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Iron Status of Pregnant Women at Different Trimester in Nsukka, Enugu State, South East, Nigeria

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Abstract

Anaemia associated with iron deficiency in pregnant women in South East , Nigeria is a serious medical issue particularly in remote areas due to poor awareness. The aim of this research work was to determine the prevalence and severity of anaemia in pregnant women in first, second and third trimester using haemoglobin and ferritin concentration as an indicator of anaemia among the subjects. Effect of age, gestational age (trimester) and intake of routine drug on haemoglobin and ferritin concentration of the subjects were also determined. In this study a total of 127 blood samples from pregnant women within the age of 20 – 49 years, in which 6 were in first trimester, 50 in second trimester and 71 in third trimester were collected. From this study, the prevalence of anaemia in the subjects based on haemoglobin concentration below 11 g/dl was 39.4%, prevalence based on ferritin concentration below 15 µg/l was 27.6%. The result of correlation analysis of haemoglobin concentration on the effect of age shows a negative correlation which is significant ($p < 0.05$) but positively correlated with ferritin concentration although not significant at ($p > 0.05$). Gestational age when correlated with haemoglobin and ferritin concentration shows a negative correlation at ($p > 0.05$). Intake of routine drug when correlated with haemoglobin shows a negative correlation at ($p > 0.05$) but when correlated with ferritin shows a positive correlation, although not significant at ($p > 0.05$). This study reveals that more than half of the subjects were anaemic and their children stands the risk of being born anaemic especially when they are exclusively breast fed. Therefore, public health campaign should be carried out to sensitize pregnant women on the need for early antenatal booking and iron supplementation during pregnancy.

Key words: Iron, haemoglobin, Ferritin, Pregnant women, anaemia, trimester, Nsukka

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1.Introduction

Iron is a type of mineral found in all cells of the body. Iron is obtained from the diet, enters the body and is carried throughout the bloodstream by a protein called transferrin, which is produced in the liver (Elzahrani, 2012). In the blood iron helps form haemoglobin which is an important protein in red blood cells. Haemoglobin is responsible for the transport of oxygen throughout the body so it can function normally. Iron is considered an important mineral because haemoglobin cannot be made without it (Elzahrani, 2012).

Iron deficiency is the most frequent nutritional deficiency disorder in the world (WHO, 2015). A recent estimate based on World Health Organization (WHO) criteria indicate that around 600-700 million people worldwide have a marked iron deficiency anaemia. Iron deficiency anaemia in pregnancy has been defined by the National Academic of Science Panel on nutrition as ferritin level lower than 15 µg/l while the World Health Organization defined anaemia in pregnancy as haemoglobin level of less than 11g/dl (Elzahrani, 2012). For non – pregnant women, the World Health Organization (WHO, 2015). defined anaemia as haemoglobin concentration less than 12g/dl and defined iron deficiency anaemia as serum ferritin concentration less than 15 µg/l.Pre-pregnancy body stores are important because during pregnancy there is a marked physiologic increase in the demands for absorbed iron to expand the woman's red blood cell mass and to secure an adequate iron supply for the function of the placenta and developing foetus (Milman, 2006). To complete a normal pregnancy without taking iron supplements and without developing iron deficiency or iron deficiency anaemia, the woman should have body iron stores at conception of ≥500 mg (WHO, 2015), which corresponds to serum ferritin concentration of 70 – 80µg/l (Milman, 2006) .

The development of iron deficiency anaemia is associated with increased risk of pre-term birth and low birth weight infants. The physiologic importance of storage iron is that it provides a rapidly available supply in the event of blood loss. To achieve iron balance, towards the end of pregnancy, the absorption of 4 – 5mg/day is necessary. Requirements are higher during periods of rapid growth in early childhood and adolescent. Worldwide, the highest prevalence figures of iron deficiency today are found in infants, children, teenagers, women of childbearing age and pregnant women. The highest prevalence today is observed in pregnant women and menstruating women (Sacham &Idris,2013) . Transfer of iron from mother to foetus occurs mainly in the last trimester of pregnancy. Therefore, during this period, a mother's food should contain surplus quantities of iron. During this time, the child is dependent on the iron reserve , received from the mother during pregnancy. In premature babies, the transplacental transfer of iron might not have taken place. Hence such babies are at risk of iron deficiency (Vasidevan et al., 2011) .

