



## **Serum Ferritin Level In Women Attending Antenatal Care In University Of Port Harcourt Teaching Hospital, Port Harcourt**

<sup>1</sup>Dr. ALUKO, Joel Ojo, <sup>2</sup>AYOADE, Titilayo Ruth & <sup>3</sup>OKONKWO, Blessing Udoka

<sup>1</sup>Department of Nursing Sciences,  
Faculty of Clinical Sciences  
University of Ilorin, Ilorin, Nigeria

<sup>2&3</sup>Department of Midwifery  
Faculty of Public Health and Toxicological Research

<sup>2</sup>Email: [titijohnson2007@gmail.com](mailto:titijohnson2007@gmail.com)

### **ABSTRACT**

The study investigated serum ferritin levels in women attending antenatal care in the university of Port Harcourt teaching hospital, Rivers State. A cross-sectional descriptive survey design was adopted for the study. Four research questions and a hypotheses were answered and tested respectively. The population of the study comprised 2500 pregnant women from which 394 was selected as sample for the study through stratified random sampling technique and determined using Fischer's sample size determination. The study adopted standardized instruments for the laboratory assay and a questionnaire was adopted as the instrument for data collection. Face and content validities were ensured by experts including the researcher's supervisors. The reliability coefficient of the instrument was calculated to be 0.77 through the use of Pearson Product Moment Correlation coefficient. The research questions were answered using mean and standard deviation. While the null hypotheses was tested using inferential statistics at 0.05 alpha level. Findings revealed an average of 11.96 per cent of the pregnant women had less than 20 micrograms per litre of serum ferritin level while 10.87 per cent had between 20 and 40 micrograms per litre of serum ferritin level. Based on the findings, the following was recommended among others that community health workers and/or midwives should be mobilized to sensitize all women and young girls on ferritin level and the need to carry out regular ferritin level check.

**Keywords:** Serum Ferritin Level, Antenatal Care, Trimester

### **INTRODUCTION**

Conventionally, a lot of emphasis has been placed by all and sundry on the need for proper management in all areas and facets of life which involves having a reserve of everything useful so as to successfully address any form of exigencies or necessities. This is also true when it comes to the workings of the physical body system during pregnancy. As the fetus develop, the need for the mother to dispense more energy and have more reserved energy comes into play. While at the same time, the need for the fetus to keep exhibiting signs of healthiness is in no doubt, vital to the mother and the maternal healthcare providers. All of these needs come with the adequate ferritin of blood plasma rich in iron that contains ferric hydroxide phosphate complexes to areas of need in the body. Definitely, blood will be present as long as the pregnant woman is alive, however, the quality of the blood cell determined by the availability of ferric hydroxide phosphate complexes is always not certain because iron is the real power being discharged by the blood cell and the real essence of blood flow and circulation to all part of body and

across the body system of the pregnant woman and it all falls back at how much of this iron is/are available within the ferritin (Milman *et al.*, 2017)

Just as the mitochondria is the power house of the cells, so also is the ferritin the power house of iron. While the ferritin usually lives in the body's cells to house iron, releasing it when the body needs it. The iron itself is an essential element for almost all living organisms including the pregnant woman and the fetus. This is premised on the fact that iron participates in a wide variety of metabolic processes, including oxygen transport, deoxyribonucleic acid (DNA) synthesis, as well as electron transport. This implies that there is a seemingly impressive relationship between ferritin levels and the health status of pregnant women. In the sense that, the amount of red blood cells that can be found in the body is determined by the extent of the ferritin in the body cells. Just as any matter is only limited to the available space. So, for instance, when there is deficiency of hemoglobin, it is needless taking iron alone to the cleaners, ferritin level also to an extent, will be culpable. Thus, it should be understood that ferritin level is the determinant of the capacity of protein in the body of a pregnant woman because ferritin functions to keep protein in a soluble and non-toxic form (Gebremichael *et al.*, 2014).

Furthermore, ferritin is found in most tissues as a cytosolic protein, but small amounts are secreted into the serum where it functions as an iron carrier. Approximately 75 per cent of a pregnant woman body's iron is absorbed by hemoglobin of red blood cells and in muscle cells such as myoglobin as well as some enzymes while about 25 per cent is stored in the ferritin (University of California San Francisco (UCSF), 2020; Abbaspour *et al.*, 2014).

Additionally, the hemoglobin requires iron so as to convey oxygen from the lungs to the body's tissues and returns carbon dioxide from the tissues back to the lungs. Hemoglobin is made up of four protein molecules (globulin chains) that are connected together. The normal adult hemoglobin (abbreviated Hgb or Hb) molecule contains two alpha-globulin chains and two beta-globulin chains. In fetuses, beta chains are not common and the hemoglobin molecule is made up of two alpha chains and two gamma chains. As the fetus grows, the gamma chains are gradually replaced by beta chains, forming the adult hemoglobin structure. Each globulin chain contains an important protein-containing porphyrin compound termed heme. Embedded within the heme compound is an iron atom that is vital in transporting oxygen and carbon dioxide in the blood of the pregnant woman (Kadry *et al.*, 2018).

Notably, the availability of sufficient oxygen in hemoglobin is also responsible for the reddish appearance of the blood. Although oxygen dissolves in blood, only 1.5 percent of oxygen in the blood is dissolved directly into the blood itself. Most of the oxygen—98.5 percent—is bound to a protein called hemoglobin and carried to the tissues. Molecules with more oxygen bound to the heme groups are brighter red. As a result, oxygenated arterial blood where the Hb is carrying four oxygen molecules is bright red, while venous blood that is deoxygenated is darker red. As a result, hemoglobin is critical to the assessment of ferritin level in the body of pregnant women because it plays an important role in maintaining the shape of the red blood cells. In their natural shape, red blood cells are round with narrow centers resembling a donut without a hole in the middle. Hence, poorly protein-saturated hemoglobin is referred to as abnormal hemoglobin and abnormal hemoglobin structure can, therefore, disrupt the shape of red blood cells and impede their function and flow through blood vessels. While muscle cells such as myoglobin as mentioned earlier is distantly related to hemoglobin as it facilitates oxygen diffusion (Loy *et al.*, 2019).

More so, myoglobin increased oxygen diffusion gradient from the capillaries to the cytoplasm. It has also been shown to have enzymatic functions. So, myoglobin is necessary for the decomposition of bioactive nitric oxide to nitrate. Owing to the fact that nitric oxide is an epigenetic molecule, the decomposition of bioactive nitric oxide to nitrate is essential in the body of a pregnant woman in order to regulate fetoplacental vascular permeability and resistance and platelet aggregation in the placenta (Januar *et al.*, 2015; Joo *et al.*, 2013).

Therefore, with the interplay of hemoglobin and myoglobin in ferritin functioning, serum ferritin levels among pregnant women can either be high moderate or low (Souza *et al.*, 2016; Adediran *et al.*, 2011). The expected serum ferritin levels' range for pregnant women that could indicate a proper body functioning is 11 to 307 micrograms per liter of ferritin blood test. In order words, any outcome below

this range can be referred to as low ferritin level while any outcome above this range could be referred to as elevated or high ferritin level (Nazario, 2020). As a result, any affected pregnant woman with low or elevated ferritin level may be at risk of: fatigue, poor cognitive skills, dizziness, headaches, restless legs syndrome, blood transfusion, preterm delivery, cesarean delivery and/or low birth weight baby. Thus, there are everyday factors that could be responsible for the different levels of ferritin among pregnant women as documented in medical and allied literature, such as: pregnancy trimester, nutrition related characteristics, parasitosis status, occupational status, pre-pregnancy or preconception menstrual flow, birth interval, body mass index (BMI) and literacy (Sholeye *et al.*, 2017).

A good number of these factors were considered as the variables of this study. It has been observed that not all pregnant women have the same serum ferritin level blood test outcome as a result of trimester age. Serum ferritin levels in the first trimester often differ in outcome among pregnant women as well as the serum ferritin levels in the second and third trimesters. In nutrition related characteristics, this is an aspect of the eating pattern of pregnant women. Pregnant women who engage in the right eating or dietary pattern will absorb the right quantity of nutrient that will take care of an aspect of low or elevated ferritin levels. Parasitosis is the presence of parasitic disease and has been discovered as one of the causes of shortage in red blood cells. This type of disease is caused by human parasite. Occupational status is another factor. Pregnant women who are engaged in occupations that saps their energy beyond what is reasonable may be prone to elevated or low ferritin levels. It is also fundamental to know that pregnant women who experienced heavy menstrual flow prior to conception are also susceptible to low ferritin levels. Studies have also revealed that women with short birth intervals are at risk of low ferritin levels.

Be that as it may, as much as likely reasons for serum ferritin levels have been highlighted, understanding the likely severity of low and elevated serum ferritin levels in pregnant women is much more pertinent to this study. This understanding will help to fully define the current status of ferritin levels among our women and provide the basis for possible remedy in the case of low or elevated ferritin levels. To ensure this, the study will prioritize the examination of serum ferritin levels among pregnant women with respect to each trimester. Also, the effect of socio-demographical characteristics and eating pattern were considered for assessment in ascertaining ferritin levels in women attending care in the university of Port Harcourt teaching hospital, Rivers State. Nevertheless, to the best of the researcher's knowledge, in recent time, no study in this direction has been conducted among pregnant women attending care in hospitals in Port Harcourt. This is the crux of this study.

