The Ind. J. Nutr. Dietet., (2001), 38, 394

A STUDY OF IRON STATUS OF PREGNANT WOMEN IN YEWA SOUTH LOCAL GOVERNMENT AREA OF OGUN STATE

OKAFOR, J.C[1]., OLOYO, R.A[2]. AND ADDO, A.A[3].

(Department of Hotel & Catering Management[1]
Department of Science Laboratory Technology, Federal Polytechnic,
P.M.B. 50 Ilaro, Ogun State, Nigeria[2])

(Received 8th June, 2001)

14

Introduction

Iron deficiency, a prevailing nutritional disorder, particularly among women of childbearing age in developing countries including Nigeria has been of concern to international agencies and government in the control of iron deficiency anaemia. If the deficiency is uncorrected it leads to greater risk associated with pregnancy and childbirth[1]. Pregnant women are vulnerable because physiological requirement for pregnancy often lead to increased iron requirement to compensate for normal iron losses and to meet the women's increased erythrocyte volume and the needs connected with foetal and placental growth[2]. Evolution of an effective programme for control and prevention of the deficiency will necessitate knowledge of the iron nutrition in this vulnerable group. The fact that nutritional needs of the individual or a group is influenced by dietary practices, eating habits, economic situations and agricultural practices and food processing conditions[3], all of which changes or varies widely call for assessment of the iron status of the individual or group before implementation of iron deficiency control programme.

This study reports the iron status of pregnant women in a community in Yewa South Local Government Area of Ogun State, Nigeria.

Materials and Methods

Experimental Subjects

Forty volunteered pregnant women between 17 and 43 years of age, and were in the gestational ages ranging from two to nine months constituted the experimental subjects. The volunteers were primarily petty traders, fashion designers (or sewing mistresses), hairdressers, civil servants, housewives and farmers, and they were all attending antenatal clinic in a local Government Healthcare Centre in Ilaro, the Headquarters of Yewa South Local Government area of Ogun State.

Haematological and Biochemical Studies

Blood samples were collected from each of the subjects into EDTA bottles and bottles free of iron and anticoagulant for haematological and biochemical studies,

[3] Department of Home Science and Management University of Agriculture, Abeokuta, Ogun State, Nigeria.

respectively. Haemoglobin content (Hb), red blood cell count (RBC) and packed cell volume (PCV) were analysed[4]. Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated[5]. Serum iron and total iron binding capacity (TIBC) were determined[6]. Transferrin saturation (TS) was calculated as a ratio of serum iron and TIBC and then expressed as percentage.

Statistical Analysis

Data obtained in the study were subjected to regression and correlation analysis and analysis of variance. Scheffe's test was used to separate significantly different treatment means. Statistical analysis was performed by the use of statistical package for social sciences on a COMPAQ personal computer[7].

Results and Discussion

Table I and II show the distribution of the pregnant women that constituted the experimental subjects in this study. Maternal age, gravidity, gestational age and the primary occupation of the women varied considerably. The maternal age ranged from 17 to 43 years and the mean being 26.2 years. Majority (87.5%) were between 20 and 35 years of age while teenagers (17-19 years old) and those that were above 35 years old constituted 7.5 per cent and five per cent respectively. The pregnant women were engaged primarily in different occupations characteristic of a rural community. Majority of them were petty traders (62.5%), while the others were hairdressers (10%), fashion designers (sewing mistresses) (10%), farmers (10%), civil servants (5%) and housewives (2.5%). The hairdressers had the least average age (22.75 years) and the civil servants were the oldest averaging 29 years.

