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Comparative Study of Iron-related Parameters in Pregnant Women of Advanced and Younger Maternal Age groups in Calabar, Nigeria

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ABSTRACT

Introduction
Gestational anaemia is at the forefront of the many health challenges confronting maternal health. It often stems from micronutrient deficiencies particularly found in low-income countries. Iron deficiency has been observed as the most common micronutrient deficiency. Iron deficiency anaemia in pregnancy is associated with adverse outcomes such as preterm birth, low birth weight, and maternal complications such as fatigue. While population differences may exist in this regard, the effect of aging on iron-related parameters of pregnant women needs to be studied.

Methods
The pregnant women consisted of equal numbers of those at advanced maternal age (from 35 years of age) and younger subjects. Blood sample was appropriately obtained from each subject for assessment of red cell and iron parameters. Microhaematocrit and cyanmethaemoglobin methods were employed for the measurement of packed cell volume and haemoglobin concentration respectively, while the iron parameters were assayed by colorimetric methods. Transferrin saturation was mathematically derived. Results are expressed as Mean±SD, while student t-test was used for analysis of data on SPSS version 22.0. Statistical significance was drawn at a $p \leq 0.05$.

Results
Pregnant women of advanced maternal age had significantly lower mean values than the younger pregnant women for serum iron (12.68 ± 1.76 µmol/L compared to 16.26 ± 2.22 µmol/L), transferrin saturation (21.37±4.69% compared to 32.04±7.51%), packed cell volume (0.34 ± 0.03l/l compared to 0.37 ± 0.03l/l) and haemoglobin concentration (114.16 ± 10.42g/l compared to 126.32 ± 11.68g/l). The TIBC was significantly higher in those at advanced age than the younger ones (60.29 ± 4.71 µmol/L, compared to 51.90 ± 5.20 µmol/L).

Conclusion
Pregnant women of advanced maternal age had lower circulating iron and red blood cell values than younger pregnant women.

Key words: Anaemia, iron, pregnancy, advanced maternal age

INTRODUCTION

Reduction in red blood cells with its attendant impairment in oxygen delivery constitutes an important health condition known as anaemia (1,2). There are various mechanisms for anaemia occurrence which border on insufficient production or early removal from circulation. Thus, the various causes of anaemia include; nutritional deficiencies, haemolytic conditions such as the haemoglobinopathies and haemorhagic conditions as well as chronic inflammatory conditions with likelihood of iron sequestration (3-5). Unfortunately, several of these predisposing factors to anaemia abound within our national population so much so that Nigeria has a record of high anaemia prevalence (6-9). The World Health Organization (WHO) has previously identified anaemia as a mortality-associated risk factor in women of reproductive age (10-12). More importantly, gestational anaemia is at the forefront of the many health challenges confronting maternal health. It often stems from micronutrient deficiencies particularly found in low-income countries where basic health infrastructure is grossly inadequate. Iron deficiency has been observed as the most common micronutrient deficiency contributing immensely to anaemia during pregnancy. Iron deficiency, if unchecked, results in iron deficiency anaemia which serves as the clinically observable manifestation (13-17). Sub-optimal iron levels in non-pregnant women of reproductive age have been previously reported in the study area which partly explains the high prevalence of nutritional deficiency in the Nigerian population of pregnant women (18,19).

Pregnancy in women of advanced age, sometimes referred to as geriatric pregnancy, is defined as pregnancy occurring in women from 35 years of age upwards. It often presents unique challenges due to physiological changes associated with aging (20,21). Iron metabolism is already known to undergo changes with age ordinarily. At the same time, iron plays a crucial role in both maternal and foetal health during pregnancy (22-24). As women age, they may experience alterations in iron metabolism, leading to an increased risk of iron deficiency anaemia. This can be exacerbated during pregnancy due to the higher iron demands to support maternal blood volume expansion and foetal development. Iron deficiency anaemia in pregnancy is associated with adverse outcomes such as preterm birth, low birth weight, and maternal complications like fatigue and increased susceptibility to infections (24,25). While population differences may exist in this regard, the dynamics of aging on general health together with possible depletion of body nutritional stores may be accounting for pronounced complications. Since there are indications that pregnancy-associated complications occur more in women of advanced maternal age as earlier stated, it is worthwhile to study iron parameters in pregnant women of advanced age.

MATERIALS AND METHODS

This comparative study enrolled 50 pregnant women and another 50 apparently healthy age-matched non-pregnant females. The pregnant women consisted of equal numbers of those at advanced maternal age (from 35 years of age) and younger subjects. All the pregnant women were within the second trimester of pregnancy during the study period. They had commenced antenatal care and were on iron supplements from their first trimester of pregnancy. Ethical considerations including confidentiality were maintained. A structured questionnaire was administered to obtain biodata and medical history.

Blood sample was appropriately obtained from each subject into dipotassium ethylene diamine tetra-acetic acid bottle at a concentration of 2mg/ml of blood for measurement of packed cell volume and haemoglobin concentration, and also plain bottle from which serum was harvested for analysis of serum iron and total iron-binding capacity. Microhaematocrit and cyanmethaemoglobin methods were employed for the measurement of packed cell volume and haemoglobin concentration respectively, while the iron parameters were assayed by colorimetric methods. Transferrin saturation was mathematically derived. Data generated were entered into Microsoft excel spreadsheet and analysed using Statistical Package for Social Sciences (SPSS) software version 22.0. Results are expressed as Mean±SD, while Student t-test was used for comparison. Statistical significance was drawn at a $p \leq 0.05$.