### **Statement of the Problem**

Low or elevated ferritin levels, although can be found in every other person, but it has been observed in several studies to be prevalent among pregnant women. Also, its cause among pregnant women has been underscored as poor health care. However, low and elevated ferritin levels have been linked to multifactorial tendencies leading to its emergence among pregnant women. Such multifactorial tendencies range from socioeconomic factors to personal lifestyle.

What therefore motivated the researcher to embark on this study is that, the life of every pregnant woman means a lot to national development and Nigeria is one of the sub-Saharan African countries marked as epicenter of low and abnormal ferritin levels among pregnant women. Discovering the status of ferritin levels among our women can serve as one of the way-outs in identifying the right solutions in putting an end to this chagrin. Put simply, the researcher wants to ascertain ferritin levels among pregnant women attending antenatal care in the university of Port Harcourt teaching hospital, Rivers State.

### **Aim and Objectives of the Study**

This study is aimed at investigating ferritin levels in women attending antenatal care in the university of Port Harcourt teaching hospital, Rivers State.

The objectives are to:

1. assess the proportion of serum ferritin levels during the first, second and third trimester of pregnancy in women attending antenatal care in university of Port Harcourt teaching hospital;
2. find out the proportion of women attending antenatal care in university of Port Harcourt teaching hospital with adequate serum ferritin level;

3. determine the effect of socio-demographical characteristics of pregnant women attending antenatal care in university of Port Harcourt teaching hospital on their serum ferritin level; and,
4. ascertain the dietary practice of the pregnant women attending antenatal care in university of Port Harcourt teaching hospital in relation to their serum ferritin level.

### **Research Questions**

The following research questions guided the study.

1. What is the proportion of serum ferritin levels during the first, second and third trimester of pregnancy among pregnant women attending antenatal care in university of Port Harcourt teaching hospital?
2. What is the proportion of women attending antenatal care in university of Port Harcourt teaching hospital with adequate serum ferritin level?
3. What is the effect of socio-demographical characteristics of pregnant women attending antenatal care in university of Port Harcourt teaching hospital on their serum ferritin level?
4. What is the dietary practice of pregnant women attending antenatal care in university of Port Harcourt teaching hospital on their serum ferritin level?

### **Hypothesis**

The under listed null hypothesis guided the study and tested at 0.05 level of significance.

- There is no significant difference in the proportion of serum ferritin levels during the first, second and third trimester of pregnancy among pregnant women attending antenatal care in university of Port Harcourt teaching hospital with respect to socio-demographical characteristics.

### **METHODOLOGY**

This study adopted a cross-sectional descriptive survey design with laboratory testing. The study was carried out in University of Port Harcourt Teaching Hospital (UPTH), currently situated at Alakahia, Port Harcourt, PMB 6173, Rivers State, Nigeria. UPTH is a host to an estimated population of 300 midwives with cutting-edge maternal health facilities catering for an estimate of 2500 women of childbearing age annually. The sample size of 394 was selected from the total population of 2186, using Fischer's sample size determination formulae. The self-structured pre-tested English language interviewer-administered questionnaire titled, "Serum Ferritin Levels in Women Attending Antenatal Care Questionnaire" (SFLWACQ) was used alongside standardized instruments such as Calbiotech Ferritin Eliza Kit. (Calbiotech, Netherland), EDTA Bottles, Plain Sample bottles, Precision Pipette, Absorbance Paper, Graph paper, Laboratory Centrifuge (Universal 320, Hettich Germany), Refrigerator, Eliza Reader. The SFLWACQ is sub-divided into two sections—A and B. Section A comprised the demographic data such as age, parity, trimester, educational level and occupation, while the section B is further sub-divided into 2 segments to wit: 1. Socio-demographical factors for ferritin levels. 2. Dietary practice in relation to ferritin level. The researcher worked hand in hand with her supervisor, the antenatal facility coordinator and laboratory scientist in the process of data collection. Subsequently, peripheral blood samples of 5ml were collected to determine the proportion of serum ferritin levels at the first, second and third trimesters respectively. The 2ml of blood samples were collected into the EDTA Samples bottles from 248 respondents who gave their consent and return the filled copies of the questionnaire. The serum ferritin level assay was stored in the plain bottles at ~20°C prior to analysis after centrifugation. The ferritin assay was done at university of Port Harcourt Teaching Hospital's laboratory. This process took four weeks for completion. However, there was a high rate of attrition among the pregnant women owing to reasons such as superstitious belief among the women, fear of the shortage of blood and need to seek husband or partner's consent before granting permission to take their blood sample. Thus, those who gave their full consent were 248 indicating 62.94% rate. All the instruments were validated by the researcher's supervisor, and other experts in School of Public Health and Toxicological Research, Africa Centre of Excellence, University of Port Harcourt. The test-retest reliability method was employed to determine the reliability of the instruments and a reliability index 0.77 was obtained. Measures of central tendency

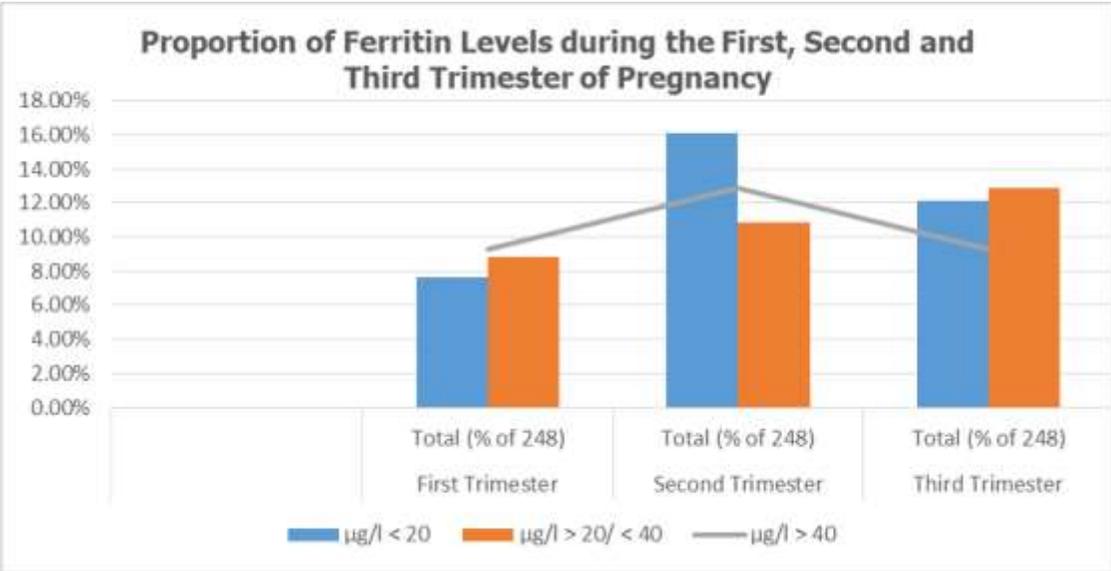
statistics (mean), simple percentage and charts was used to answer the research questions while inferential statistics was used to answer the null hypothesis 0.05 level of significance.

## RESULTS

**Research Question 1:** *What is the proportion of serum ferritin levels during the first, second and third trimester of pregnancy among pregnant women attending care in university of Port Harcourt teaching hospital?*

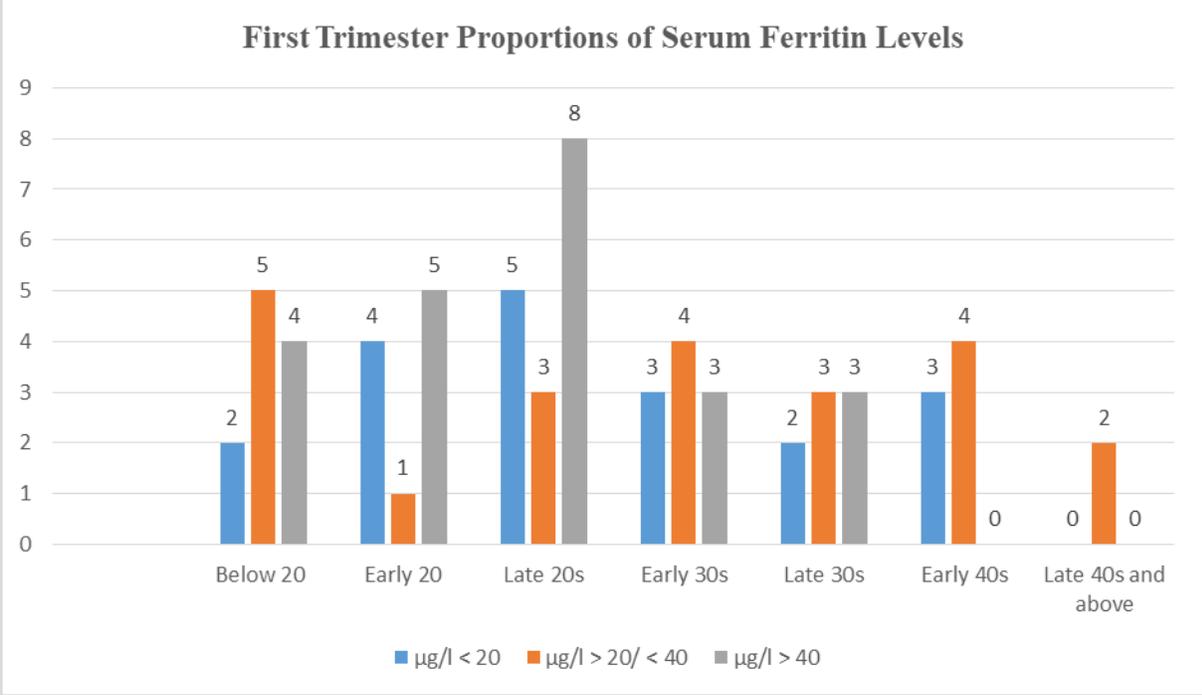
**Table 1: Frequency and simple percentage on the proportion of serum ferritin levels during the first, second and third trimester of pregnancy among pregnant women attending care in university of Port Harcourt teaching hospital.**

