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Iron Status of Premenopausal Women in a Nigerian University Community

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Abstract: Premenopausal women are most susceptible to iron deficiency. Iron deficiency occurs in about 25% of pre-menopausal women due to the increased iron loss from menstruation. This study aims at assessing the iron status of premenopausal women in a university community in Lagos, Nigeria, in order to determine the occurrence of anaemia among the subjects. A total of 98 Academic and Non-academic female staff of the Lagos State university, Lagos, Nigeria aged 22-46 years participated in this study. They were subjected to anthropometry measurements which include measurements of height, weight and BMI. Blood haematocrit and haemoglobin levels were determined by the microhaematocrit centrifugation and cynomethemoglobin methods, while serum Iron was estimated by the bathophenanthroline method. Linear regression analysis was used to test the association between haemoglobin (Hb), Packed Cell Volume (PCV) and Serum Iron (SI) levels of the subjects. There was an inverse relationship between PVC and SI which was statistically significant ($p<0.05$). Serum Iron and Haemoglobin were observed to have a positive and significant correlation ($r = 0.967$, $p<0.05$). There was an inverse correlation between haematological parameters and age which was not significant ($p>0.05$). 13.16% of all subjects showed anaemia. The distribution of SI values in anaemia was (Hb<11 g dL^{-1}) and non-anaemic (Hb>11 g dL^{-1}). A 44.7% of the premenopausal women had haemoglobin level below 12 g dL^{-1} which puts them at a very high risk of nutritional anaemia.

Key words: Anaemia, PVC, serum iron, bmi and haemoglobin

INTRODUCTION

Iron deficiency is a common nutritional disorder which has many adverse consequences including decreased work and exercise performance, immune system abnormalities and neurological dysfunction (Cook and Lynch, 1986; Maziya-Dixon *et al*., 2003). Iron Deficiency Anaemia (IDA) is particularly prevalent among babies, children, women, ethnic groups and low-income families and, to a greater extent, among people living in developing countries (WHO, 2001).

The highest prevalence figures for iron deficiency are found in infants, children, teenagers and women of childbearing age. Hence, it is a major public health problem with adverse consequences especially for women of reproductive age (Shetty, 2002). In Nigeria 24.3% of women and 35.3% pregnant women are at different stages of iron deficiencies (Maziya-Dixon *et al*., 2003).

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Premenopausal women are in the demographic group that is most susceptible to iron deficiency (Valberg *et al*., 1976). Iron deficiency occurs in about 25% of pre-menopausal women due to the increased iron loss from menstruation. The consequences of iron deficiency are numerous as iron plays a central part in the transport of oxygen in the body and is also essential in many enzyme systems. In pregnant women iron deficiency contributes to maternal morbidity and mortality and increases risk of fetal morbidity, mortality and low birth weight (Viteri, 1997). The increased requirements for iron during pregnancy and lactation also increase the risk of iron deficiency in this group. Long-standing iron deficiency in general terms also results in a reduction in physical working capacity and productivity of adults. These functional impairments are economically important (Shetty, 2002).

This study aims at assessing the iron status of premenopausal women in a university community in Lagos, Nigeria, in order to determine the occurrence of anaemia among the subjects.

MATERIALS AND METHODS

Subjects

A total of 98 academic and non-academic female staff of the Lagos State University, Lagos, Nigeria aged 22-46 years participated in this study.

The study was approved by the biomedical ethical committee of the Lagos State University, Lagos, Nigeria. The subjects gave informed consent to the study. This study was carried out at the department of Biochemistry, Lagos State University, Lagos, Nigeria from September, 2006 to January, 2007.

Anthropometry Measurements

Height

The height of the subjects was determined to the nearest 0.5 cm with a stature meter (2 m). The subjects took off their shoes before each measurement. The subjects were asked to stand backing the metre rule placed against the wall with their feet parallel to it. The head was held erect, the arms were hanging at the sides in a natural manner and a small ruler was gently lowered making contact with the top of the head.

Weight

A Salter scale was used in measuring the weight of the subjects. The scale was standardized before each measurement was taken. The subjects were asked to remove their shoes and any extra apparel that could add to their weight. The weight for each subject was determined while the subject stood still and upright. The scale was checked before each measurement to reduce the zero error due to parallax.

Body Mass Index

The Body Mass Index (BMI) was calculated using the formula weight/height^2 (kg m^{-2}).

Blood Samples

Approximately 10 mL of blood (Non-fasting) was collected intravenously from each subject. Blood samples were drawn into vacutainer tubes. Blood haematocrit and haemoglobin levels were determined by the microhaematocrit centrifugation and cynomethemoglobin method, respectively (Billett, 1990). Serum Iron was estimated by the bathophenanthroline method (Peters and Giovanniello, 1956).