Haemoglobin concentrations are used to characterize, and serve as iron benchmark for anaemia and iron deficiency anaemia have been provided by the WHO (2015). Iron deficiency is commonly caused by the combination of blood loss and insufficient dietary intake. (Milman, 2006) .Pregnant women are particularly vulnerable to iron deficiency which is the most prevalent global nutrition deficiency and the most common cause of anemia worldwide. There is a current concern that irrespective of worldwide campaign against anaemia in pregnancy, women of reproductive age still enter into pregnancy without proper iron stores and could give birth to children with inadequate iron deposit.

Anaemia associated with iron deficiency in pregnant women in South East Geopolitical zone of of Nigeria is a serious medical issue particularly in remote areas due to poor awareness. Therefore, there is urgent need to carry out public health campaign so as to sensitize pregnant women on the need for early antenatal booking and iron supplementation during pregnancy. The scientific information from this research will enhance this sensitization. This research aimed at investigating the iron status of pregnant women at different trimester in Nsukka, Enugu State, South East, Nigeria.

2. Materials and Methods

2.1 Subjects

One hundred and twenty-seven pregnant women at different trimester (Ochei & Kolhatkar, 2008) were in the first trimester; 50 were in the second trimester and 71 were in the third trimester), all living at Nsukka community, Enugu State, Nigeria, were recruited for this study. All experimental protocols were carried out in accordance with the World Medical Association Declaration of Helsinki and all subjects provided written consent. Ethical approval (UNN/FBMS/EC/1017) was obtained from the Ethics and Bio safety Committee of Faculty of Biological Sciences, University of Nigeria, Nsukka, Enugu State, Nigeria. The objectives and benefit of this study was carefully explained to the subject before they accepted to take part in the study.

2.2Study Area

Pregnant women attending the antenatal clinic in Nsukka Divisional Health Centre were recruited for the study. This is the major public maternity unit within Nsukka community. The hospital gives quality healthy service and sensitize pregnant women on how to take care of themselves during the course of their pregnancy.

2.3 Equipments and Instruments

Equipment and instrument used for the study were obtained from Shalom Research Laboratory and Projex Laboratory and other scientific shop in Nsukka. They include; centrifuge (model 800D; New Life Medical Instrument, England), Spectrophotometer (model SPM721- 2000, Biodiagnosis Inc., USA), refrigerator (Haier thermo cool, England), non-anticoagulated bottles, EDTA bottles, micropipette (Volume Range 0-1000µl; Swastika Scientific Instrument Private Ltd, Mumbai India), micro titer plate reader (model MR 9602A; Biotech USA).

2.4 Chemicals/Reagent

Analytical grade chemicals were used in this study. The reagents and chemicals used for haemoglobin determination were Darbkin's reagent which contain potassium cyanide, potassium ferricyanide, and sodium bicarbonate. Cal biotech kits for determination of ferritin which contain biotin reagent, streptavidin coated micro wells, ferritin reagent (horseradish peroxide), ferritin calibrator, substrate A (tetramethylbenzidine), substrate B (hydrogen peroxide) and stop solution (hydrochloric acid).

2.5 Data Collection

The following were the inclusive criteria for selection of subject; their age, trimester, routine drug, pregnancy history, resident within Nsukka community, Enugu State, consent to participate in the study, willingness to give 5ml of blood.

2.6 Sample Collection

A known volume, 5ml of blood sample was collected from each participant by venepuncture using disposable needles and syringes. Thereafter, 3ml of the blood sample were transferred into a labeled plane container. The blood was allowed to clot, spun at the speed of 4000rmp for 10 minutes using centrifuge. The serum obtained was carefully separated using Pasteur pipette and transferred to a new plain container, while the whole blood was discarded properly according to the best practice of laboratory waste disposal. The remaining 2ml of the blood sample was transferred into ethylene diamine tetraacetic acid (EDTA bottle). It was properly kept for malaria parasite and haemoglobin determination.