Variable	Value labels (Years of Age)	µg/l < 20	µg/l > 20/ < 40	µg/l > 40
<b>First Trimester</b>	Below 20	2	5	4
	Early 20	4	1	5
	Late 20s	5	3	8
	Early 30s	3	4	3
	Late 30s	2	3	3
	Early 40s	3	4	---
	Late 40s and above	---	2	---
	<b>Total (% of 248)</b>	<b>19 (7.66%)</b>	<b>22 (8.87%)</b>	<b>23 (9.27%)</b>
<b>Second Trimester</b>	Below 20	6	4	5
	Early 20	5	9	6
	Late 20s	6	3	8
	Early 30s	8	7	6
	Late 30s	6	4	4
	Early 40s	7	--	3
	Late 40s and above	2	--	---
	<b>Total (% of 248)</b>	<b>40 (16.13%)</b>	<b>27 (10.89%)</b>	<b>32 (12.90%)</b>
<b>Third Trimester</b>	Below 20	4	3	4
	Early 20	5	4	5
	Late 20s	6	7	4
	Early 30s	4	5	-
	Late 30s	5	6	5
	Early 40s	3	4	3
	Late 40s and above	3	3	2
	<b>Total (% of 248)</b>	<b>30 (12.10%)</b>	<b>32 (12.90%)</b>	<b>23 (9.27%)</b>



**Figure 1: Bar chart on respondents’ proportion of serum ferritin levels during the first, second and third trimesters of pregnancy represented in percentages.**

Results in Table 1 indicated that out of a total of 248 peripheral blood sampling, 19, 22 and 23 pregnant women in their first trimester had proportions of serum ferritin levels of: less than 20; between 20 and 40; as well as above 40 respectively. Pregnant women between the ages of late 20s had highest proportions of serum ferritin levels in their first trimester, as shown in the Table. The proportion of serum ferritin levels during the first trimester of pregnancy among the pregnant women attending care in university of Port Harcourt teaching hospital, as explained, is represented in the figure below:



**Figure 2: Bar chart on respondents’ proportion of serum ferritin levels during the first trimester of pregnancy represented in percentages.**

Furthermore, results in Table 1 indicated that out of a total of 248 peripheral blood sampling -- 40, 27 and 32 pregnant women in their second trimester had proportions of serum ferritin levels of: less than 20; between 20 and 40; as well as above 40 respectively. Pregnant women within the ages of early 30s and late 20s had the highest proportions of serum ferritin levels in their second trimester, as shown in the Table. The proportion of serum ferritin levels during the second trimester of pregnancy among the pregnant women attending care in university of Port Harcourt teaching hospital, as explained, is represented in the figure below:

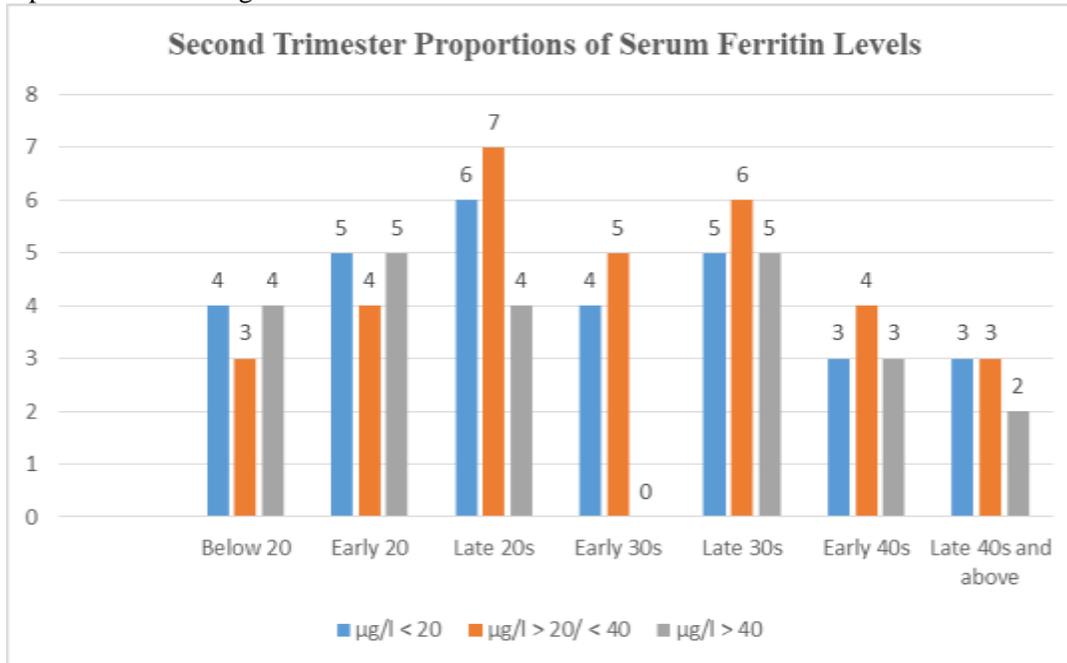


Figure 3: Bar chart on respondents' proportion of serum ferritin levels during the second trimester of pregnancy represented in percentages

More so, results in Table 1 indicated that out of a total of 248 peripheral blood sampling-- 30, 32 and 23 pregnant women in their third trimester had proportions of serum ferritin levels of: less than 20; between 20 and 40; as well as above 40 respectively. Pregnant women within the ages of early 20s and late 30s had the highest proportions of serum ferritin levels in their third trimester, as shown in the Table. The proportion of serum ferritin levels during the third trimester of pregnancy among the pregnant women attending care in university of Port Harcourt teaching hospital, as explained, is represented in the figure below

