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Original Research Article

Impact of Inter-Pregnancy Interval on Maternal Serum Ferritin, Haematocrit Level and Fetal Outcome in University of Ilorin Teaching Hospital Ilorin, Nigeria

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Abstract

Background: Short inter-pregnancy interval (SIPI) has been linked with low maternal haematological indices and adverse fetal outcome. The World Health Organization (WHO) recommended a minimum of 24 months inter-pregnancy interval to reduce the risk of adverse maternal and fetal outcomes. However, sub-optimal pregnancy spacing is common in many developing countries including Nigeria. ***Objectives:*** To determine the impact of inter-pregnancy interval on maternal serum ferritin, haematocrit level and fetal outcome among parturient in University of Ilorin Teaching Hospital, Ilorin, Nigeria. ***Study Design:*** A prospective cohort study of parturient less than 20weeks gestation. Those who did not satisfy the WHO recommended inter-pregnancy interval of at least 24months were categorized as group II while gestational age and social status matched parturient who satisfied the WHO recommendation were in group I. ***Methodology:*** A total of 316 parturient who satisfied the inclusion criteria were recruited for the study by systematic sampling. These were equal number of 158 participants each as subject and control. Subject and control were matched for gestational age and social status. The serum ferritin and haematocrit levels as well as fetal outcome were evaluated for each participant. The results were analysed using SPSS version 20.0 with appropriate tables and figures generated. ***Results:*** There was statistically significance difference in the mean levels of serum ferritin (P<0.001) and haematocrit (P<0.001) at booking for the two groups of participants. There was statistically significant difference in the gestational age at delivery (P<0.001) with higher rate of preterm delivery (22.1% vs. 1.9%; P<0.001) in group II compared to group I. In addition, there were higher percentages of group II babies with 1st (32.5% vs. 9.6%; P<0.001) and 5th minute (18.2% vs. 1.9%; P<0.001) APGAR scores < 7 compared to group I babies (P<0.001). The mean birth weight was lower in group II (2.70±0.35 vs. 3.10±0.31; P<0.001) with higher need for neonatal resuscitation (16.9% vs. 2.6%; P<0.001) and intensive care admission (18.2% vs. 1.3%; P<0.001) among neonates of women in group II. Neonatal anaemia (15.4% vs. 0.0%; P<0.001) occurred only in group II participants' babies. Neonatal mortality was zero for group I and 18(11.7%) for group II babies. ***Conclusion:*** Inter-pregnancy interval below the WHO recommendation is associated with low maternal serum ferritin and haematocrit levels as well as adverse fetal outcome. ***Recommendations:*** Adequate child spacing should be emphasized during antenatal visits, postpartum counselling, postnatal clinic visits as well as other contacts with non-pregnant women of reproductive age.

Keywords: Inter-pregnancy, Interval, Maternal, Serum, Ferritin, Haematocrit, Fetal, Outcome.

INTRODUCTION

The strenuous processes associated with the physiology of pregnancy, delivery and lactation is nutritionally and mentally demanding on the women [1]. To obtain the needed reserves for quality pregnancy outcome proper spacing of pregnancy is essential. Adverse obstetric outcomes such as ante-partum anaemia, perinatal and maternal morbidity and mortality have been linked with sub-optimally spaced pregnancies [1, 2]. Inter-pregnancy interval is defined as the period between delivery of the previous infant and conception of the current pregnancy [3, 4].

Properly spaced pregnancies allow the physiological changes of pregnancy to return to the non-pregnant state and also avail the woman the opportunity to recover from the effects of pregnancy and lactation [4]. This process occurs due to decrease in hormonal levels such as oestrogen secreted during

pregnancy. The involution of the uterus to its pre-pregnancy size occurs within six weeks postpartum while onset of menstruation and ovulation depends on if the woman is breastfeeding [3]. Extra time should be allowed after the return of physiological changes of pregnancy to the non-pregnant state for adequate recovery before another conception.