Gravidity (record of previous pregnancies) ranged from 0 to 8 with an average of 2.80. Twenty five per cent of the women were primigravidas, whereas those who had between one and three previous pregnancies constituted 42.5 per cent. the remaining (32.5 %) had four or more previous pregnancies. Hairdressers and fashion designers had fewer previous pregnancies than women in the other job categories. Furthermore, it was observed that age and gravidity were positively correlated ($r = 0.743$ $P > 0.01$). Results of the present study are in agreement with earlier findings of Bowering *et al* [8] who noted that maternal age and gravidity were positively correlated and that pregnant women above 35 years old were at risk of being anaemic. Observations made in this study therefore tended to suggest that the category of pregnant women that are vulnerable to anaemic condition and who needed healthcare most do not attend the clinic.

Observations on gestational age of the women showed that they did not seek antenatal care earlier than two months of pregnancy. The gestation period ranged from two to nine months with an average of 5.9 months. In view of the variation in the gestational age, the period was divided into trimesters. Results in Table II indicate the description of the subjects according to trimester of pregnancy. Fewer women were in their first trimester than those in the other two trimesters. Women in their first trimester

TABLE I

Occupation , Mean Age, Gravidity, Gestation Period, Biochemical Parameters and Haematological Picture of Pregnant Women

Parameter	All pregnant women	Occupation*											
		Trading		Hairdressing		Fashion dressing		Civil servant		Housewife		Farming	
Percentage of women	100	62.50		10.00		10.00		5.00		2.50		10.00	
	Mean	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD
Age (yrs)	26.23	27.0^{b}	± 6.44	22.8^{b}	± 4.03	23.5^{cd}	± 3.70	29.0^{a}	± 4.24	25.0^{bc}	± 0.0	26.5^{b}	± 6.46
Gradivity	2.80	3.40^{a}	± 2.60	0.75^{b}	± 0.96	1.00^{b}	± 1.16	2.50^{a}	± 3.54	3.00^{a}	± 0.0	3.00^{a}	± 2.45
Gestation (months)	5.90	5.96^{b}	± 2.03	5.75^{bc}	± 2.06	5.50^{bc}	± 1.92	4.50^{c}	± 2.12	8.00^{a}	± 0.0	6.25^{b}	± 2.36
PCV (%)	30.68	31.2^{b}	± 2.87	25.5^{c}	± 5.92	30.0^{b}	± 3.92	34.0^{a}	± 5.66	33.0^{a}	± 0.0	31.0^{b}	± 1.83
Hb (g/dl)	9.75	9.73^{ab}	± 1.02	8.19^{b}	± 2.17	10.01^{a}	± 1.17	11.23^{a}	± 2.33	11.44^{a}	± 0.0	10.06^{a}	± 5.2E-02
RBC ($mmx10^{12}$)	4.20	4.26^{a}	± 0.44	3.28^{b}	± 1.02	4.18^{a}	± 0.57	4.65^{a}	± 0.78	4.80^{a}	± 0.0	4.35^{a}	± 0.48
MCHC (g/100 ml)	31.94	31.40	± 2.45	31.93	± 1.37	33.53	± 3.44	32.90	± 1.41	34.70	± 0.0	32.53	± 1.75
MCH (pg)	23.34	22.84	± 2.00	25.30	± 1.47	24.10	± 2.23	24.10	± 0.98	23.60	± 0.0	23.33	± 2.42
MCV (fl)	73.16	72.76	± 3.17	79.50	± 7.18	71.93	± 2.57	73.15	± 7.1E-02	68.80	± 0.0	71.58	± 3.74
Serum iron (µmol/l)	11.11	10.29	± 3.98	14.60	± 7.70	13.68	± 4.05	10.75	± 2.48	11.70	± 0.0	10.25	± 5.75
TIBC (µmol/l)	68.81	68.09	± 19.70	82.65	± 11.27	70.05	± 5.49	52.10	± 15.13	67.00	± 0.0	67.03	± 10.13
TS (%)	17.34	16.65	± 8.64	18.36	± 11.15	19.73	± 6.27	22.26	± 11.22	17.46	± 0.0	15.75	± 9.42

* Mean values in a row denoted by different superscripts differ significantly at $P < 0.05$.

of pregnancy had higher but non-significant average gravidity than those in their second and third trimesters. These results tended to suggest that those who had pregnancies more frequently sought antenatal care at the early stage of the present pregnancy than those who had record of lower gravidity. This might be a consequence of health education received in the regular antenatal care clinic during the management of their previous pregnancies. The mean gestational period for the housewives was significantly higher than the rest of the occupational groups. The civil servants had the least mean gestational period. There was no marked difference among the traders, hairdressers, fashion designers and the farmers.