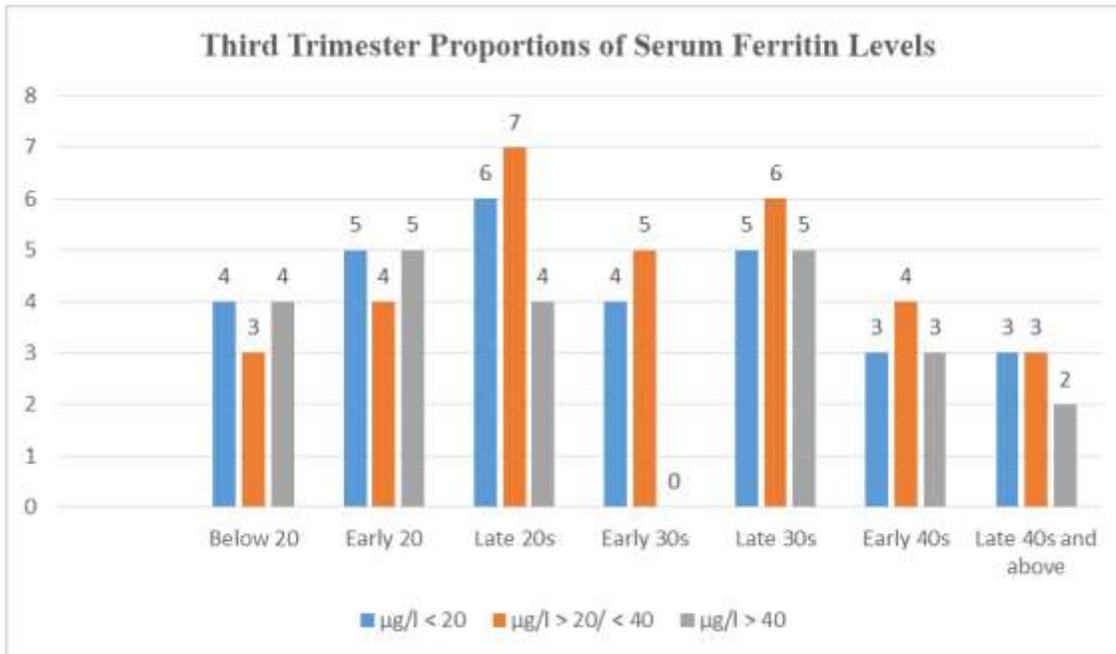
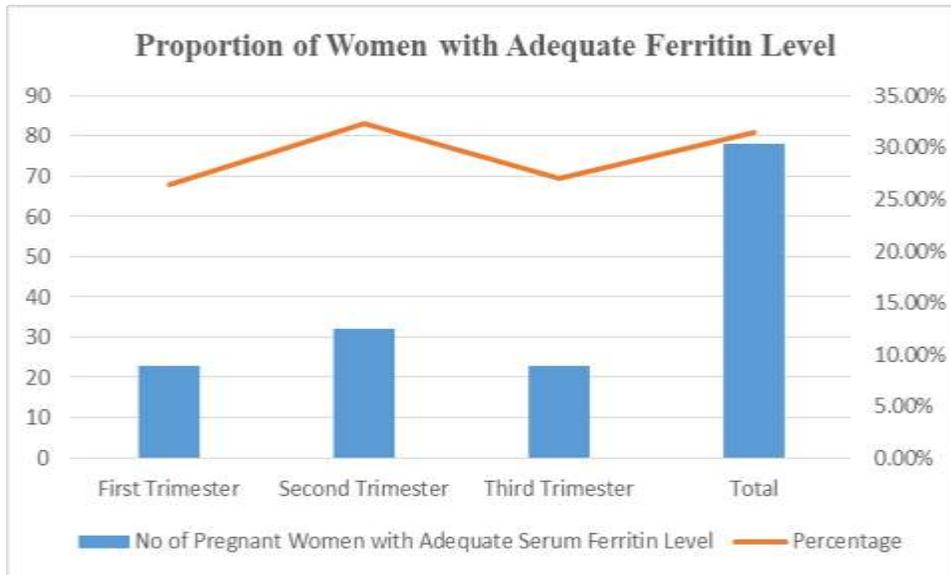


Figure 4: Bar chart on respondents' proportion of ferritin levels during the third trimester of pregnancy represented in percentages

**Research Question 2:** What is the proportion of women attending care in university of Port Harcourt teaching hospital with adequate serum ferritin level?

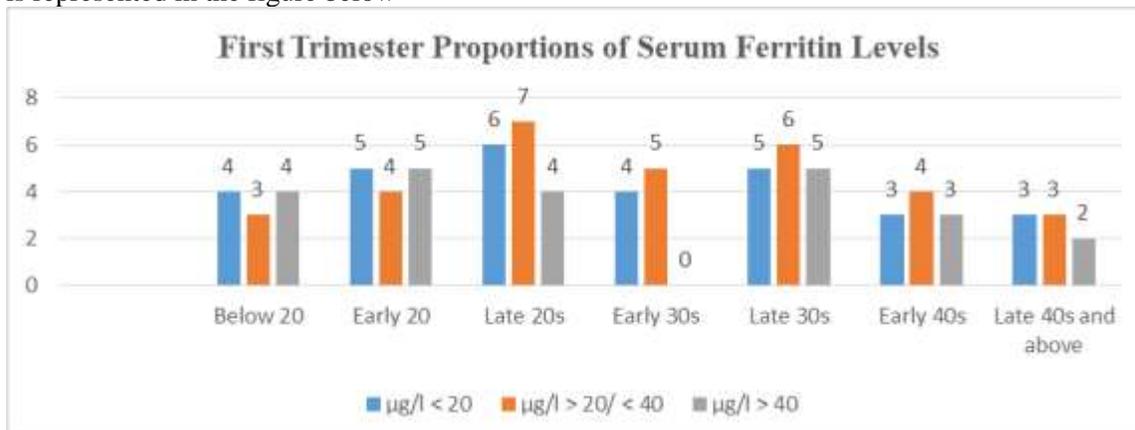
**Table 2:** Frequency and simple percentage on the proportion of women attending care in university of Port Harcourt teaching hospital with adequate serum ferritin level.

Variable	Value labels (Years of Age)	$\mu\text{g/l} < 20$ (Inadequate)	$\mu\text{g/l} > 20 / < 40$ (Borderline)	$\mu\text{g/l} > 40$ (Normal)
<b>First Trimester</b>	Below 20	2	5	4
	Early 20	4	1	5
	Late 20s	5	3	8
	Early 30s	3	4	3
	Late 30s	2	3	3
	Early 40s	3	4	---
	Late 40s and above	---	2	---
	<b>Total (% of 64)</b>	<b>19 (21.84%)</b>	<b>22 (25.29%)</b>	<b>23 (26.45%)</b>
<b>Second Trimester</b>	Below 20	6	4	5
	Early 20	5	9	6
	Late 20s	6	3	8
	Early 30s	8	7	6
	Late 30s	6	4	4
	Early 40s	7	--	3
	Late 40s and above	2	--	---
	<b>Total (% of 99)</b>	<b>40 (40.40%)</b>	<b>27 (27.27%)</b>	<b>32 (32.32%)</b>
<b>Third Trimester</b>	Below 20	4	3	4
	Early 20	5	4	5
	Late 20s	6	7	4
	Early 30s	4	5	-
	Late 30s	5	6	5
	Early 40s	3	4	3
	Late 40s and above	3	3	2
	<b>Total (% of 85)</b>	<b>30 (35.29%)</b>	<b>32 (37.65%)</b>	<b>23 (27.06%)</b>



**Figure 5: Bar chart on respondents' proportion of the total number of pregnant women having adequate serum ferritin levels during the first, second and third trimesters of pregnancy represented in percentages.**

Results in Table 2 showed that out of a total of 87 peripheral blood sampling of respondents in their first trimester-- 19, 22 and 23 pregnant women in their first trimester had proportions of serum ferritin levels of: inadequate, borderline and normal respectively. The implication of this is that only 26.45 per cent of the pregnant women in their first trimester of pregnancy had a proportion of serum ferritin level that can be considered as adequate as shown in the Table. The proportion of women attending care in university of Port Harcourt teaching hospital with adequate serum ferritin level in their first trimester, as explained, is represented in the figure below



**Figure 6: Bar chart on respondents' proportion of pregnant women having inadequate and adequate serum ferritin levels during the first trimester of pregnancy represented in percentages**

Results in Table 2 showed that out of a total of 99 peripheral blood sampling of respondents in their second trimester-- 40, 27 and 32 pregnant women in their second trimester had proportions of serum ferritin levels of: inadequate, borderline and normal respectively. The implication of this is that only 32.32 per cent of the pregnant women in their second trimester of pregnancy had a proportion of serum ferritin level that can be considered as adequate as shown in the Table. The proportion of women attending care in university of Port Harcourt teaching hospital with adequate serum ferritin level in their second trimester, as explained, is represented in the figure below

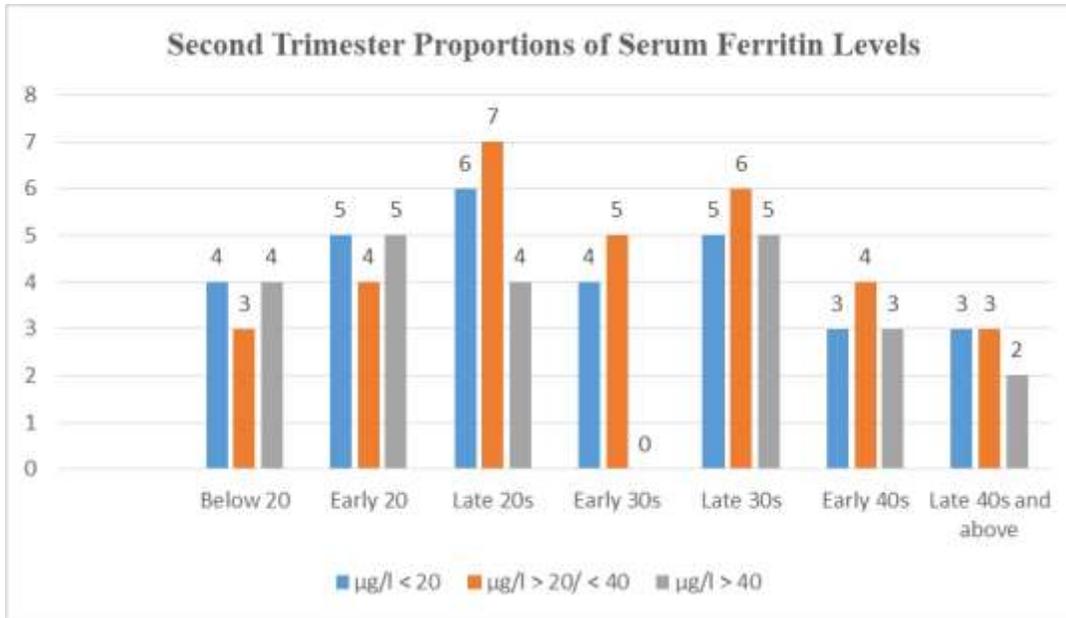


Figure 7: Bar chart on respondents' proportion of pregnant women having inadequate and adequate serum ferritin levels during the second trimester of pregnancy represented in percentages