Statistical Analysis

Statistical analysis was carried out using the student T-test was used to compare haematological values of the subjects. Linear regression analysis was used to test the association between haemoglobin (Hb), Packed Cell Volume (PCV) and Serum Iron (SI) levels of the subjects.

RESULTS

Characteristics of the Subjects

All the subjects were married women working in the university. Their ages ranged between 22 and 46 years and the mean was 31.82±5.81 years (Table 1).

The Height, Weight and Body Mass Index (BMI) of the subjects are shown in Table 1. The mean Hb, PCV and SI are shown in Fig. 1. According to WHO criterion of haemoglobin concentration, 15.8% of the subjects had its levels less than 10 g dL^{-1}, 28.9% of the subjects were marginal while majority (55.3%) had Hb value greater than 12 g dL^{-1}.

Linear Regression

Linear regression analysis showed that PCV = 35.55-0.024 age (n = 38; r = 0.025); SI = 73.18-0.080 age (n = 38; r = -0.026). Both showed an inverse relationship between PVC and SI which was statistically significant ($p>0.05$). Serum Iron and Haemoglobin were observed to have a positive and significant correlation (r = 0.967, $p>0.05$).

The relationship and association between haematological parameters and age was checked (Table 2). The linear regression analysis for the subjects showed that (Hb = 0.33368,

Table 1: Characteristics of subjects

Variables	Values
Age	31.82±5.81
Height (m)	1.60±0.06
Weight (kg)	65.26±12.45
Body mass index (kg m^{-2})	25.49±7.28

Table 2: Distribution of haematological values of the subjects

Variables (g dL^{-1})	N	%	HB (g dL^{-1})	PVC a (%)	PI a (g dL^{-1})
Hb <11	15	15.3	8.18±2.23	24.58±.01	42.41±15.36
			(5.2-10.7)	(15.5-32.0)	(25.7-67.5)
Hb<11.9	28	28.6	11.52±0.30	34.55±0.92	63.55±9.09
			(11.0-11.8)	(33.0-35.5)	(47.1-85.7)
Hb≥12	55	56.1	12.54±0.51	37.62±1.36	81.71±12.45
			(12.0-13.7)	(36.0-41.0)	(64.3-111.4)

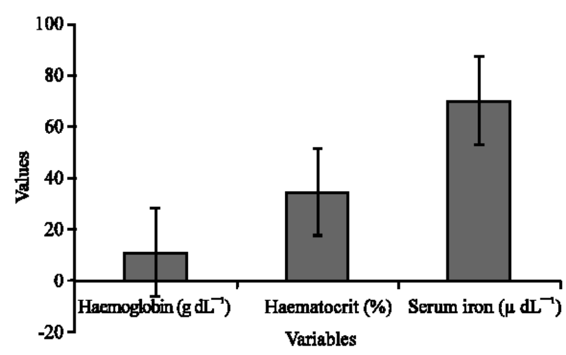

Fig. 1: Mean values of Hb, PCV and SI Data = Mean±SD

Table 3: The occurrence of anaemia in subjects with respect to WHO criteria of HB<11 g dL^{-1}; SI<50 µ dL^{-1} and PCV 33%

Criteria	Female (n = 98)	N	%
HB<1 g dL^{-1}	15	15	15.30
PVC<33%	15	15	15.30
SI<50 µ 100 dL^{-1}	13	13	13.30

PVC-0.0137); (n = 38, r = 0.998, p<0.05). This revealed an inverse correlation which was not significant (p>0.05). Data obtained showed a haemoglobin value of 13.35 g dL^{-1} for PVC value of 40%.

Occurrence of Anaemia in Subjects

Based on WHO criteria for classification of separating anaemic subjects, 13.30% of all subjects showed anaemia (Table 3). The distribution of Serum Iron values in anaemia was (Hb<11 g dL^{-1}) and non-anaemic (Hb>11 g dL^{-1}).

The iron value below the WHO cut off of 50 µ dL^{-1} for anaemic subject was 83.3%, while 3.12% of non-anaemic subject had S.I below the WHO cut off for anaemia.

DISCUSSION

Iron deficiency remains the most common nutritional deficiency in the world. Screening for iron deficiency anaemia among vulnerable populations, including premenopausal, menopausal and postmenopausal female subjects, is recommended by the Centers for Disease Control and Prevention (1998) and the American Academy of Pediatrics (2000). Premenopausal women are generally at a higher risk of having depleted iron status and iron deficiency anaemia because of the demands of menstruation, which justifies the need for studies in this area.