RESULTS

Table1 compares serum iron, total iron binding capacity (TIBC), transferrin saturation, packed cell volume (PCV) and haemoglobin concentration between pregnant women attending the ante-natal clinic at the University of Calabar Teaching Hospital (UCTH) and non-pregnant women (controls). Pregnant women had significantly lower mean values than non-pregnant women for serum iron (14.47 ± 2.69 µmol/L compared to 21.37 ± 5.19 µmol/L), transferrin saturation (26.71 ± 8.21% compared to 34.99 ± 11.10%), packed cell volume (0.36 ± 0.04 compared to 0.39 0.03) and haemoglobin concentration (120.24 ± 12.56 compared to 127.08 11.52). The TIBC was significantly higher in pregnant women than in the non-pregnant women (62.37 ± 6.11 µmol/L, compared to 56.10 ± 6.48 µmol/L).

In Table 2, pregnant women of advanced maternal age had significantly lower mean values than the younger pregnant women for serum iron (12.68 ± 1.76 µmol/L compared to 16.26 ± 2.22 µmol/L), transferrin saturation (21.37±4.69% compared to 32.04±7.51%), packed cell volume (0.34 ± 0.03l/l compared to 0.37 ± 0.03l/l) and haemoglobin concentration (114.16 ± 10.42g/l compared to 126.32 ± 11.68g/l). The TIBC was significantly higher in those at advanced age than the younger ones (60.29 ± 4.71 µmol/L, compared to 51.90 ± 5.20 µmol/L).

Table 1. Iron-related parameters of pregnant and non-pregnant women

Parameters	**Pregnant Women n = 50**	**Non-pregnant Women n = 50**	**P-Value**
Serum iron (µmol/L)	14.47±2.69	21.37±5.19	0.001
TIBC (µmol/L)	62.37±6.11	56.10±6.48	0.001
Transferrin saturation (%)	26.71±8.21	34.99±11.10	0.001
Packed cell volume (l/l)	0.36 ± 0.04	0.39 ± 0.03	0.001
Haemoglobin conc. (g/l)	120.24 ± 12.56	127.08 ± 11.82	0.006

Values are expressed as Mean±SD; TIBC = Total Iron Binding Capacity; * = Significant at P≤0.05

Table 2. Iron-related parameters of pregnant women based on maternal age

Parameters	**Pregnant Women of advanced age n = 25**	**Pregnant Women of young age n = 25**	**P-Value**
Serum iron (µmol/L)	12.68 ± 1.76	16.26 ± 2.22	0.001
TIBC (µmol/L)	60.29 ± 4.71	51.90 ± 5.20	0.001
Transferrin saturation (%)	21.37±4.69	32.04±7.51	0.001
Packed cell volume (l/l)	0.34 ± 0.03	0.37 ± 0.03	0.001
Haemoglobin conc. (g/l)	114.16 ± 10.42	126.32 ± 11.68	0.001

Values are expressed as Mean±SD; TIBC = Total Iron Binding Capacity; * = Significant at P<0.05

DISCUSSION

Females of reproductive age are prone to nutritional deficiency due to a number of factors such as inadequate dietary intake, physiological monthly loss in menstrual blood as well as history of previous conceptions (17). For these reasons, the additional demand placed by pregnancy is more likely to result in a negative balance and the occurrence of a deficiency state with consequent adverse maternal and foetal outcomes (25-28). Screening for anaemia in clinical practice relies on measurement of concentrations relative to whole blood volume without highlighting possible underlying mechanisms. It is necessary to investigate specific nutritional factors. The current study focused on iron-related parameters including indicators of anaemia. This work considered pregnancy in general as well as the effect of advanced maternal age on measured parameters. The pregnant women who were enrolled in this study had significantly lower mean serum iron level and transferrin saturation with higher total iron binding capacity compared to non-pregnant women. This trend extended to their red cell parameters that were also significantly lower, though within the reference range for pregnant women. Physiologically increased demand for foetal growth and an expanded maternal blood volume have long been recognized as the explanation for gestational micronutrient deficiency and anaemia (15,17).

Furthermore, the study observed that geriatric pregnant women had significantly lower mean serum iron levels, elevated TIBC, and lower transferrin saturation in addition to lower packed cell volume and haemoglobin concentration when compared to non-geriatric pregnant women. Some reports have suggested that women in their third decade of life are more at risk of unfavorable pregnancy outcomes, while maternal age over 35 years has been observed as one of the major risk factors for iron deficiency and iron deficiency anemia in pregnant women (20,21,29,30). In the light of these previous studies, reasons for insufficient circulating iron in the older pregnant women could relate to poor dietary intake, age-associated chronic conditions affecting iron status as well as reduced efficiency of iron absorption and utilization. In some cases, high parity with consequential toll on iron stores might be a contributing factor Hence, the diminished iron availability for erythropoiesis in geriatric pregnancy could be linked to both age-related factors and increased iron demands during pregnancy.

Conclusion

Pregnant women of advanced maternal age had lower circulating iron and red blood cell values than younger pregnant women. This implies lesser availability of iron and a tendency for anaemia in pregnancy at advanced maternal age.

Conflict of Interest

The authors declare no conflict of interest.

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