Results in Table 2 showed that out of a total of 85 peripheral blood sampling of respondents in their third trimester-- 30, 32 and 23 pregnant women in their third trimester had proportions of serum ferritin levels of: inadequate, borderline and normal respectively. The implication of this is that only 27.06 per cent of the pregnant women in their third trimester of pregnancy had a proportion of serum ferritin level that can be considered as adequate as shown in the Table. The proportion of women attending care in university of Port Harcourt teaching hospital with adequate ferritin level in their third trimester as explained is represented in the figure below

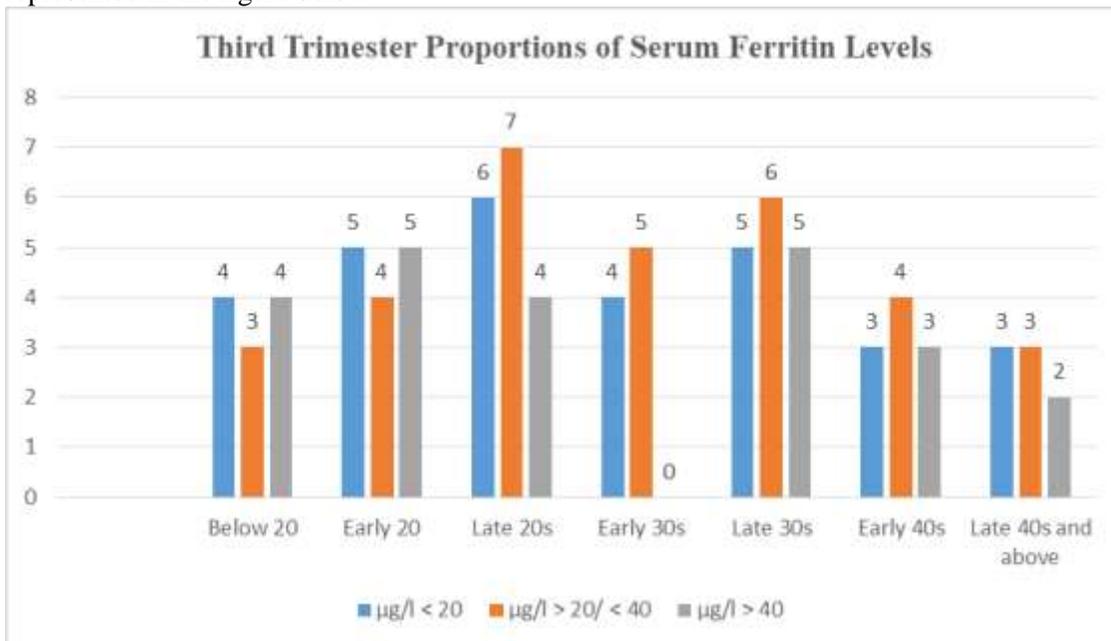


Figure 8: Bar chart on respondents' proportion of pregnant women having inadequate and adequate serum ferritin levels during the third trimester of pregnancy represented in percentages

**Research Question 3:** *What is the effect of socio-demographical characteristics of pregnant women attending care in university of Port Harcourt teaching hospital on their serum ferritin level?*

Table 3: Weighted mean scores and standard deviation on the effect of socio-demographical characteristics of pregnant women (first trimester) attending care in university of Port Harcourt teaching hospital on their serum ferritin level

S/N	Items	$\mu\text{g/l} < 20$ (Inadequate)		$\mu\text{g/l} > 20/ < 40$ (Borderline)		$\mu\text{g/l} > 40$ (Normal)	
		X (1.5)	Sd	X (1.5)	Sd	X (1.5)	Sd
1	Is there flooding where you live?	1.53	1.24	1.51	1.23	1.30	1.14
2	Is there constant electricity where you live?	1.32	1.15	1.43	1.20	1.58	1.26
3	Do you live in a building very close to drainage system.?	1.48	1.22	1.22	1.11	1.07	1.03
4	Is your source of water for everyday activity from well?	1.51	1.23	1.29	1.14	1.07	1.03
5	Is your source of water for everyday activity from borehole?	1.93	1.39	1.72	1.31	1.55	1.25
6	Is your source of water for everyday activity from river?	1.15	1.07	1.05	1.02	0.89	0.94
7	Do you spend most of your weekdays at my place of work?	1.68	1.30	1.66	1.29	1.54	1.24
8	Do you spend most of your weekdays doing house chores?	1.81	1.35	1.65	1.28	1.55	1.25
9	Do you use shared toilet at home?	1.85	1.36	1.73	1.32	1.55	1.25
10	Do you wake up with signs of insect bites where you live?	1.59	1.26	1.68	1.30	1.42	1.19
	<b>Cluster</b>	<b>1.74</b>	<b>1.32</b>	<b>1.49</b>	<b>1.22</b>	<b>1.35</b>	<b>1.16</b>

Results in Table 3 showed the mean and standard deviation statistics on the effect of socio-demographical characteristics of pregnant women attending care in university of Port Harcourt teaching hospital on their serum ferritin levels in first trimester of pregnancy. The mean scores of the respondents showed that they differ in socio-demographical characteristics in their first trimester of pregnancy and as a result, fall into the three different categories of serum ferritin levels proportion of less than 20 which is inadequate serum ferritin levels' proportion; between 20 and 40 serum ferritin which is the borderline serum ferritin levels'

proportion as well as above 40 which is normal serum ferritin levels' proportion. This is shown in the figure below.

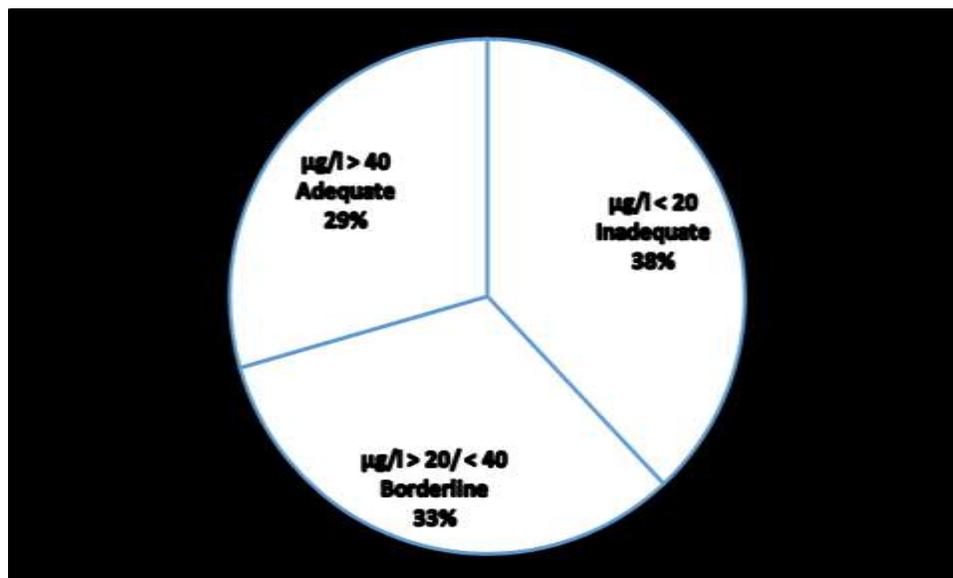


Figure 9: Pie chart on the effect of socio-demographical characteristics of respondents on their serum ferritin levels in first trimester of pregnancy.

Table 4: Weighted mean scores and standard deviation on the effect of socio-demographical characteristics of pregnant women (second trimester) attending care in university of Port Harcourt teaching hospital on their serum ferritin level

S/N	Items	μg/l < 20 (Inadequate)		μg/l > 20 / < 40 (Borderline)		μg/l > 40 (Normal)	
		X (1.5)	Sd	X (1.5)	Sd	X (1.5)	Sd
1	Is there flooding where you live?	1.54	1.24	1.58	1.26	1.24	1.11
2	Is there constant electricity where you live?	1.12	1.06	1.32	1.15	1.38	1.18
3	Do you live in a building very close to drainage system?	1.52	1.23	1.25	1.12	1.20	1.10
4	Is your source of water for everyday activity well?	1.51	1.23	1.39	1.18	1.42	1.19
5	Is your source of water for everyday activity borehole?	1.54	1.24	1.60	1.27	1.53	1.24
6	Is your source of water for everyday activity river?	1.45	1.20	1.23	1.11	1.14	1.07
7	Do you spend most of your weekdays at your place of work?	1.63	1.28	1.59	1.26	1.52	1.23
8	Do you spend most of your weekdays doing house chores?	1.72	1.31	1.68	1.30	1.54	1.24
9	Do you use shared toilet at home?	1.57	1.25	1.60	1.27	1.32	1.15
10	Do wake up with signs of insect bites where you live?	1.64	1.28	1.49	1.22	1.18	1.09
	<b>Cluster Mean and Standard Deviation</b>	<b>1.52</b>	<b>1.23</b>	<b>2.47</b>	<b>1.57</b>	<b>1.35</b>	<b>1.16</b>