2.7 Haemoglobin determination

Haemoglobin determination was done using standard method as described by (Ochei & Kolhatkar, 2008) .The haemoglobin determination is based on light intensity principle on the dilution of blood (from EDTA) in a solution called Drabkin's solution, which contains potassium cyanide and potassium ferricyanide. Red blood cells are haemolysed and haemoglobin is released which is converted to methaemoglobin by reacting with potassium ferricyanide. The methaemoglobin is converted to cyanmethaemoglobin (which has maximum absorbance of 540nm) by potassium cyanide. The colour intensity measured at 540 nm is proportional to the total haemoglobin concentration.The blood sample (20 µl) was diluted in 8ml of Dakin's solution by 1:250. The tube was then covered and inverted several times and left to stand for 5 minutes to ensure complete conversion. The cyanmethaemoglobin (HiCN) was poured into a cuvette. The spectrophotometer was set to 100% transmitter at 540nm using Drabkin's solution as blank. The haemoglobin value was then determined by multiplying by a factor of 36.8 to give the actual haemoglobin value.

2.8 Ferritin determination

Serum ferritin determination was done using enzyme immunoassay method as described by (Addison et al., 1972) and as contained in Calibiotech ferritin kit. The principle is based on enzyme reaction where streptavidin coated micro well react with ferritin biotin reagent (monoclonal biotinylated antibody) and the serum containing the native antigen from an antibody-antigen complex. The biotin attached to the antibody binds to streptavidin on the micro well resulting in immobilization of the complex. After incubation the antibody-antigen bound fraction is separated from unbound antigen by decanting. Another antibody that is directed to a different epitome labeled with an enzyme was added leading to an enzyme labeled antibody-antigen-biotinylated complex. Excess enzyme is washed out using the washing buffer. A suitable substrate is added to produce a colour effect measurable with

the use of spectrophotometer. Prior to assay, the reagent was allowed to stand at room temperature (20 – 25°C). The reagent was gently mixed before use. The desired number of coated strips was placed in to the holder for patient's specimen to be assayed in duplicate. A known volume, 25 µl (0.02ml) of ferritin standard, control and samples wasPipette into appropriate wells and 100µl of biotin reagent was added into each well. Thereafter the plate was shaken for 10 – 30 minutes. The plate was covered and incubated for 30 minutes at room temperature (20 - 25^{0}c). Liquid was removed from all wells and washed well for three times with 30x wash buffer. The plate was tapped and blotted dry with absorbance paper. After which 100µl (0.100 ml) of the enzyme reagent was added into each well and was covered and incubated for 30 minutes at room temperature (20 - 25^{0}c). The liquids from all wells were removed and washed for three times with 300x wash buffer. The plate was tapped and blotted dry using absorbance paper. The substrate, 100µl (0.100ml) was added into all wells and incubated for 15 minutes at room temperature. Thereafter 50µl (0.050ml) of stop solution was added into all well and was carefully mixed for 10 -20 minutes at room temperature. The absorbance in each well was read at 450nm within 15 minutes after adding the stop solution (using wavelength of 620 – 630nm) in a micro plate reader.

2.9 Data Analysis

Data was expressed as mean ± standard error of mean (SEM) and test of statistical significance was carried out using One-Way Analysis of Variance (ANOVA). Pearson test was performed to assess the correlation between Haemoglobin concentration, serum ferritin with other variables.

3.0 Results

3.1 Demographical Information on Pregnant Women.

Table 1 shows the demographical information of pregnant women. One hundred and twenty-seven pregnant women aged 20 – 49 years participated in the study. The age distributions were 20 – 24 years (26.8%), 25 – 29 years (37%), 30 – 34 years (20.4%), 35 – 39 years (12.6%), 40 -44 years (2.4%) and 45 – 49 years (0.8%). Among the pregnant women used in this study, six (4.7%) were in their first trimester, fifty (39.4%) were in their second trimester and seventy-one (55.9%) in their third trimester. A total number of fifty-six(44.1%) took the routine drugs regularly, while seventy-one (55.9%) did not.

3.2 Prevalence of Anaemia Using Haemoglobin Concentration Alone

Table 2 shows the result of prevalence of anaemia using haemoglobin concentration alone. From the table 39.4% of the pregnant women were anaemic based on haemoglobin less than 11g/dl. In first trimester, 0.79% were anaemic, second trimester 18.89% were anaemic while 19.69% were anaemic in the third trimester.

3.3 Prevalence of Anaemia Using Ferritin Concentration Alone

Table 3 shows the prevalence of anaemia using ferritin concentration alone. From the result 27.6% of the subjects were anaemic based on ferritin concentration less than 15µl. In first trimester 3.94% were anaemic, 11.81% were anaemic in second trimester while 11.81% were anaemic in third trimester.

