons is essential and the condition can be corrected. More importantly, according to the previous studies by Merritt[20], Joosten *et al.*[24] and Coban *et al.*[25] iron deficiency, particularly in elderly persons often points to an underlying gastrointestinal pathology, including malignancy. Anaemia in the elderly (defined as people aged >65 years) is common and increasing as the population ages. In older patients, anaemia of any degree contributed significantly to morbidity and mortality and has a significant effect on the quality of life. Despite its clinical importance, anaemia in the elderly is under-recognized and

evidence-based guidelines on its management are lacking[26]. Nonetheless, based on the WHO definition, studies have estimated that, in people over 65 years, the prevalence of anaemia is 12% in those living in the community, 40% in those admitted to the hospital and as high as 47% in nursing home residents. All in all, an estimated 17% of those over 65 have been found to be anaemic[23,27].

Again, poor diet which invariably would lead to insufficient supply of iron necessary for building block for the production of red cells would ultimately lead to a reduction in red cell parameters and iron related parameters as well as blood loss and inability to absorb enough iron from foods can also be a causes of anaemia. This was laid bare in this work.

CONCLUSION

This study demonstrated that haemoglobin, PCV and iron related parameters are reduced in elderly people in Calabar South LGA of Cross River state and will serve as a good reference material for further investigation. It is recommended therefore, that elderly people should be placed on balance diet which is a necessity for blood cell production to prevent anaemia. Facilities such as old people home should be made to understand the basic requirement of the elderly, which is good diet, mineral and iron supplement.

SIGNIFICANCE STATEMENT

This study discovered that Hb, PCV, SI, TIBC and TS levels are lowered in elderly people suggesting microcytic hypochromic anaemia, which can be beneficial for the management and treatment of elderly people. This study will help the researchers to uncover the critical areas of anaemia in elderly that many researchers were not able to explore. Thus a new theory on anaemia in elderly may be use in detecting an early iron deficiency in elderly people.

REFERENCES

1. DeMaeyer, E. and M. Adiels-Tegman, 1985. The prevalence of anaemia in the world. World Health Stat. Quart., 38: 302-316.
2. Felt, B.T., J.L. Beard, T. Schallert, J. Shao and J.W. Aldridge *et al*., 2006. Persistent neurochemical and behavioral abnormalities in adulthood despite early iron supplementation for perinatal iron deficiency anemia in rats. Behav. Brain Res., 171: 261-270.
3. Van Vliet, A.H.M., J.M. Ketley, S.F. Park and C.W. Penn, 2002. The role of iron in *Campylobacter* gene regulation, metabolism and oxidative stress defense. FEMS Microbiol. Rev., 26: 173-186.
4. Pollitt, E., 1990. Malnutrition and Infection in the Classroom. United Nations Educational Scientific and Cultural Organization (UNESCO), Paris, France, ISBN-13: 978-9231026621, Pages: 211.
5. WHO., 1994. Report of WHO/UNICEF/UNU consolation on indicators and strategies for iron deficiency and anemia programmer. World Health Organization, Geneva, Switzerland.
6. WHO., 2014. Proposed working definition of an older person in Africa for the MDS project. World Health Organization, Geneva, Switzerland.
7. Freedman, M.L. and D.G. Sutin, 1998. Blood Disorders and their Management in Old Age. In: Brocklehurst's Textbook of Geriatric Medicine and Gerontology, Tallis, R., H.M. Fillit, J.C. Brocklehurst and H. Fillit (Eds.). 5th Edn., Churchill Livingstone, New York, USA., ISBN-13: 9780443053702, pp: 1247-1288.
8. Smith, D.L., 2000. Anemia in the elderly. Am. Family Physician, 62: 1565-1572.
9. Ania, B.J., V.J. Suman, V.F. Fairbanks and L.J. Melton III, 1994. Prevalence of anemia in medical practice: Community versus referral patients. Mayo Clinic Proc., 69: 730-735.
10. Conrad, M.E., W.H. Crosby, A. Jacobs, J.P. Kaltwasser and J. Nusbacher, 1981. The Hippocratian principle of 'primum nil nocere' demands that the metabolic state of a donor should be normalized prior to a subsequent donation of blood or plasma. How much blood, relative to his body weight, can a donor give over a certain period, without a continuous deviation of iron metabolism in the direction of iron deficiency? Vox Sanguinis, 41: 336-343.
11. Cook, J.D., B.S. Skikne, S.R. Lynch and M.E. Reusser, 1986. Estimates of iron sufficiency in the US population. Blood, 68: 726-731.
12. Walters, G.O., F.M. Miller and M. Worwood, 1973. Serum ferritin concentration and iron stores in normal subjects. J. Clin. Pathol., 26: 770-772.
13. Addison, G.M., M.R. Beamish, C.N. Hales, M. Hodgkins, A. Jacobs and P. Llewellin, 1972. An immunoradiometric assay for ferritin in the serum of normal subjects and patients with iron deficiency and iron overload. J. Clin. Pathol., 25: 326-329.
14. Usanga, E.A., 1990. Iron stores of Nigerian blood donors as assessed by serum ferritin concentration. Cent. Afr. J. Med., 36: 170-173.
15. Casale, G., C. Bonora, A. Migliavacca, I.E. Zurita and P. de Nicola, 1981. Serum ferritin and ageing. Age Ageing, 10: 119-122.
16. Witte, D.L., 1991. Can serum ferritin be effectively interpreted in the presence of the acute-phase response? Clin. Chem., 37: 484-485.
17. Tilg, H., H. Ulmer, A. Kaser and G. Weiss, 2002. Role of IL-10 for induction of anemia during inflammation. J. Immunol., 169: 2204-2209.