Results in Table 4 showed the mean and standard deviation statistics on the effect of socio-demographical characteristics of pregnant women attending care in university of Port Harcourt teaching hospital on their ferritin level in second trimester of pregnancy. The mean scores of the respondents showed that they differ in socio-demographical characteristics in second trimester of pregnancy and as a result, fall into the three different categories of serum ferritin levels proportion of less than 20 which is inadequate serum ferritin levels' proportion; between 20 and 40 serum ferritin which is the borderline serum ferritin levels' proportion as well as above 40 which is normal serum ferritin levels' proportion. This is shown in the figure below

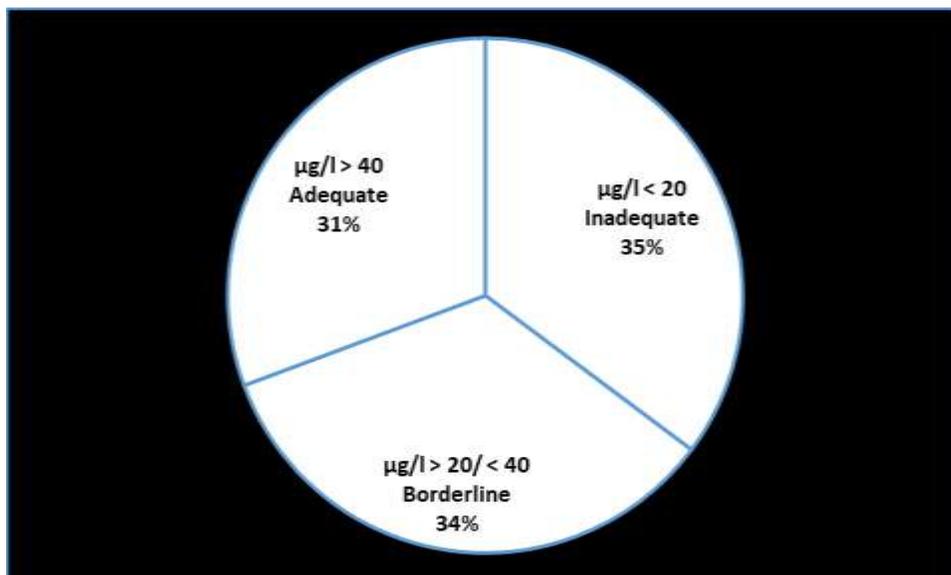


Figure 10: Pie chart on the effect of socio-demographical characteristics of respondents on their serum ferritin levels in second trimester of pregnancy

Table 5: Weighted mean scores and standard deviation on the effect of socio-demographical characteristics of pregnant women (third trimester) attending care in university of Port Harcourt teaching hospital on their serum ferritin level

S/N	Items	μg/l < 20 (Inadequate)		μg/l > 20/ < 40 (Borderline)		μg/l > 40 (Normal)	
		X (1.5)	Sd	X (1.5)	Sd	X (1.5)	Sd
1	Is there flooding where you live?	1.49	1.22	1.53	1.24	1.27	1.13
2	Is there constant electricity where you live?	1.28	1.13	1.44	1.20	1.43	1.20
3	Do you live in a building very close to drainage system?	1.57	1.25	1.38	1.15	1.12	1.06
4	Is your source of water for everyday activity from well?	1.50	1.23	1.24	1.11	1.12	1.06
5	Is your source of water for everyday activities borehole?	1.74	1.32	1.81	1.35	1.55	1.25
6	Is your source of water for everyday activity from river?	1.48	1.22	1.46	1.21	1.12	1.06
7	Do you spend most of your weekdays at your place of work?	1.59	1.26	1.62	1.27	1.37	1.17
8	Do you spent most of your weekdays doing house chores?	1.75	1.32	1.51	1.23	1.37	1.17
9	Do you use shared toilet at home?	1.56	1.25	1.52	1.23	1.48	1.22
10	Do you wake up with signs of insect bites where you live?	1.58	1.26	1.52	1.23	1.22	1.11
	<b>Cluster Mean and Standard Deviation</b>	1.55	1.25	1.50	1.23	1.30	1.14

Results in Table 5 showed the mean and standard deviation statistics on the effect of socio-demographical characteristics of pregnant women attending care in university of Port Harcourt teaching hospital on their serum ferritin level in third trimester of pregnancy. The mean scores of the respondents showed that they differ in socio-demographical characteristics in third trimester of pregnancy and as a result, fall into the three different categories of serum ferritin levels proportion of less than 20 which is inadequate serum ferritin levels' proportion; between 20 and 40 serum ferritin which is the borderline serum ferritin levels' proportion as well as above 40 which is normal serum ferritin levels' proportion. This is shown in the figure below

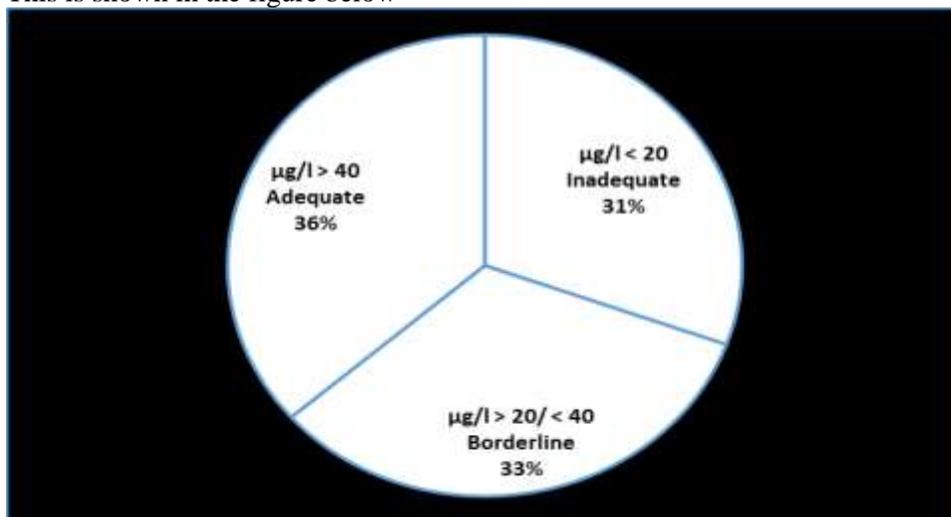


Figure 11: Pie chart on the effect of socio-demographical characteristics of respondents on their serum ferritin levels in third trimester of pregnancy

**Research Question 4:** *What is the effect of dietary practice of pregnant women attending care in university of Port Harcourt teaching hospital in relation to their serum ferritin level?*

Table 6: Weighted mean scores and standard deviation on the effect of dietary practice of the pregnant women (first trimester) attending care in university of Port Harcourt teaching hospital in relation to their serum ferritin level

S/N	Items	μg/l < 20 (Inadequate)		μg/l > 20 / < 40 (Borderline)		μg/l > 40 (Normal)	
		X	Sd	X	Sd	X	Sd
		(2)		(2)		(2)	
1	How often do you eat vegetables?	2.17	1.47	2.23	1.49	2.45	1.57
2	How often do you eat red meat?	2.41	1.55	2.06	1.44	1.43	1.20
3	How often do you drink chocolate tea?	1.84	1.36	1.92	1.39	2.00	1.41
4	How often do you drink green tea?	1.99	1.41	1.85	1.36	2.21	1.49
5	How often do you drink herbal tea?	2.03	1.43	2.00	1.41	1.95	1.40
6	How often do you Eat cheese?	2.01	1.42	2.28	1.51	2.13	1.46
7	How often do you eat fried rice?	2.12	1.46	2.01	1.42	2.00	1.41
8	How often do you eat corn pap?	2.08	1.44	2.09	1.45	2.11	1.45
9	How often do you eat oranges?	1.95	1.40	2.14	1.46	2.38	1.54
10	How often do you eat cucumber?	1.98	1.41	2.08	1.44	2.22	1.49
	<b>Cluster Mean and Standard Deviation</b>	2.06	1.44	2.07	1.44	2.08	1.44

Results in Table 6 showed the mean and standard deviation statistics on the effect of dietary practice of the pregnant women attending care in university of Port Harcourt teaching hospital in relation to their serum ferritin level in first trimester of pregnancy. The mean scores of the respondents showed that they differ in dietary practice in first trimester of pregnancy and as a result, fall into the three different categories of serum ferritin levels proportion of less than 20 which is inadequate serum ferritin levels' proportion; between 20 and 40 serum ferritin which is the borderline serum ferritin levels' proportion as well as above 40 which is normal serum ferritin levels' proportion. This is shown in the figure below