Table 1: Demographical Information on Pregnant Woman

Participant(n=127)	Number	Percentage (%)
Age (years)		
20-24	34	26.8
25-29	47	37
30-34	26	20.4
35-39	16	12.6
40-44	3	2.4
45-49	1	0.8
Stage of Pregnancy		
1st Trimester	6	4.7
2nd Trimester	50	39.4
3rd Trimester	71	55.9
Intake of Iron Supplements		
Regular	56	44.1
Irregular	71	55.9

Table 2: Prevalence of anaemia using Haemoglobin Concentration alone. (Anaemia = Hb $< 11g/dl$

Gestation age (n=127)	Number	Percentage (%)
First trimester	1	0.79
Second trimester	24	18.89
Third trimester	25	19.72
Total	50	39.40

Table 3: Prevalence of Anaemia using Ferritin Concentration alone . (Anaemia = ferritin<15µl).

Gestation age (n=127)	number	percentage (%)
First Trimester	5	3.94
Second Trimester	15	11.81
Third Trimester	15	11.81
Total	35	27.60

3.4 Prevalence of Anaemia using Combined Haemoglobin and Ferritin Concentration in pregnant women in first, second and third trimester.

Table 4 shows the prevalence of anaemia and non-anaemic pregnant women both in first, second and third trimester. From the result none of the subjects were anaemic in first trimester, 26% of the subjects were anaemic in second trimester while 11.3% of the subjects were anaemic in third trimester. Based on ferritin level alone 66.6% of the subjects were anaemic in first trimester, 46% in second trimester while 53.5% of the subjects in third trimester were anaemic. Conversely, 16.7% of the subjects in first trimester, 22% in second trimester while 23.9% in third trimester were anaemic based on low haemoglobin and ferritin level respectively

3.5 Effect of Age on Haemoglobin and Ferritin Concentration

Table 5 shows the effect on haemoglobin and ferritin concentrations. From the table, mean haemoglobin concentration has a significant different ($p < 0.05$) when age range of 40 – 45 years is compared to other age range. However, the age range of 30 – 34 years are non-significantly different ($p > 0.05$) when compared to age range of 35 -39 years and 40 – 44 years. Mean ferritin concentration shows that the age range of 40 – 44 years and 45 – 49 years are significantly ($p < 0.05$) different when compare to the age range of 20 – 24 years, 25 – 29 years, 30 – 34 years and 35 – 39 years. However, the age range of 20 – 25 years and 35 – 39 years are significantly ($p < 0.05$) lower than the age range of 30 – 34 years.

3.6. The Effect of Gestation Age (first, second and third trimester) on Haemoglobin and Ferritin Concentrations

Table 6 shows the effect of gestational age on haemoglobin and ferritin concentrations. from the results, the mean concentration of haemoglobin in the first trimester (11.60 ± 1.86) shows no significant ($p > 0.05$) difference when compared to second (11.03 ± 1.56) and third trimester (11.06 ± 1.64). The mean value of ferritin concentration in the first trimester (16.24 ± 3.10) was significantly ($p < 0.05$) lower when compare to the mean ferritin concentration in the second trimester (75.72 ± 9.50) and third trimester (66.53 ± 5.09).

Table 4: Prevalence of Anaemia using Combined Haemoglobin and Ferritin Concentration in first, second and third trimester.

Parameters	Prevalence (%)		
	First Trimester (n=6)	Second Trimester (n=50)	Third Trimester (n=71)
Normal Hb and Normal Ferritin	1(16.7)	3(6)	8(11.3)
Low Hb and Normal Ferritin	(0)	13(26)	8(11.3)
Low Ferritin and Normal Hb	4(66.6)	23(46)	38(53.5)
Low Hb and Low Ferritin	1(16.7)	11(22)	17(23.9)

Table 5: The Effect of Age on Haemoglobin and Ferritin Concentrations

Age Range	Mean Hb (g/dl)	Mean Ferritin (µg/l)
20-24 years (n=34)	11.57 ± 1.37	24.87 ± 5.72
25-29 years (n=47)	11.20 ± 1.91	86.84 ± 11.01
30-34 years (n=26)	10.69 ± 1.03	90.06 ± 12.20
35-39 years (n=16)	10.58 ± 1.75	80.99 ± 10.41
40-44 years (n=3)	10.38 ± 0.58	8.32 ± 1.36
45-49 years (n=1)	64 ± -	8.78 ± -

Result are expressed in mean ± standard deviation; Hb = Haemoglobin

Table 6:The Effect of Gestation Age (first, second and third trimester) on Haemoglobin and Ferritin Concentrations

Gestation age	Mean Hb (g/dl)	Mean Ferritin (µg/l)
First Trimester (n=6)	11.60 ± 1.86	16.24 ± 3.10
Second Trimester (n=49)	11.03 ± 1.56	75.72 ± 9.50
Third Trimester (n=72)	11.06 ± 1.64	66.53 ± 5.09

Result are expressed in mean ± standard deviation.