There has been a worldwide obstetric controversy about optimal inter-pregnancy interval until the WHO recommended an interval of at least 24 months after a live birth before attempting the next pregnancy in order to reduce the risk of adverse maternal, perinatal and infant outcomes [5]. This recommendation was considered by the WHO in agreement with the WHO/UNICEF recommendation of a breastfeeding period of at least two years [5]. However, Researchers still use normal inter-pregnancy interval of 18 months [3, 6].

IPI either short or long has been associated with adverse obstetric outcomes [6, 7]. Long inter-pregnancy interval (LIPI) is IPI of 72 months and above while Short inter-pregnancy interval (SIPI) is IPI of less than 24 months. LIPI has been associated with increased risk of gestational hypertension, premature rupture of membranes (PROM) and difficult labour [1]. Studies have shown that intervals of three to five years are safer for both mother and infant as opposed to two years or less [4, 9].

It has been recorded that increased risk of preterm births [4, 10, 11] low birth weight (LBW) [4, 11, 12] intrauterine growth restriction (IUGR) [1, 4] and anaemia are associated with SIPI. One in every two inter-pregnancy intervals in some parts of Africa falls short of the WHO recommendation [13].

The after effects of SIPI such as perinatal, infant and childhood mortality as well as maternal mortality, have been linked to maternal depletion syndrome. This is a biological phenomenon that refers to an inadequate recuperation of the mother from one pregnancy leading to an in-hospitable intrauterine environment to accommodate a subsequent pregnancy [14-16]. It is characterized by poor maternal health and deficiency of nutrients. Maternal depletion syndrome is mainly evaluated using haematological parameters such as the haematocrit which evaluates current anaemic status and serum ferritin which shows the level of iron store. Diagnosis of iron deficiency can be made using serum iron, total iron -binding capacity (TIBC), serum ferritin, serum transferrin receptor levels and red cell -derived protoporphyrin [17, 18]. Pregnancy leads to a progressive fall in serum iron and ferritin levels and an increase in TIBC, free protoporphyrin and transferring receptor levels. Many parameters may be needed to diagnose mild deficiency of serum iron, however, a markedly reduced serum ferritin (< 12 µ g/L) remains diagnostic.[17] The best first- line diagnostic tool for suspected iron deficiency is serum ferritin [17].

There are limited evidence to show the impact of inter-pregnancy interval on the maternal haematocrit, serum ferritin level as well as fetal outcome in Nigeria. Few studies are available on the effect of IPI on pregnancy outcome and none was conducted in Ilorin. Among the available studies none evaluated the effect of IPI on serum ferritin and haematocrit levels. This represents a knowledge gap which this study aims to provide answers to.

Due to the scarcity of studies on this topic in Nigeria, there is a need for more research to add to the body of evidence, this will influence practice in terms of patient counselling hence resulting in improved obstetric outcome which is a step towards achieving safe motherhood.

METHODOLOGY

Study Area

The study was carried out in the Department of Obstetrics and Gynaecology, University of Ilorin Teaching Hospital, Ilorin, Kwara State, Nigeria which is located at Oke-Oyi, Old Jebba Road in Ilorin. It predominantly plays the role of a teaching hospital but equally offers primary and secondary health services. It serves as a major referral centre for Kwara State and parts of the nearby states of Oyo, Osun, Ekiti, Kogi and Niger states. The hospital is approved for and undertakes undergraduate and postgraduate medical training. It is a training centre for Nursing, Post Basic Nursing in Midwifery, Accident and Emergency as well as Paediatric Nursing, Community Health Officers and Health Information Management System. The hospital has facilities for the major clinical departments i.e. Obstetrics and Gynaecology, Paediatrics, Surgery, Internal Medicine and clinical laboratories. Obstetric services are delivered by four firms; each firm consists of consultants, resident doctors and house officers.