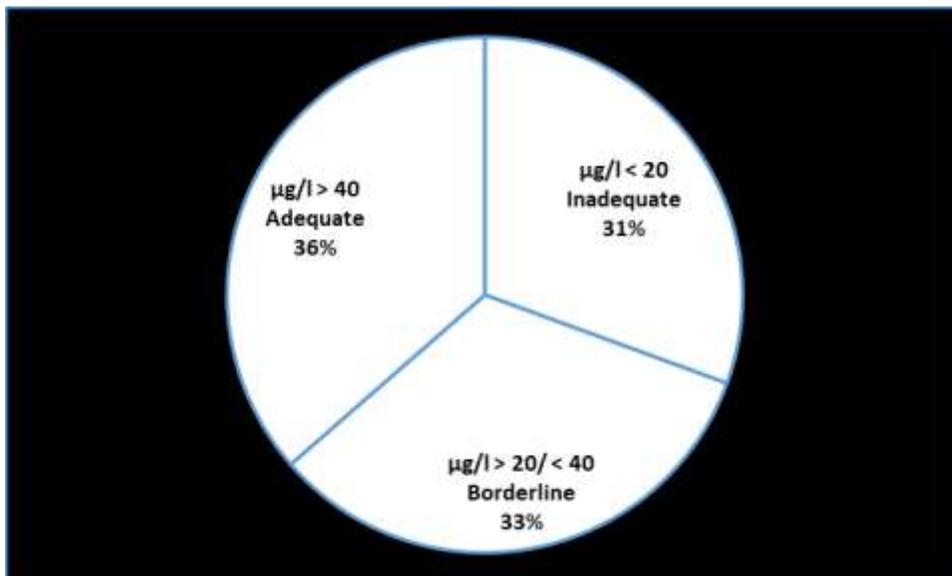


Figure 12: Pie chart on the effect of respondents' dietary practice on their serum ferritin levels in first trimester of pregnancy

Table 7: Weighted mean scores and standard deviation on the effect of dietary practice on the serum ferritin level of pregnant women (second trimester) attending care in university of Port Harcourt teaching hospital

S/N	Items	$\mu\text{g/l} < 20$		$\mu\text{g/l} > 20/ < 40$		$\mu\text{g/l} > 40$	
		<b>(Inadequate)</b>		<b>(Borderline)</b>		<b>(Normal)</b>	
		X	Sd	X	Sd	X	Sd
		(2)		(2)		(2)	
1	How often do you eat vegetables?	2.15	1.47	2.32	1.52	2.88	1.70
2	How often do you eat red meat?	2.52	1.59	1.86	1.36	2.03	1.43
3	How often do you drink chocolate tea?	1.63	1.27	2.03	1.43	2.03	1.43
4	How often do you drink green tea?	1.48	1.22	1.65	1.29	2.33	1.53
5	How often do you drink herbal tea?	1.73	1.32	1.61	1.27	1.47	1.21
6	How often do you eat cheese?	1.41	1.19	2.13	1.46	2.79	1.67
7	How often do you eat fried rice?	1.41	1.19	1.84	1.36	2.05	1.43
8	How often do you eat corn pap?	1.48	1.22	2.03	1.43	2.43	1.56
9	How often do you eat oranges?	1.86	1.36	2.11	1.45	2.96	1.72
10	How often do you eat cucumber?	1.62	1.27	1.99	1.41	2.81	1.68
	<b>Cluster Mean and Standard Deviation</b>	3.73	1.32	1.96	1.40	2.38	1.54

Results in Table 7 showed the mean and standard deviation statistics on the effect of dietary practice on the serum ferritin level of pregnant women (second trimester) attending care in university of Port Harcourt teaching hospital in second trimester of pregnancy. The mean scores of the respondents showed that they differ in dietary practice in second trimester of pregnancy and as a result, fall into the three different categories of serum ferritin levels proportion of less than 20 which is inadequate serum ferritin levels' proportion; between 20 and 40 serum ferritin which is the borderline serum ferritin levels' proportion as well as above 40 which is normal serum ferritin levels' proportion. This is shown in the figure below.

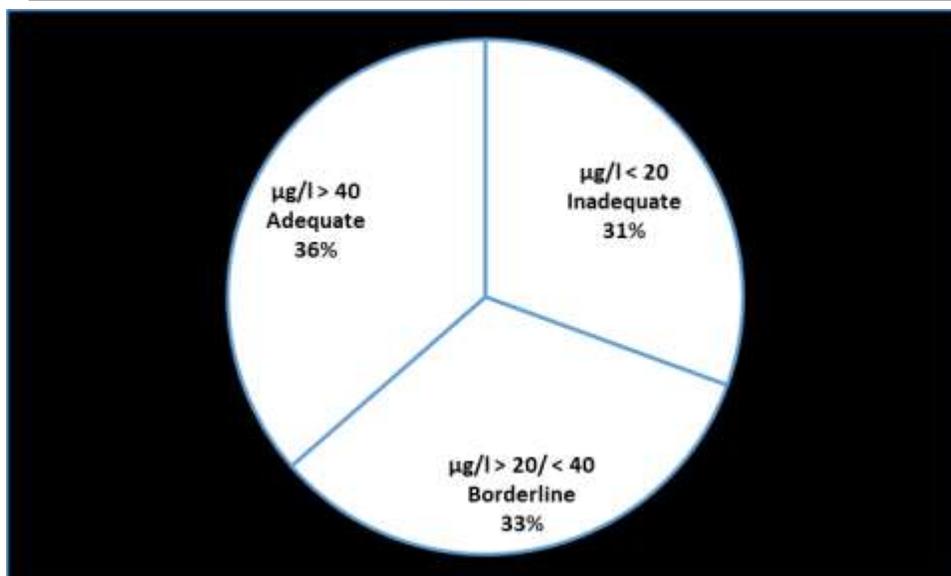


Figure 13: Pie chart on the effect of respondents' dietary practice on their serum ferritin levels in second trimester of pregnancy

Table 8: Weighted mean scores and standard deviation on the effect of dietary practice on the serum ferritin level of pregnant women (third trimester) attending care in university of Port Harcourt teaching hospital

S/N	Items	μg/l < 20 (Inadequate)		μg/l > 20 / < 40 (Borderline)		μg/l > 40 (Normal)	
		X (2)	Sd	X (2)	Sd	X (2)	Sd
1	How often do you eat vegetables?	2.17	1.47	2.23	1.49	2.45	1.57
2	How often do you eat red meat?	2.41	1.55	2.06	1.44	1.43	1.20
3	How often do you drink chocolate tea.?	1.84	1.36	1.92	1.39	2.00	1.41
4	How often do you drink green tea.?	1.99	1.41	1.85	1.36	2.21	1.49
5	How often do you drink herbal tea?	2.03	1.43	2.00	1.41	1.95	1.40
6	How often do you eat cheese?	2.01	1.42	2.28	1.51	2.13	1.46
7	How often do you eat fried rice?	1.41	1.19	1.84	1.36	2.05	1.43
8	How often do you eat corn pap?	1.48	1.22	2.03	1.43	2.43	1.56
9	How often do you eat oranges?	1.86	1.36	2.11	1.45	2.96	1.72
10	How often do you eat cucumber?	1.62	1.27	1.99	1.41	2.81	1.68
<b>Cluster Mean and Standard Deviation</b>		<b>1.88</b>	<b>1.37</b>	<b>2.03</b>	<b>1.43</b>	<b>2.24</b>	<b>1.50</b>

Results in Table 8 showed the mean and standard deviation statistics on the effect of dietary practice on the ferritin level of pregnant women attending care in university of Port Harcourt teaching hospital in third trimester of pregnancy. The mean scores of the respondents showed that they differ in dietary practice in third trimester of pregnancy and as a result, fall into the three different categories of serum ferritin levels proportion of less than 20 which is inadequate serum ferritin levels' proportion; between 20 and 40 serum ferritin which is the borderline serum ferritin levels' proportion as well as above 40 which is normal serum ferritin levels' proportion. This is shown in the figure below

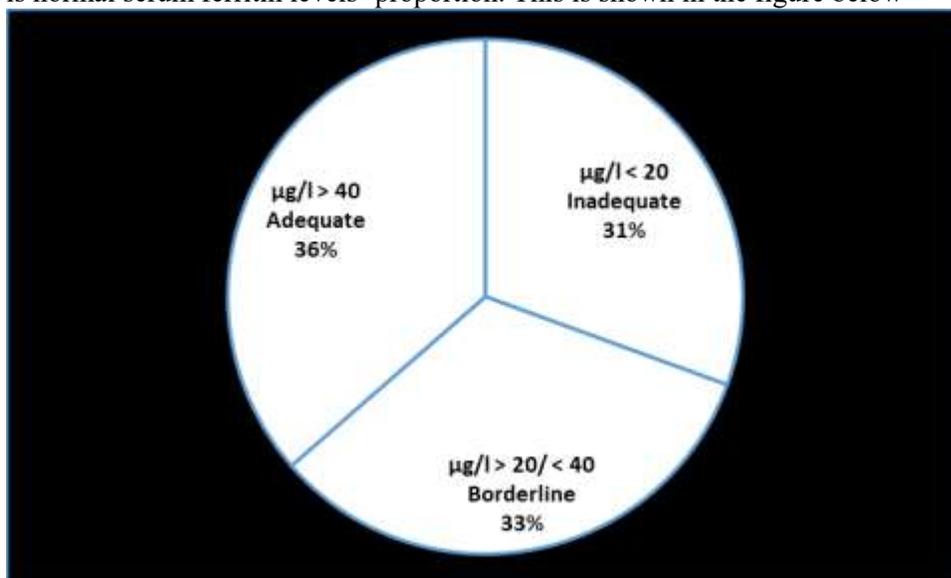


Figure 14: Pie chart on the effect of respondents' dietary practice on their serum ferritin levels in third trimester of pregnancy

### 4.3 Test of Hypothesis

**Hypothesis 1:** There is no significant difference in the proportion of serum ferritin levels during the first, second and third trimester of pregnancy among pregnant women attending care in university of Port Harcourt teaching hospital with respect to socio-demographical characteristics

Table 9: ANOVA on the mean difference of the proportion of serum ferritin levels during the first, second and third trimester of pregnancy among pregnant women attending care in university of Port Harcourt teaching hospital with respect to socio-demographical characteristics.