All subjects used for this study were married women between the ages of 22 to 46 years with a mean height of 1.60 m and average weight of 65.26 kg. It was also observed that most of the subjects were slightly overweight. The observed BMI was similar to results reported by Rangan *et al*. (1998) in a similar study in young Australian female students. The association between iron deficiency and overweight may have important public health and clinical implications (Nead *et al*., 2004). Bodnar *et al*. (2004) reported that women with elevated BMI are at high risk of postpartum anemia. They found that the risk of postpartum anaemia sharply increased for women with BMI values from 24 through 36. This suggests that the studied women are at a high risk of anaemic conditions owing to their BMI (>25.49). Untoro *et al*. (1998) illustrated the detrimental effect of a combined low BMI and anaemia and the possible beneficial effects of interventions for the improvement of BMI and haemoglobin status.

It was also observed that 15.8% of the subject had Hb levels less than 11 g dL^{-1}, 28.9% subject were marginal and 55.3% had Hb value greater than 12 g dL^{-1}. This is lower than that in adult women in the USA (Kim *et al*., 1993), Canada (Beaton *et al*., 1989) and France (Fricker *et al*., 1990).

From the results obtained, it was observed that packed cell volume is directly proportional to haemoglobin which means that as the PVC increases, Hb also increases Also, 15.79% of the subject had PVC value less than 33 and 13.16% had Serum Iron (SI) value less than 50 µg 100 dL^{-1}.

To detect the occurrence of anaemia using the WHO criteria, it would not be justifiable to use only the Serum Iron. There would be a failure to detect 2.63% of the population that might be considered anaemic using an Hb test. Determining the frequency distribution of the haematological parameter it was observed that, out of studied population 15.8% had severe anaemia (HB<11.0 g dL^{-1}), 28.9% (n = 21) had marginal anaemia HB = 11 or 11.9 g dL^{-1} . While 55.3% were not anaemic with Hb values greater than 12 g dL^{-1}.

Thus, a large part of the women may be considered to be at a high risk of anaemia. This may be attributed to their diets. The prevalence of iron deficiency in developing regions is aggravated by reliance on staple food crops (Faber *et al*., 2005). Dietary staples in Nigeria are starch and vegetable products. Inhibitory factors such as fibers, polyphenolics, phosphates, proteins and organic acids commonly present in such diets contribute significantly to a high incidence of iron deficiency anaemia by preventing dietary iron absorption (Whittaker and Ologunde, 1990). Fortification of these inexpensive food staples may be a practical intervention approach for achieving long-term enhancement of iron status. Meats provide the greatest amounts of iron in its most available form (heme iron). In the absence of iron supplementation of the diet, users of meats would demonstrate superior iron status compared with individuals who reduce or avoid such foods.

The mean value and distribution curve of Serum Iron showed that only 5.26% of the population had SI values below the cut off levels proposed by WHO (50 μg dL^{-1}) 86.8% where in a low normal range (51 to 100 μg dL^{-1}) whether anaemic or non anaemic. Results of studies by Eftekhari *et al*. (2006) showed that in adults, iron deficiency is accompanied by reduced serum. The iron status of the studied women was comparable to that of other healthy premenopausal women in industrialized countries (Fogelholm *et al*., 1993).

Anaemic women have lower iron values than non-anaemic women but in most of the subjects these levels are just above normal. It has been demonstrated that when body iron stores are reduced, the amount of iron absorbed increases in proportion to the depletion of the stored (Bothwell, 2000).

The report demonstrates that a fairly large body of female proportion in the university 44.7% with Hb less than 12 g dL^{-1}(putting them at 15.8% of those below 11 g dL^{-1} and 28.9% of those marginal at HB = 11-11.9 g dL^{-1}) has a high risk of nutritional anaemia and precarious iron balance. Numerous factors such as pregnancy and the use of oral contraceptives (common among this group) which increase iron equilibrium with no iron stores to draw on anaemia immediately supervene (Cook *et al*., 1986; Bothwell, 2000). In developing countries, 25 to 30% of women have no iron reserves at all (WHO, 1992, 2001).

Interventions aimed at reducing the prevalence of anaemia among premenopausal females are therefore required. During pregnancy, iron status and compliance to iron supplements should be monitored. Distributing iron tablets on a weekly basis for a period of two to three months has been proven to be a cheap and effective intervention to reduce anaemia prevalence among premenopausal women (Gross *et al*., 1994).

CONCLUSION

In conclusion, about 44.7% of the premenopausal women had haemoglobin level below 12 g dL^{-1} which puts them at a very high risk of nutritional anaemia. It is recommended that women with low Hb and low serum iron should undergo periodical retesting. In addition, further studies on haematopoietic measurement are needed to understand and determine the best way for its eradication.

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