Iron is required for normal erythropoiesis, and its deficiency is associated with abnormal production in number and size of red blood cells as well as low level of production and incorporation of haemoglobin in the erythrocytes[9]. Consequently, anaemia due to iron deficiency is established by the estimation of erythrocyte indices such as RBC count, Hb, PCV (haematocrit), MCV, MCHC and MCH (Dallman and Reeves, 1984). While the first three indices indicate concentration of each in absolute terms, the last three describe the alteration in size and haemoglobin concentration of individual erythrocyte and thus constitute the basis for classification of the anaemic condition as normocytic, macrocytic, microcytic or hypochromic. Mean red cell indices for all pregnant women are shown in Table I. Going by the acceptable levels of the indices[8] (mean values for all pregnant women recorded in this study) indicated that whereas RBC met acceptable the level (i.e. ≥3.9 mm x 10^{12}), the other two indices were either low (i.e. < 10 g Hb/dl) or marginal (i.e. 30 - 35.9% PCV). Mean values for all the three indices varied significantly with the primary occupation of the subjects, and that the hairdressers recorded the least mean values and hence appeared to be the most deficient. The three indices are age dependent[5,10], hence the experimental subjects were grouped into

TABLE II

Mean age, Gravidity , Gestation Period, Biochemical Parameters and Haematological Picture of Pregnant Women According to Trimester of Pregnancy*

Parameter	First		Trimester Second		Third	
Percentage of women	12.50		45.00		42.50	
	Mean	± SD	Mean	± SD	Mean	± SD
Age (yr)	26.80	± 3.899	26.06	± 6.795	26.24	± 5.54
Gravidity	3.20	± 2.280	2.72	± 2.907	2.76	± 2.137
PCV (%)	32.20	± 3.347	29.33	± 3.481	31.65	± 3.741
Hb (g/dl)	10.62	± 1.260	9.12	± 1.290	10.17	± 1.044
RBC (mm x 10^{12})	4.40	± 0.566	3.96	± 0.539	4.39	± 0.625
MCHC (g/100 ml)	32.98	± 0.901	31.33	± 2.981	32.26	± 1.873
MCH (pg)	24.20	± 1.794	23.10	± 2.253	23.359	± 1.893
MCV (fl)	73.46	± 4.089	73.76	± 4.228	72.43	± 4.107
Serum iron (μmol/l)	8.64^{c}	± 3.910	10.47^{b}	± 3.83	12.52^{a}	± 5.160
TIBC (μmol/l)	64.48^{c}	± 13.607	67.31^{b}	± 15.454	71.67^{a}	± 20.321
TS (%)	14.63^{c}	± 9.789	16.52^{b}	± 7.258	19.00^{a}	± 9.355

* Mean values in a row denoted by different superscripts differ significantly at P<0.05

three age categories and the proportion of the women in each category meeting experimental normal levels recommended by Bowering *et al* [8] are depicted in Figure 1. It was observed that 10 per cent, 7.5 per cent and 90 per cent of the women met acceptable levels of Hb (≥11 g/dl), PCV (≥36%) and RBC (≥3.9 mm x 10^{12}), respectively. Also, low and unacceptable erythrocyte indices were not limited to pregnant women of a particular age group except in the case of RBC counts where deficiently state were observed among women of 35 years and below. Teenagers among the subjects suffered most as they were either deficient or met the required levels of PVC and Hb marginally.