3.7 The Effect of Routine Drugs on Haemoglobin and Ferritin Concentrations

From the result in table 7 below, the mean haemoglobin concentration of those that received routine drug (11.30 ± 1.73 g/dl) was slightly higher compared to those who didn't receive the drug (10.59 ± 1.49 g/dl). However, the mean ferritin concentration of pregnant women who receive routine drug (58.53 ± 4.08 µg/l) was significant higher ($p < 0.05$) when compared to the concentration of those that didn't receive (75.17 ± 9.10 µg/l).

3.8 Correlation Analysis of age range, Gestation age and Intake of Routine Drugs on the Haemoglobin and Ferritin Concentrations of Pregnant Women.

The correlation table 8 below, shows that age is negatively correlated with haemoglobin but positively correlated with ferritin. This means that as age of the subjects was increasing, their haemoglobin level was decreasing. This decrease was statistically significant ($p < 0.05$). however, the ferritin level was increasing with an increase in the age of the subjects, although not significant ($p > 0.05$). Gestational age when correlated with the haemoglobin and ferritin concentration shows a negative correlation ($p > 0.05$). This implies that increase as gestational age of the subjects' increases, there was a decrease in haemoglobin and ferritin concentrations. Also, from the result, intake of routine drugs when correlated with the haemoglobin concentration shows a negative correlation ($p > 0.05$) but when correlated with ferritin concentration shows a positive correlation ($p > 0.05$), which means that intake of routine drug seems to have reduced the haemoglobin level but increase ferritin level of the subjects.

Table 7: The Effect of Routine Drug on Haemoglobin and Ferritin Concentrations

Groups	Mean Hb (g/dl)	Mean Ferritin (µg/l)
Regular (n=57) Regular (n=57)	11.30 ± 1.73	58.53 ± 4.08
Irregular (n=70)	10.59 ± 1.49	75.17 ± 9.10

Result are expressed in mean ± standard deviation; Hb = Haemoglobin

Table 8: Correlation Analysis of Age range, Gestationage and Routine Drugs on the Haemoglobin andFerritin Concentrations of Pregnant Women.

Groups	Mean Hb (g/dl)	Mean Ferritin(µg/l)
Age	- 0.260**	0.083
Stage of Pregnancy	- 0.36	- 0.021
Intake of Supplements	- 0.126	0.057

Correlation is significant at p- value ($p <0.05$)

4. Discussion

Iron deficiency is one of the most important nutritional disorder among pregnant women worldwide. It could directly or indirectly contribute to the high rate of maternal, perinatal morbidity and mortality seen in Nigeria (Rodger et al ., 2015).

Iron deficiency anaemia was highly prevalent among pregnant women used in this study. Using the World Health Organisation criterion of haemoglobin level below 11g/dl to define anaemia in pregnant women, 39.4% of the pregnant women used in this study were anaemic, with a total number of 0.79% in first trimester, 18.89% in second trimester and 19.69% in third trimester. This result is in support with the data obtained from previous studies in developing countries showing a range from 35.5% to 75.0% (Omigbodum, 2004) . The prevalence of anaemia in this study based on haemoglobin level (39.4%) is within the range with the findings of other studies carried out in Nigeria, (Mcmahon, 2013) , (40.2%); (Anorlu et al., 2006) (35.3%); and (Baker & Greer, 2010) (51.8%). The 39.4% value from this study is however lower than 64.1% reported by (Ezugwu et al., 2013) in Enugu state. This could be as a result of educational and economic status of the subjects. However, the prevalence of 39.4% is higher than the 10.4% value obtained at Ibadan in south-West Nigeria (Pasricha et al., 2010) and 21.6% obtained by (Alem et al., 2013) in Northwest Ethiopia. This may be due to the differences in feeding habits, routine drug intake or some other factors not considered in their research.