Study Population

The study population was pregnant women at less than 20weeks gestation who satisfied the inclusion criteria for the study and was receiving antenatal care at the study site during the study period.

Inclusion Criteria

Preceding pregnancy must have been carried to the age of fetal viability i.e. 28weeks, certainty about the date of last menstrual period or a first trimester ultrasound scan for dating, non-use of iron-containing drugs in the index pregnancy prior to recruitment and consent to participate in the study and deliver at the study site.

Study Design

The study was a prospective cohort study; participants were pregnant women at less than 20weeks

gestational age who consented to participate in the study and also satisfied the inclusion criteria.

At recruitment, participants were categorized into two groups (i.e. Groups I and II) based on the inter-pregnancy interval of the woman.

Group I: were women who satisfied the WHO recommended inter-pregnancy interval of 24months and above.
Group II: were women who do not satisfy the WHO recommended inter-pregnancy interval; these were women with inter-pregnancy interval less than 24months. They were followed up at the antenatal clinic until six weeks after the end of pregnancy. Complaints of participants were attended to during antenatal clinic as well as other times as indicated.

Study Tool: The study tool was data collection sheets.

Sample Size

The sample size was 316 comprising equal number of 158 participants who satisfied WHO recommended inter- pregnancy and those who did not satisfy the recommendation. It was determined by a previously validated formula for cohort study [14].

Sampling Technique

The sampling method was systematic sampling. First, all pregnant women were screened to determine those who satisfied the inclusion criteria. Second, eligible women were screened to determine those who satisfied the WHO recommended inter-pregnancy interval (group I). Those who did not satisfy the WHO recommended inter-pregnancy interval (group II) were recruited after matching for gestational age and social status. The serum ferritin level and haematocrit were determined.

Patients Recruitment

Recruitment of participants in the study was at the antenatal booking clinic. All antenatal attendees were counselled about the study and interested women were screened to determine eligibility using the inclusion criteria. Eligible women were grouped into two based on the study protocol as outlined above and a written informed consent obtained. Initial information were obtained including socio-demography, history of index pregnancy and past obstetric history. The gestational age was ascertained from the last menstrual period or a first trimester ultrasound scan and the expected date of delivery calculated. Also, the date of the last delivery was ascertained and the inter-pregnancy interval calculated. Recruitments were done by the researcher with assistance from the research assistants. The research assistants were four junior residents (one from each firm) who were trained about the study protocol (such as the contents of the information sheet, consent form, data collection sheet and also sample collection) daily for one week before commencement of the study.

Sample Collection

A volume of 4ml of venous blood was collected from a prominent vein on the antecubital fossa of each participant. A tourniquet was applied at a point proximal to the site, the site was cleaned with sterile cotton swab soaked in 70% alcohol. Thereafter, a hypodermic needle attached to a 5ml syringe was inserted into the vein and the required amount of blood withdrawn gradually. Haemostasis was secured after untying the tourniquet using firm pressure with a dry cotton swab. From the sample collected, 2ml was dispensed immediately into a plain bottle for evaluation of serum ferritin while the remaining 2ml was dispensed into ethylenediaminetetraacetic acid (EDTA) bottle for haematocrit estimation.

Sample Processing and Analysis

The serum ferritin sample was allowed to stand for one hour to allow clotting, it was centrifuged at 3000rpm for 3minutes and the serum obtained was transferred into another plain bottle. It was refrigerated at 2-8^{o}c for a maximum period of 5days within which it was analyzed using AccuBind^{TM} Ferritin Microplate ELISA [19].

The sample for haematocrit which was an anti-coagulated whole blood was centrifuged; the portion of space occupied by the packed red blood cells was termed the packed cell volume (PCV) and was expressed as the proportion in percentage or decimal number of the red blood cells in a given volume of whole blood which was also called the haematocrit.

Patients Follow Up/Data Collection

Patients follow up involved routine antenatal protocol, active management of labour and recording of labour and delivery events as well as maternal and fetal outcomes in the study data collection sheet. Postnatal evaluation and six weeks postnatal clinic visit were conducted.