While maternal age was positively correlated with haemotocrit, Hb and RBC, it was negatively correlated with MCV, MCH and MCHC. With the exception of MCH ($r = -0.343$ $P > 0.05$), correlation coefficients for the relationship with all indices were non-significant. The result tended to suggest that at younger age the pregnant women produced and incorporated less haemoglobin into the enlarged erythrocytes (macrocytes), but as they grow older, more haemoglobin were produced and incorporated into smaller sized erythrocytes (microcytes). The results therefore are suggestive of incidence of macrocytic anaemia, (among younger women, a condition that changed slightly toward Microcytic anaemia) as the women grow older. Indeed, mean values of the MCHC, MCH and MCV for all the women were within ranges of values (i.e. MCHC, 31 to 38 g/100 ml; MCH, 22 to 26 pg; MCV, 72 to 79 fl) characteristic of microcytic anaemia[5].

Mean values of all the erythrocyte indices in the three trimesters of pregnancy (Table II), although not significantly different from each other, they were correlated with gestational age as with maternal age. Regression equations describing the relationships are given in Table III. Letsky[11] noted that the indices rose progressively during pregnancy at different rates depending on the number of previous pregnancies and size of the foetus. Higher rates were associated with more frequent

TABLE III

Estimated Regression Equations of Relationships Between Gestational Age and Haematological and Biochemical Indices

Parameter	t-value	Trend line*	R^2
PCV (%)	0.884*	$y = -4E\text{-}14x^2 + 0.265x + 29.112$	1.00
Hb (g/dl)	0.325^{ns}	$y = -7E - 15x^2 + 0.0345x + 9.55$	1.00
RBC (mm x 10^{12})	1.116*	$y = 0.0545x + 3.8762$	1.00
MCV (fl)	-1.027*	$y = 1E\text{-}13x^2 - 0.3397x + 75.159$	1.00
MCH (pg)	-1.274*	$y = -0.2072x + 24.565$	1.00
MCHC (g/100 ml)	-0.711*	$y = 2E\text{-}14x^2 - 0.1384x + 32.752$	1.00
Serum iron (μmol/l)	2.088*	$y = -0.0755x^2 + 1.577x + 4.7269$	0.11
TIBC (μmol/l)	0.685*	$y = -9E - 14x^2 + 0.9631x + 63.125$	1.00
TS (%)	1.456*	$y = 0.9758x + 11.584$	1.00

* Significant at P>0.05; ns-Non significant at P<0.05; *y, haematological or biochemical index; x, gestational age (months)