The prevalence of anaemia using ferritin concentration alone from this study shows that 27.6% of the subjects were anaemic. This is based on ferritin concentration below 15µg/l, with 3.94% in first trimester, 11.8% in second trimester and 11.8% in third trimester. Late antenatal booking may have contributed to a rise in prevalence, since most of the subjects in this study started their antenatal booking during the second and third trimester (Owolabi & Olalorun, 2014).

The result of effect of haemoglobin on gestational age (Trimester) from this study shows higher value (11.60±1.86) in the first trimester when compared to the second trimester (11.03±1.56) and the third (11.06±1.64) trimester. This result is in accordance with (Kumar et al., 2013) and (Goswani et al., 2014) , which reported that increase in gestational age does not affect haemoglobin concentration. Also, (Hogue, 2006) reported that the prevalence of anaemia among pregnant women of in Bida, Niger State based on haemoglobin level shows no difference when compared with other trimesters. This could be as a result of greater expansion of plasma volume with increase in red blood cell volume (Perez et al., 2005). Plasma volume expands nearly 50% and consequently haemoglobin level decreases. However, ferritin level in second trimester was higher when compared to first and third trimester respectively According to (Bencaiova & Breymann, 2014). serum ferritin concentration is maximum in second trimester and then falls with advance gestational age in third trimester. This could be as a result of iron supplement consumption by the subject in second trimester since they normally start their prenatal care in second trimester. By third trimester, the iron demand by the foetus increases leading to a general decline in ferritin levels. Gestational age when correlated with haemoglobin and ferritin concentration shows a negative correlation ($p > 0.05$). This implies that as gestational age of the subject increases, there was a decrease in maternal haemoglobin and ferritin concentration. This result agrees with the report of (Demmouche et al., 2011) and (Nik et al., 2012) .

The result of the effect of age on this study shows a slightly levels of haemoglobin concentration among subjects within the age of 20 – 24 years and 25 – 29 years but lower levels among subjects within the age of 30 -34 years and 45 – 49 years. This is to say that haemoglobin level decreases as age increases. This could be as a result of the physiological function of the cells (Finberg, 2011) . This result agrees with the findings reported by (Marieb & Hoehn, 2013) and (Galti et al., 2012) in Ethiopia. However, ferritin concentration increased among subjects within the age of 25 – 29 years and 35 – 39 years but decreased among subjects within the age of 40 – 44 years and 45 – 49 years. An increase in ferritin concentration among the subject could be as a result of high intake of food that contain iron while a decrease in ferritin concentration among the subject could also be as a result of inability of the subject to absorb iron (Sharp & Sari, 2007). This agrees with the report of (Kozuki et al., 2012) .The result of correlation analysis on the effect of age on haemoglobin concentration shows a negative correlation but positively correlated with ferritin concentration. This means that as the age of the subjects was increasing, their haemoglobin level was decreasing. This decrease was statistically significant ($p < 0.05$). However,ferritin concentration of the subject was increasing with an increase in age, although not significant ($p > 0.05$). this result is in accordance with the results of previous study done by (Sanku et al ., 2014).

Report from most developing countries shows that iron supplement intake during the time of pregnancy has limited effectiveness. This could be as a result of poor adherence, infection, inefficient health care systems and

high rate of pre-existing anaemia (Alizadeh et al, 2014). Prevalence of anaemia among pregnant women in this study is high despite the fact that they received an average intake of routine drug. This finding is similar to that of Alizadeh et al., 2014) and (Hemmininki & Rimpela, 1991). The result of haemoglobin concentration of the subject who had the routine drug in this study shows a slight difference on intake of routine drug among pregnant women when compared to those that did not. Although there was a decrease in ferritin concentration of those that took the routine drug while there was an increase in ferritin concentration of those that are not regularly taking the routine drug. This could be that the subjects are already iron deficient before taking the routine drug. This result is in accordance with results as reported by (Mcmahon, 2013) which said that the level of serum ferritin falls early in the development of iron deficiency and it is not affected by recent iron ingestion while an increase in the ferritin level of those that are not taking the routine drug could be as a result of the subjects taking other supplement apart from the one issued to them, although this result varies with the previous report of (Arise, 2017). Intake of routine drug when correlate with haemoglobin concentration shows a negative correlation at ($p>0.05$) but when correlate with ferritin concentration shows a positive correlation at ($p>0.05$). This implies that increase in intake of routine drug seems to reduce the haemoglobin level but increase ferritin level among the subjects.