Data Analysis

The data were analyzed using the Statistical Package for Social Sciences software (SPSS) version 20.0. Appropriate tests of significance (Relative Risk for strength of association, Z-test for difference between continuous variables, Chi-square for comparison of proportions). Pearson's correlation coefficient and Spearman's correlation were used to demonstrate correlation between continuous and categorical variables respectively. Results were presented using tables and figures.

Ethical Consideration

An institutional approval for this study has been obtained from the Ethical Review Committee of University of Ilorin Teaching Hospital, Ilorin. Informed

written consent was obtained from each participant after adequate counselling and the data obtained from the study were treated with confidentiality and used solely for the purpose of the study.

Limitations of the Study:

1. The study was a single centre study; a multicentre study with a larger number of participants may be more representative.
2. Monitoring of participants and their babies were up to 6weeks postpartum, long-term effects of IPI outside puerperium was not determined by this study.
3. The late antenatal booking disallowed earlier recruitment and evaluation in the first trimester thereby limiting the evaluation to the second trimester.
4. The effects of IPI on serum ferritin and haematocrit were evaluated with a single estimation at gestational age < 20weeks due to limitation of fund. Thus, sequential evaluation at each trimester with appropriate support may provide clearer information on the relationship with pregnancy.
5. There was difficulty in recruiting participants since most women take haematinics as safe medication prior to booking which exclude them from the study.

RESULTS

The study was conducted over a period of 11months (9th January, 2017 to 20th November, 2017). A total of 316 participants were enrolled comprising 158 participants in each group. Six of the participants did not deliver in the study centre (2 in the group I and 4 in the group II respectively). These six participants were not included in the analysis of pregnancy outcome.

Table 1 showed the socio-demographic characteristics of participants.

Table 1: Socio-demographic variables of the study participants

Variable	Group I	Group II	Total	χ^2/t	*p* value
	n (%)	n (%)	n (%)		
Age (years)					
21 – 30	77 (48.7)	86 (54.4)	163 (51.6)	1.131^{Y}	0.568
31 – 40	79 (50.0)	72 (45.6)	151 (47.8)		
> 40	2 (1.3)	0 (0.0)	2 (0.6)		
Mean ± SD	31.62 ± 3.89	31.35 ± 3.34		0.676^{t}	0.499
Range	24 – 47	23 – 40			
Marital Status					
Single	3 (1.9)	0 (0.0)	3 (0.9)	1.346^{Y}	0.246
Married	155 (98.1)	158 (100.0)	313 (99.1)		
Employment					
Employed	121 (76.6)	101 (63.9)	222 (70.3)	6.057	0.014*
Unemployed	37 (23.4)	57 (36.1)	94 (29.7)		
Education					
Primary	14 (8.9)	53 (33.5)	67 (21.2)	42.716^{Y}	<0.001*
Secondary	56 (35.4)	66 (41.8)	122 (38.6)		
Tertiary	88 (55.7)	37 (23.4)	125 (39.6)		
No formal education	0 (0.0)	2 (1.3)	2 (0.6)		
Ethnicity					
Yoruba	125 (79.1)	99 (62.7)	224 (70.9)	11.307^{Y}	0.010*
Hausa	5 (3.2)	19 (12.0)	24 (7.6)		
Igbo	25 (15.8)	35 (22.2)	60 (19.0)		
Others	3 (1.9)	5 (3.2)	8 (2.5)		
Husband's Occupation					
Civil servant	98 (62.0)	53 (33.5)	151 (47.8)	26.592^{Y}	<0.001*
Trader	50 (31.6)	85 (53.8)	135 (42.7)		
Farmer	6 (3.8)	18 (11.4)	24 (7.6)		
Others	4 (2.5)	2 (1.3)	6 (1.9)		
Husband's Education					
Primary	12 (7.6)	29 (18.4)	41 (13.0)	37.079^{Y}	<0.001*
Secondary	50 (31.6)	82 (51.9)	132 (41.8)		
Tertiary	96 (60.8)	42 (26.6)	138 (43.7)		
No formal education	0 (0.0)	5 (3.2)	5 (1.6)		