18. Lewis, S.M., B.J. Bain and I. Bates, 2006. Dacie and Lewis Practical Haematology. 10th Edn., Churchill Livingstone, USA., ISBN-10: 9780443066603, pp: 412-414.
19. Henry, J.B., 1984. Clinical Diagnosis and Management by Laboratory Methods. 17th Edn., W. B. Saunders, Philadelphia, USA., ISBN-10: 0721646573, pp: 1434.
20. Merritt, B.Y., 2014. Mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). https://emedicine.medscape.com/article/2054497-overview
21. Davis, C.P., 2016. Hemoglobin. https://www.medicinenet.com/hemoglobin/article.htm#what_is_hemoglobin
22. Joosten, E., W. Pelemans, M. Hiele, J. Noyen, R. Verhaeghe and M.A. Boogaerts, 1992. Prevalence and causes of anaemia in a geriatric hospitalized population. Gerontology, 38: 111-117.
23. Guralnik, J.M., R.S. Eisenstaedt, L. Ferrucci, H.G. Klein and R.C. Woodman, 2004. Prevalence of anemia in persons 65 years and older in the United States: Evidence for a high rate of unexplained anemia. Blood, 104: 2263-2268.
24. Joosten, E., B. Ghesquiere, H. Linthoudt, F. Krekelberghs and E. Dejaeger *et al*., 1999. Upper and lower gastrointestinal evaluation of elderly inpatients who are iron deficient. Am. J. Med., 107: 24-29.
25. Coban, E., A. Timuragaoglu and M. Meric, 2003. Iron deficiency anemia in the elderly: Prevalence and endoscopic evaluation of the gastrointestinal tract in outpatients. Acta Haematol., 110: 25-28.
26. Sauder, R. and S.L. Thein, 2014. Anemia in the elderly: Clinical implications and new therapeutic concepts. Haematologica, 99: 1127-1130.
27. Gaskell, H., S. Derry, R.A. Moore and H.J. McQuay, 2008. Prevalence of anaemia in older persons: Systematic review. BMC Geriatr., Vol. 8. 10.1186/1471-2318-8-1.