5. Conclusion

The study reveals that anaemia during pregnancy is highly prevalent. More than halve of the subjects were anaemic in both first, second and third trimester. This implies that children born by anaemic mothers stand the risk of being anaemic especially during exclusive breast feeding. Report obtained from previous studies have shown that iron reserve received by children as foetus during pregnancy runs out within 4 to 6 months after child birth thereby exposing infants to the risk of anaemia. Hence, public awareness campaign is recommended to create awareness on the need for early antenatal booking to provide opportunity for early detection and treatment of anaemia. There is a need to educate and implement strategies that will improve iron status of pregnant women. This will lead to sufficient placenta iron transfer to the unborn child.

Authors' Contribution

KCU and PNO conceived the idea of this research and produced the experimental design. KCU,PNO,DOA, IEU and KLE conducted the experiment. KLE and IEU ran statistical analysis. All the authors read the work and participated in editing and reviewing it.

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Conflict of Interest

We declare that there was no conflict of interest

References

Elzahrani, S.S. (2012) . Prevalence of Iron Deficiency Anaemia among Pregnant Women Attending Antenatal Clinics at Al-Hada Hospital. Journal of Medical Nutrition, 3 (1):10 – 14.

WHO (2006) . Haemoglobin concentration for the diagnosis of anaemia and assessment severity.Vitamin and mineral nutrition information system: Geneva, World Health Organization. http//www.who.int/vmins/indicators/haemoglobin.

Milman, N. (2006) . Iron supplementation during pregnancy, Effect on iron status markers, serumerythropoietin and human placental lactogen. A placebo controlled study in 207 Danish women. Danish Medical Bulletin, 38: 471– 476.

Sachan, B., Idris, M. & Singh, A. (2013) . Effect of socio – demographic characteristic on the prevalence of anaemia among school going adolescent girls in Lucknow district, India.South East Asia Journal of Public Health, 2 (1): 8 – 12.

Vasudevan, D.M., Sreekumari,S. & Kanna, V.(2011) Biochemistry for medical students.

6th edition. Jaypee Brothers' Medical Publishers. Pp 422 – 630.

J.Ochei, J. & Kolhatkar, A. (2008). Medical Laboratory Science Theory and Practice. McGraw Hill, New York. Pp. 663-665.

Addison, G.M., Beamish, M.R.., Hales, C.N., Hodgkins, M., Jacobs, A. & Llewellin,P.(1972). An immunoradiometric assay for ferritin in the serum of normal subjects And patients with iron deficiency and iron overload. Journal of Clinical Pathology 25:326-329.

Rodger,M., Sheppard, D , Gandara, E. & Tinmouth, A (2015) . Haematological problems in obstetrics. Best Research Clinical Obstetrics and Gynaecology. 29 (5): 671 – 684.

Omigbodum, A.O. (2004). Recent trends in the management of anaemia in pregnancy. Tropical Journal of Obstetrics and Gynecology, 21 (1): 1 – 3.

Mcmahon, L.P. (2013) . Iron deficiency in pregnancy. Obstetrics Medicine. 3 (1): 17 – 24, 2013

Anorlu,R.I., Odum,C.U., & Essien, EE. (2006) . Asymptomatic malaria parasitemia in pregnant women at booking in a primary health care facility in a periurban community in Lagos, Nigeria. African Journal of Medical Science, 1: 39 – 41.

Baker,R.D., & F.R. Greer,F.R.(2010) . Diagnosis and prevention of iron deficiency and iron deficiency anaemia in infants and young children (0 – 3 years). Pediatrics. 126: 1040 – 1050.

Ezugwu, E.C., Mbah, B.O., Chigbu,C.O. & Onah, H.E. (2013) . Anaemia in the united states. Pediatric health problem in Enugu, South East Nigeria. Journal of Obstetrics and Gynecology, 3: 451 – 454.

Pasricha, S.R., Flecknoe-Brown, S.C., Allen, K.J., Gibson,P.R., McMahon, L.P., Olynyk,J.K., Roger, S.D., Savoia,H.F., Tampi, N.R. & Thomson, A.R.(2010) . Diagnosis and management of iron deficiency anaemia: a clinical update. Medical Journal,193: 525 -532.