χ^2: Chi square test; t: Independent samples T test; ^{Y}: Yates corrected; *: *p* value < 0.05 (statistically significant)

Maternal age

The participants in group I were within the age range of 24-47years (mean age of 31.62±3.89) while group II participants were aged 23-40years (mean age 31.35±3.34) which was not statistically significant (P= 0.499). The highest percentage of participants was in the age group of 21-30years 163(51.6%) while the least number of participants were > 40years 2(0.6%).

Marital status

Majority of the participants were married 313(99.1%) of these, 155(98.1%) were in group I and 158(100.0%) were in group II while 3(0.9%) were single.

Occupation

One hundred and twenty-one (76.6%) from group I and 101(63.9%) from group II were employed; this was statistically significant (P = 0.014).

Educational status

Primary education was attained by 67 (21.2%) participants; 14(8.9%) from group I and 53(33.5%) from group II (P< 0.001) which was statistically significant. Secondary education was 56(35.4%) vs 66(41.8%). 125 (39.6%) had tertiary education; 88(55.7%) from group I and 37 (23.4%) from group II. 2(0.6%) had no formal education and were from group II.

Ethnicity

The ethnic group distribution was among the Yorubas 224(70.9%), Igbos 60(19.0%), Hausas 24(7.6%) and others 8(2.5%).

Husband's occupation

151 (47.8%) husbands of participants were Civil Servant; 98(62.0%) of these were in group I while 53(33.5%) belong to group II (P< 0.001).

Husband's education

138 (43.7%) of the husbands had tertiary education; 96(60.8%) were husbands of group I participants and 42(26.6%) belong to group II participants while 41(13.0%) had primary education; 12(7.6%) belong to group I and 29(18.4%) while 5(1.6%) who had no formal education belonged to group II.

Table 2 showed obstetric history of the study participants.

Table 2: Obstetric history of the study participants

Variable	Group I	Group II	Total	χ^2/t	*p* value
	n (%)	n (%)	n (%)		
Gravidity					
2	51 (32.3)	50 (31.6)	101 (32.0)	0.924	0.630
3 – 4	87 (55.1)	93 (58.9)	180 (57.0)		
> 4	20 (12.7)	15 (9.5)	35 (11.1)		
Parity					
1 – 2	106 (67.1)	117 (74.1)	223 (70.6)	1.822^{Y}	0.402
3 – 4	50 (31.6)	39 (24.7)	89 (28.2)		
> 4	2 (1.3)	2 (1.3)	4 (1.3)		
Living Children					
None	0 (0.0)	2 (1.3)	2 (0.6)	0.556^{Y}	0.906
1	60 (38.0)	58 (36.7)	118 (37.3)		
2 – 3	85 (53.8)	87 (55.1)	172 (54.4)		
≥ 4	13 (8.2)	11 (7.0)	24 (7.6)		
Gestational age at booking					
1st trimester					
Mean ± SD	8.90± 2.19	11.00 ± 2.45		-2.565	0.015*
2nd trimester					
Mean ± SD	16.47 ± 1.46	17.29 ± 1.14		-5.260	<0.001*
Overall					
Mean ± SD	15.75 ± 2.38	16.81 ± 2.10		-4.183^{t}	<0.001*
Range	6 – 19	7 – 19			

χ^2: Chi square test; t: Independent samples T test; ^{Y}: Yates corrected; *: *p* value < 0.05 (statistically significant)

Gravidity

There was no statistically significance difference in the gravidity of the participants. 101(32.0%) participants were gravid 2; of these 51(32.3%) were in group I and 50(31.6%) were in group II (P=0.630). Majority of participants 180(57.0%) were gravid 3-4 while 35(11.1%) were > gravid 4.