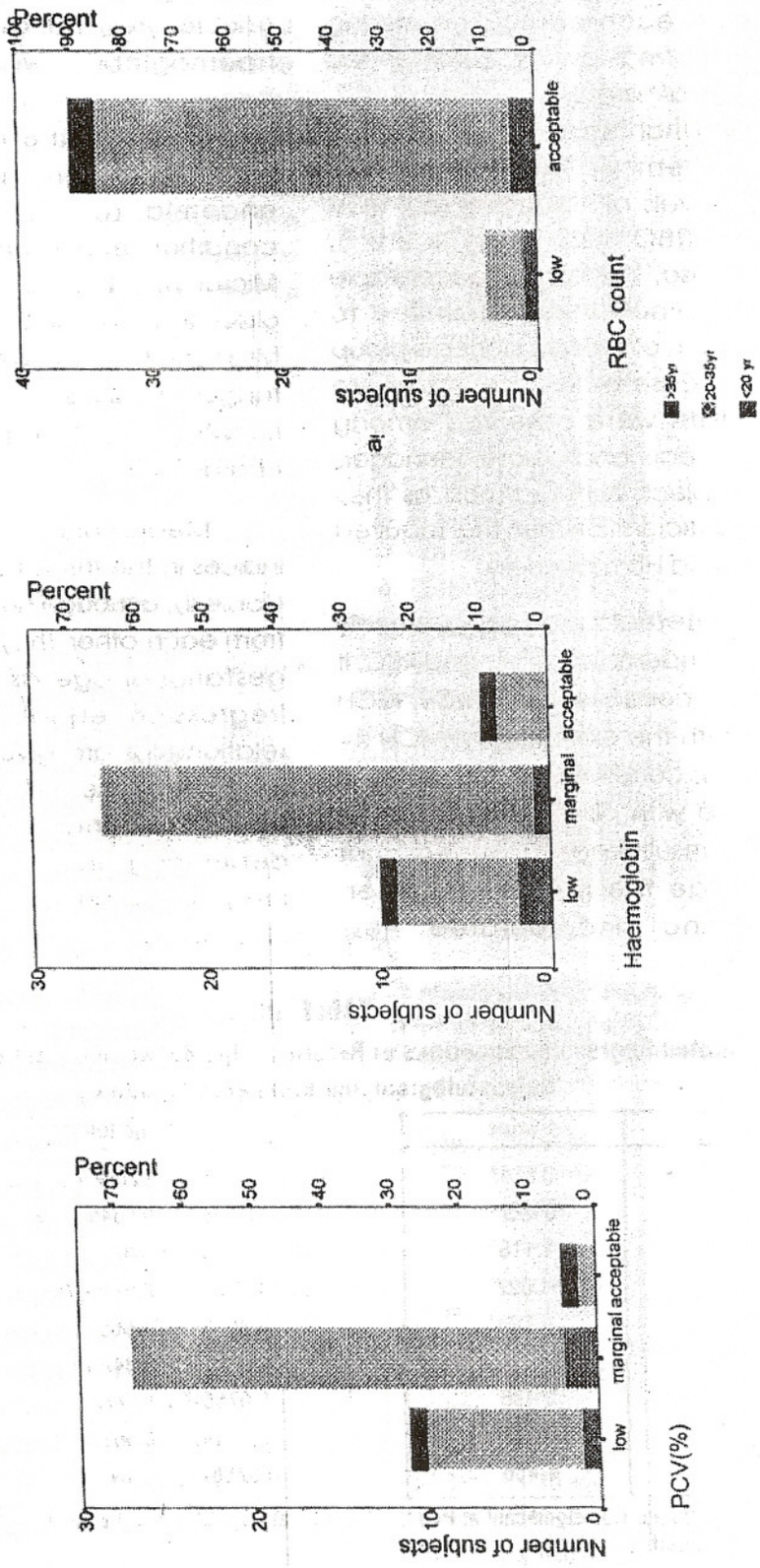

Figure 1 : Percentage of women meeting acceptable levels of the erythrocyte indices according to age group