Variable	Sum of squares	df	Mean square	F	Sig
Between groups	82.712	2	12.334	85.31	0.00
Within groups	122.083	245	0.227		
Total	204.795	247			

Results in Table 9 showed that means square between groups and mean square within groups are 12.334 and 0.227 respectively. The degrees of freedom between groups, within groups and total are 2, 245 and 247 respectively. The calculated f-value is 85.31 which is significant at 0.00 alpha level. Since, 0.00 alpha level is less than 0.05 alpha level, the calculated f-value is also significant at 0.05 alpha level. As the calculated f-value is significant at 0.05 alpha level, the null hypothesis is not retained. This implies that

there is a significant difference in the proportion of serum ferritin levels during the first, second and third trimester of pregnancy among pregnant women attending care in university of Port Harcourt teaching hospital with respect to socio-demographical characteristics.

## DISCUSSION OF FINDINGS

### **Proportion of pregnant women attending care in university of Port Harcourt teaching hospital with adequate serum ferritin levels during the first, second and third trimester of pregnancy**

The findings revealed the proportion of pregnant women attending care in university of Port Harcourt teaching hospital with adequate ferritin levels during the first, second and third trimester of pregnancy as follows: first trimester of pregnancy- 23 pregnant women, second trimester of pregnancy- 32 and third trimester of pregnancy- 23 pregnant women. This is in line with the findings of Bhale *et al.*, (2013) who acknowledged that ferritin provides a reserve of iron readily available for the formation of hemoglobin and other haem proteins. Ferritin levels are considered the gold standard for the diagnosis of iron-deficiency anemia in pregnancy. Significantly lower proportion of serum ferritin were observed in 2nd and 3rd trimesters of pregnancy than in the 1st trimester. Also, serum ferritin levels were found to decrease significantly in all the three trimesters as compared to controls (Bhale, *et al.*, 2013).

### **Effect of socio-demographical characteristics of pregnant women attending care in university of Port Harcourt teaching hospital on their serum ferritin level**

The findings revealed effect of socio-demographical characteristics of pregnant women attending care in university of Port Harcourt teaching hospital on their serum ferritin level as follows: poor living environment, workload, insect bites and/or infestation. This is in consonance with the findings of Harville *et al.*, (2018) who acknowledged that housing conditions generally, is a potentially important but under-investigated aspect of women's lives during pregnancy. This was corroborated by Region of Peel - Public Health (n.d) that environmental concerns when pregnant matters to the life of the mother and the fetus. Exposure to certain havocs in the environment when pregnant may affect the pregnancy and/or the health of the baby. Larsen (2015) also noted that few studies on job stress relative to pregnancy have been carried out, but both animal and epidemiological studies have shown effect of exposure to stressful conditions during pregnancy and adverse effects on the offspring.

### **Dietary practice of pregnant women attending care in university of Port Harcourt teaching hospital on their serum ferritin level**

The findings revealed the effect of dietary practice of pregnant women attending care in university of Port Harcourt teaching hospital on their serum ferritin level as follows: regular consumption of red meat, regular consumption of chocolate tea, intake of herbal tea, and regular consumption fried rice. This is in line with the findings of Berry *et al.*, (2019) who noted that red meat is a good source of certain nutrients, especially vitamin B-12 and iron and the human body needs these nutrients to produce new red blood cells. Red meat is also high in protein, which is necessary for building muscle, bone, other tissues, and enzymes. However, some research has linked regular consumption of red meat to a number of health problems in pregnancy which directly and negatively impacts ferritin level through diseases and this has been found to lead to maternal mortality. Jane (2017) noted that drinking tea, a known inhibitor of ferritin, with the same meal depletes ferritin level by a whopping 64%. This is related to another study that drinking a cup of instant chocolate tea with a bread meal depletes ferritin level by 60–90% (Reyes *et al.*, 2018; Jane, 2017).

## CONCLUSION

Based on the findings of this study, it can be concluded that low proportion (26%) of the pregnant women attending antenatal care in University of Port Harcourt Teaching Hospital had adequate serum ferritin level. It was also reviewed that there is significant difference in the proportion of serum ferritin level at different trimester of pregnancy. 26.4% of the pregnant women had adequate serum ferritin level in their first trimester 32.32% in their second trimester while 27.06% of the pregnant women had adequate serum ferritin level in their 3<sup>rd</sup> trimester of pregnancy.

## RECOMMENDATIONS

In the light of the discoveries made in this study, the following recommendations were made:

1. Community health workers and/or midwives should be mobilized to sensitize all women and young girls on ferritin level and the need to carry out regular ferritin level check.
2. Free and quality iron supplements should be made available to females above 18 years and to all pregnant women in all government-owned health facilities in Rivers State.
3. Health education should be provided regularly to female above 18 years and to pregnant women on adequate diet with emphasis on iron building diet and the need to avoid stress during pregnancy.
4. Fruits should be made available to pregnant women at subsidized rate in all government-owned antenatal clinics in Rivers State.
5. There should be free check of serum ferritin level for all pregnant women in all government owned hospital in Rivers State.
6. Rivers state government through the ministry of health and ministry of environment should carry out state-wide fumigation.
7. Rivers state government through the ministry of health should provide free mosquito nets for all pregnant women.

## REFERENCES

- Abbaspour, N., Hurrell, R., & Kelishadi, R. (2014). Review on protein and its importance for human health. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences*, 19(2), 164-171.
- Adediran, A., Gbadegesin, A., Adeyemo, T. A., Akinbami, A. A., Akanmu, A. S., Osunkalu, V., Ogbenna, A. A., & Oremosu, A. (2011). Haemoglobin and ferritin concentrations of pregnant women at term. *Obstetric medicine*, 4(4), 152–155.
- Gebremichael, T. G., & Welesamuel, T. G. (2020). Adherence to protein-folic acid supplement and associated factors among antenatal care attending pregnant mothers in governmental health institutions of Adwa town, Tigray, Ethiopia: Cross-sectional study. *Plos one*, 15(1), e0227090.
- Januar, V., Desoye, G., Novakovic, B., Cvitic, S., & Saffery, R. (2015). Epigenetic regulation of human placental function and pregnancy outcome: considerations for causal inference. *American journal of obstetrics and gynecology*, 213(4), S182-S196.
- Joo, J. E., Hiden, U., Lassance, L., Gordon, L., Martino, D. J., Desoye, G., & Saffery, R. (2013). Variable promoter methylation contributes to differential expression of key genes in human placenta-derived venous and arterial endothelial cells. *BMC genomics*, 14(1), 475.
- Kadry, S., Sleem, C., & Samad, R. A. (2018). Hemoglobin levels in pregnant women and its outcomes. *Biom Biostat Int J*, 7(4), 326-336.
- Loy, S. L., Lim, L. M., Chan, S. Y., Tan, P. T., Chee, Y. L., Quah, P. L., ... & Shek, L. P. C. (2019). Protein status and risk factors of iron deficiency among pregnant women in Singapore: a cross-sectional study. *BMC public health*, 19(1), 397.
- Milman, N., Taylor, C. L., Merkel, J., & Brannon, P. M. (2017). Protein status in pregnant women and women of reproductive age in Europe. *The American journal of clinical nutrition*, 106(suppl\_6), 1655S-1662S.
- Nazario, B. (2020, September 14). Ferritin blood test. [www.webmd.com/a-to-z-guides/ferritin-blood-test](http://www.webmd.com/a-to-z-guides/ferritin-blood-test)
- Sholeye, O. O., Animasahun, V. J., & Shorunmu, T. O. (2017). Anemia in pregnancy and its associated factors among primary care clients in Sagamu, Southwest, Nigeria: A facility-based study. *Journal of family medicine and primary care*, 6(2), 323–329.
- Souza, J. S., Brunetto, E. L., & Nunes, M. T. (2016). Iron restriction increases myoglobin gene and protein expression in Soleus muscle of rats. *Anais da Academia Brasileira de Ciências*, 88(4), 2277-2290.