Parity: The largest percentage of participants 223(70.6%) were para 1-2, 89(28.2%) were para 3-4 while 4(1.3%) were > para 4.

Living children

Majority of the participants 172(54.4%) had 2-3 living children and all the participants in group I had at least 1 living child while 2(0.6%) of women in group II had no living child (P= 0.906).

Gestational age at booking

The mean gestational age of participants who booked in 1st trimester was 8.90±2.19weeks vs 11.00±2.45weeks; (P=0.015) while that of those who booked in 2nd trimester was 16.47±1.46weeks vs 17.29±1.14weeks; (P<0.001). The gestational age range at booking of group I participants was 6-19 weeks with overall mean of 15.75±2.38weeks vs 7-19weeks with overall mean of 16.81±3.10weeks of group II (P< 0.001) which is statistically significant.

Table 3 showed serum ferritin and haematocrit levels of participating parturient.

Table 3: Serum ferritin and haematocrit levels of participating parturient

Variables	Group I	Group II	T	*p* value
Serum Ferritin (ng/ml)				
1st trimester				
Mean ± SD	46.83 ± 3.38	35.83 ± 3.05	9.373	<0.001*
2nd trimester				
Mean ± SD	36.07 ± 3.11	32.36 ± 2.66	4.128	<0.001*
Overall				
Mean ± SD	37.40 ± 3.15	32.61 ± 2.68	-14.558	<0.001*
Range	6.00 – 340.00	2.30 – 190.00		
Median (IQR)	43.75 (12.50 – 95.63)	30.00 (20.00 – 60.00)		
Haematocrit (%)				
1st trimester				
Mean ± SD	32.50 ± 3.02	28.08 ± 2.91	12.515	<0.001*
2nd trimester				
Mean ± SD	33.36 ± 3.67	27.90 ± 2.66	14.376	<0.001*
Overall				
Mean ± SD	33.24 ± 3.59	27.92 ± 2.67	14.964	<0.001*
Range	28 – 44	23 – 35		
Median (IQR)	32.00 (30.00 – 35.25)	28.00 (25.00 – 30.00)		

t: Independent samples T test;*: *p* value < 0.05 (statistically significant)

Serum ferritin level

The mean levels of serum ferritin of group I and group II participants in 1st trimester was 46.83±3.38ng/ml vs 35.83±3.05ng/ml; (P<0.001) while that in 2nd trimester was36.07±3.11ng/ml vs 32.36±2.66ng/ml; (P<0.001). There was statistically significance difference between the overall mean levels of serum ferritin of the group I and group II; 37.40±3.15ng/ml vs 32.61±2.68ng/ml (P< 0.001).

Serum haematocrit level

The mean haematocrit levels of group I participants in 1st trimester was 32.50±3.02% as opposed to 28.08±2.91% in group II ; (P<0.001) while that in 2nd trimester was 33.36±3.67% vs 27.90±2.66%; (P<0.001). The overall mean haematocrit levels of the participants in group I, 33.24±3.59% compared to 27.92±2.67% of group II participants (P< 0.001) was statistically significant.

Table 4 showed antenatal follow-up and complications among participants.

Table 4: Antenatal follow-up and complications among participants

Variable	Group I	Group II	Total	χ^2	*p* value
	n (%)	n (%)	n (%)		
Pre-eclampsia					
Yes	2 (1.3)	4 (2.5)	6 (1.9)	0.170^{Y}	0.680
No	156 (98.7)	154 (97.5)	310 (98.1)		
Ante-partum haemorrhage					
Yes	2 (1.3)	5 (3.2)	7 (2.2)	0.584^{Y}	0.445
No	156 (98.7)	153 (96.8)	309 (97.8)		
Gestational diabetes					
Yes	1 (0.6)	5 (3.2)	6 (1.9)	1.529^{Y}	0.216
No	157 (99.4)	153 (96.8)	310 (98.1)		