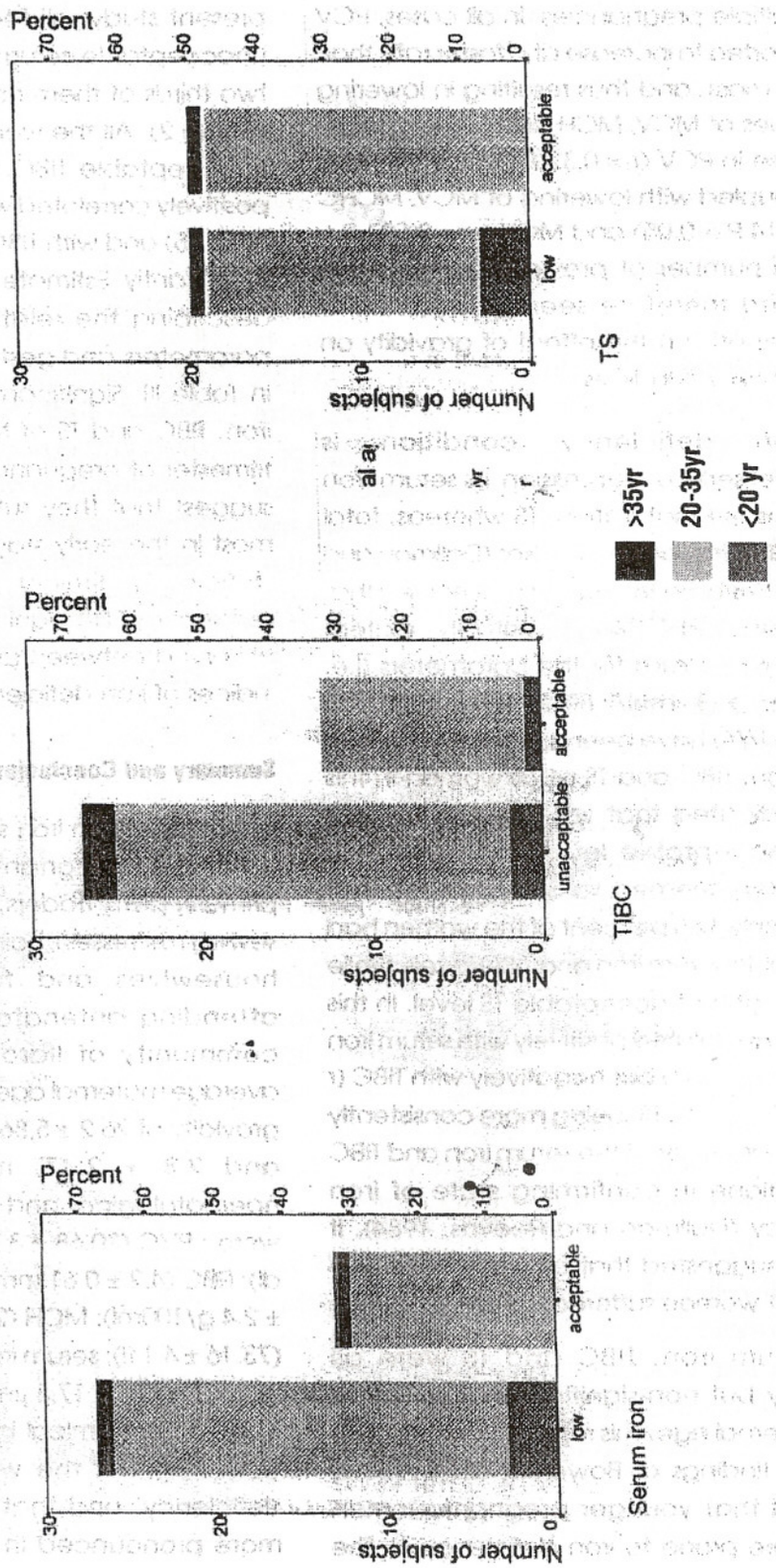

Figure 2 : Percentage of women meeting acceptable levels of the biochemical indices according to age group

and multiple pregnancies. In all cases, PCV was reported to increase at a faster rate than the cell mass, and thus resulting in lowering the values of MCV, MCH and MCHC. In this study, rise in PCV ($r = 0.32$ $P > 0.05$), Hb and RBC, coupled with lowering of MCV, MCHC ($r = -0.414$ $P > 0.05$) and MCH ($r = -0.527$ $P > 0.05$) as number of previous pregnancies increased therefore seemed to confirm earlier reports on the effect of gravidity on the erythrocyte indices.

Iron deficiency condition is characterised by depression in serum iron and transferrin saturation, TS whereas, total iron binding capacity, TIBC rises (Dallman and Reeves, 1984). Bowering *et al*[8] observed that serum iron and TS were positively related. Acceptable values for the parameters (i.e. serum iron, ≥13 µmol/l; TIBC, ≥46 to 70 µmol/l; and TS, ≥16%) have been specified[8,10]. Mean serum iron, TIBC and TS of all women in this study indicated that while serum iron fell below acceptable level, the other two parameters seemed satisfactory (Table I). Indeed, only 32.5 per cent of the women had acceptable serum iron and TIBC levels, while 50 per cent met acceptable TS level. In this study, TS was related positively with serum iron ($r = 0.777$ $P > 0.01$) but negatively with TIBC ($r = -0.579$ $P > 0.01$). TS, being more consistently helpful than either of the serum iron and TIBC values alone in confirming state of iron deficiency (Dallman and Reevas, 1984), it may be suggested that at least half of the pregnant women suffered iron deficiency.