Alem, M., Enonogew,B., Gelaw,A., Keilaw,T., Seid,M. & .Olkeba,J.Y.(2013) Prevalence of anaemia and associated risk factors among pregnant women attending antenatal care atAzezo Health center Gondar Town, North West Ethiopian. Journal of Interdiscioline Histocompathology, 1:137 – 144.

Owolabi,M.O. & D.A. Olalorum, D.A.(2014). Socio – demographic factor of anaemia in pregnancy in south western Nigeria. South African family practice. 54: 222 – 227.

Kumar,K.J., Asha, N., Murthy,D.S., Sujatha,M. & Manjunath, V. (2013). Maternal anaemia in various trimester and its effect on new-born weight and maturity: an observational study. International Journal of Preventive Medicine, 4 (2): 193 – 198.

Goswami,T.M., Patel,V.N., Pandya,N.H., Mevada,A.K., Desai,K.S. & Solanki, K.B. (2014) Maternal anaemia during pregnancy and its impact on perinatal outcome. International Journal of Biomedical and Advance Research,5 (2): 99 – 102.

Hogue, M. (2006). Prevalence of anaemia in pregnancy at Greentown South Africa, Tropical Journal of Obstetrics and Gynaecology, 23 (1):3-7.

Perez,E.M., Hendrick,M.K., Beard,J.L., Murrary – Kolb, L.E., Berg,A., Tomlinson,M., Irlam, J., Isaacs,W., Njengele,T. & Sive, A. (2005) Mother – infant interactions and infant development are altered by maternal iron deficiency anaemia. Journal of Nutrition, 135: 850 – 855.

Bencaiova,G. & Breymann, C. (2014). Mild anaemia and pregnancy outcome in a swiss collective. Journal of Pregnancy, 67 (4): 337 – 342.changes in haematological parameter during pregnancy. Indian Journal of Haematology and Blood Transfusion, 28 (3): 144 – 146.

Demmouche, A. , Khelil, A & Moulessehoul, S.(2011) . Anaemia among pregnant women in Sidi Bel Abbes Region West Alegra: epidemiology study. Journal of Blood Disorders and Transfusion, 2(3): 1 – 6.

Nik,R.N., Mohed, N.S, & Ismail, I.M. (2012) . The rate and risk factors for anaemia among pregnant mothers in Jerten Terenggance Malaysia. Journal of Community Medicine and Health Education, 2(150):2167 – 2711.

Finberg, K.E. (2011). Unravelling mechanism regulating systematic iron homeostasis. American Society of Haematology. 1: 532 – 537.

Marieb, E.N. & K. Hoehn, K. (2013). Effect of pregnancy on the mother. In: human anatomy and physiology. 9th edition. Pearson Education: New York, 28: 1082 – 1083.

Galti,M.G., Becuuci ,E., Fargnoli,F., Fagioli, M., Aden, U., & Buonocore, G (2012). .Functional maturation of neocortex:a base of viability. The Journal of Maternal – Fetal and Neonatal Medicine, 25 (51): 101 – 103.

Sharp, P. & Sari, S.K.(207) .Molecular mechanism involve in intestinal iron adsorption.World Journal of Gastroenterology, 13: 4716 – 4724.

Kozuki, N., Lee, A.C., & Katz, J. (2012). Moderate to severe, but not mild, maternal anaemia is associated with increased risk for gestational age outcomes. The Journal of Nutrition, 142 (2): 358 – 362.

Sanku, D., Sankar, G., & Madhuchhand, G. (2010) . Prevalence of anaemia in women ofreproductive age in Meghalaya: a logistic regression analysis. Turkish Journal of Medical Science, 40 (5): 783 – 789.

Alizadeh, L A., Rgoof,A., Salehi, L. & Ramzi, M.(2014) Impact of maternal haemoglobin concentration on fetal outcome in adolescent pregnant women. Iranian Red Crescent Medical Journal, 16 (8): 190 – 196.

Hemmininki, E. & Rimpela, U, (1991) A randomized comparism of routine verses selective supplementation during pregnancy. Journal of American Collection of Nutrition, 10: 3 – 10.

Arise, F. (2017). Prevalence of anaemia and its associated factors among pregnant women receiving antenatal care. Journal of Blood Medicine, 8: 35 – 138.