Variable	Group I	Group II	Total	χ^2	*p* value
	n (%)	n (%)	n (%)		
Urinary tract infection					
Yes	5 (3.2)	11 (7.0)	16 (5.1)	2.370	0.124
No	153 (96.8)	147 (93.0)	300 (94.9)		
Anaemia					
Yes	13 (8.2)	22 (13.9)	35 (11.1)	2.603	0.107
No	145 (91.8)	136 (86.1)	281 (88.9)		
Antenatal hospital admission					
Yes	9 (5.7)	26 (16.5)	35 (11.1)	9.286	0.002*
No	149 (94.3)	132 (83.5)	281 (88.9)		
Indication for antenatal admission (n = 35)					
Anaemia	1 (11.1)	9 (34.6)	10 (28.6)	2.252^{Y}	0.813
Urinary tract infection	4 (44.4)	5 (19.2)	9 (25.7)		
Hypoglycaemia	0 (0.0)	3 (11.5)	3 (8.6)		
Preeclampsia	2 (22.2)	3 (11.5)	5 (14.3)		
Haemorrhage	0 (0.0)	4 (15.4)	4 (11.4)		
Malaria	2 (2.2)	2 (7.7)	4 (11.4)		

χ^2: Chi square test; ^{Y}: Yates corrected; *: *p* value < 0.05 (statistically significant)

Antenatal follow-up

Six (1.9%) of the participants developed pre-eclampsia; 2(1.3%) of these were in group I while 4(2.5%) were in group II (P=0.680). There were 7(2.2%) cases of antepartum haemorrhage; 2(1.3%) were in group I while 5(3.2%) were in group II (P=0.584). 6(1.9%) of participants developed gestational diabetes; 1(0.6%) of these were in group I while 5(3.2%) were in group II (P=0.216). There were 16(5.1%) of participants who developed urinary tract infection during antenatal follow-up; 5(3.2%) of these women were in group I while 11(7.0%) were in group II (P=0.124) which was not statistically significant. Antepartum anaemia were found in 35(11.1%) participants; 13(8.2%) were from group I while 22(13.9%) were in group II (P=0.107) which was not significant statistically. 35(11.1%) participants had antenatal hospital admission; 9(5.7%) were in group I while 26(16.5%) were in group II (P= 0.002) which was statistically significant. The commonest indication for admission was anaemia 10(28.6%) followed by urinary tract infection 9(25.7%). Other indications were pre-eclampsia 5(14.3%), antepartum haemorrhage 4(11.4%), malaria 4(11.4%) and hypoglycaemia 3(8.6%).

Table 5 showed maternal outcome among participants.

Table 5: Maternal outcome among participants

Variable	Group I	Group II	Total	χ^2	*p* value
	n (%)	n (%)	n (%)		
Onset of labour					
Spontaneous	152 (97.4)	142 (92.2)	294 (94.8)	4.327	0.038*
Induced	4 (2.6)	12 (7.8)	16 (5.2)		
Mode of delivery					
Spontaneous vaginal	151 (96.8)	138 (89.6)	289 (93.2)	4.523^{Y}	0.104
Assisted vaginal	0 (0.0)	1 (0.6)	1 (0.3)		
Caesarean section	5 (3.2)	15 (9.7)	20 (6.5)		
Gestational age at delivery					
< 37 weeks	3 (1.9)	34 (22.1)	37 (11.9)	29.950	<0.001*
≥ 37 weeks	153 (98.1)	120 (77.9)	273 (88.1)		

χ^2: Chi square test; ^{Y}: Yates corrected; *: *p* value < 0.05 (statistically significant)