Serum iron, TIBC and TS were all positively but non-significantly correlated with maternal age. This result is in agreement with the findings of Bowering *et al* [8]. Who reported that younger pregnant women were more prone to iron deficiency. In the present study, all teenagers had low and unacceptable serum iron and TS, and that two thirds of them had unacceptable TIBC (Figure 2). All the women above 35 yrs had unacceptable TIBC. Gestational age was positively correlated with serum iron ($r = 0.321$ $P > 0.05$) and with TIBC and TS, although not significantly. Estimated regression equations describing the relationship between the parameters and gestational age are given in Table III. Significantly lower mean serum iron, TIBC and TS of the subjects in the first trimester of pregnancy (Table II) tended to suggest that they suffered iron deficiency most in the early stage of pregnancy. The deficiency diminished in later stages of pregnancy. No significant correlation was observed between gravidity and the three indices of iron deficiency.

Summary and Conclusion

A study on iron status was conducted among 40 pregnant women who were primarily petty traders, fashion designers (i.e. sewing mistresses), hairdressers, civil servants, housewives and farmers; and were attending antenatal clinic in the rural community of Ilaro. The subjects had average maternal age, gestational age and gravidity of 26.2 ± 5.86 yrs, 5.9 ± 1.98 months and 2.8 ± 2.47, respectively. Mean haematological and biochemical indices were : PVC (30.68 ± 3.7%); Hb (9.75 ± 1.3 g/dl); RBC (4.2 ± 0.61 mm x 10^{12}); MCHC (31.94 ± 2.4 g/100ml); MCH (23.34 ± 2.03 pg); MCV (73.16 ± 4.1 fl); serum iron (11.11 ± 5.55 µmol/l); TIBC (68.81 ± 17.3 µmol /l); and TS (17.34 ± 8.43%). Biochemical indices indicated that about half of the women suffered iron deficiency, and that the deficiency was more pronounced in the first trimester of

pregnancy. Erythrocyte indices showed that younger women with fewer record of previous pregnancy suffered macrocytic anaemia, whereas older women with more frequent pregnancy had microcytic anaemia.

REFERENCES

1. United Nations. Micronutrient Deficiency - The Global Situation. ACC / SCN. 2nd Report on World Nutrition Situation, 1993, Vol. 9.

2. Serge, H. Iron and Folate Deficiency Anaemias. Children in the Tropics. 1990, No. 186.

3. Latunde - Dada, G.O. and Neale, R.J. Availability of iron from foods. Journal of Food Technology, 1986, 21 : 255 - 268.

4. Lamb, G.M., Manual of Vaterinary Laboratory Techniques. Kenya, CIBA - Geigy, 1981.

5. Harper, H.A., Review of Physiological Chemistry, 15 Ed. Lange Medical Publication, 1975, Los Altos, California.

6. O'Malley, J.A., Hassan, A., Shiley, J.and Traynor, H. Simplified determination of serum iron and total iron binding capacity. Clinical Chemistry, 1970, 16 : 92 - 96.

7. SPSS Inc. SPSS 9.0 for Windows. Standard Version, 1998.

8. Bowering, J., Lowenberg, R.L. and Morrison, M.A. Nutritional studies of pregnant women in East Harlem. *Am. J. Clin. Nutr.*, 1980, 33 : 1987 - 1996.

9. Bell, W.R., Hematologic abnormalities in pregnancy. *Med. Clin. North Am.*, 1977, 61 : 165.

10. Dallman, P.R. and Reevas, J.D. Laboratory diagnosis of iron deficiency : In iron Nutrition in Infancy and Childhood. Nestle Nutrition. Switzerland, 1984.