NB: 6 study participants that were lost to follow up not included

Maternal outcome

Two hundred and ninty-four (94.8%) participants had spontaneous onset of labour; 152(97.4%) of these participants were in group I while 142(92.2%) were in group II (P=0.038) which was statistically significant. There was no statistically significance difference in the mode of delivery. 289(93.2%) participants had spontaneous vaginal delivery; 151(96.8%) of these were in group I while 138(89.6%) in group II (P=0.104). 1(0.3%) participant had assisted vaginal delivery while 20(6.5%) participants had caesarean section. 5(3.2%) of those who had caesarean section were from group I while 15(9.7%) were from group II. 37(11.9%) participants

delivered at gestational age < 37weeks; 3(1.9%) of these were in group I while 34(22.1%) were in group II (P< 0.001) which was statistically significant. 273(88.1%) delivered at gestational age ≥ 37weeks.

Table 6 showed fetal outcome and neonatal status: Sixty-five (21.0%) babies delivered by the participants had 1st minute APGAR scores of <7. 15(9.6%) of these babies were delivered by group I mothers while 50(32.5%) of these babies belong to group II mothers (P< 0.001) which was statistically significant. 245(79.0%) babies had 1st minute APGAR scores ≥ 7. There was statistically significance difference in the 5th minute APGAR scores. 31(10.0%) babies had 5th minute APGAR scores of <7; 28(18.2%) babies belong to group II mothers while 3(1.9%) babies belong to group I mothers (P< 0.001). 279(90.0%) babies had 5th minute APGAR scores ≥ 7. 30(9.7%) babies had need for resuscitation; 26(16.9%) of these babies were delivered by group II participants while 4(2.6%) were delivered by group I participants (P< 0.001). 280(90.3%) babies had no need for resuscitation. The number of babies admitted in NICU was statistically significant. There were 30(9.7%) babies that had NICU admission; 28(18.2%) babies belong to group II mothers while 2(1.3%) babies belong to group I mothers (P< 0.001). 280(90.3%) babies had no NICU admission. 292(94.2%) of babies delivered by participants were discharged home; 156(100.0%) of these babies belong to group I participants while 136(88.3%) were of group II participants (P< 0.001) which was statistically significant. 18(11.7%) babies delivered by group II participants died while no death was recorded of group I participants' babies. The mean birth weight of babies of group I and group II mothers; 3.10±0.31kg vs 2.70±0.35kg (P< 0.001) was statistically significant. The mean placental weight of group II babies were higher compared to group I babies; 0.53±0.05kg vs 0.52±0.04kg (P= 0.014) which was statistically significant.

Table 6: Fetal outcome and neonatal status

Variable	Group I	Group II	Total	χ^2	*p* value
	n (%)	n (%)	n (%)		
1st minute APGAR					
< 7	15 (9.6)	50 (32.5)	65 (21.0)	24.422	<0.001*
≥ 7	141 (90.4)	104 (67.5)	245 (79.0)		
5th minute APGAR					
< 7	3 (1.9)	28 (18.2)	31 (10.0)	22.762	<0.001*
≥ 7	153 (98.1)	126 (81.8)	279 (90.0)		
Need for resuscitation					
Yes	4 (2.6)	26 (16.9)	30 (9.7)	18.178	<0.001*
No	152 (97.4)	128 (83.1)	280 (90.3)		
NICU Admission					
Yes	2 (1.3)	28 (18.2)	30 (9.7)	25.321	<0.001*
No	154 (98.7)	126 (81.8)	280 (90.3)		
Final neonatal state					
Discharged home	156 (100.0)	136 (88.3)	292 (94.2)	19.358	<0.001*
Died	0 (0.0)	18 (11.7)	18 (5.8)		
Birth weight					
Mean ± SD	3.10 ± 0.31	2.70 ± 0.35		10.815^{t}	<0.001*
Range	2.50 – 4.60	1.70 – 4.60			
Median (IQR)	3.00 (2.90 – 3.20)	2.70 (2.40 – 2.90)		3596.500^{U}	<0.001*
Placenta weight					
Mean ± SD	0.52 ± 0.04	0.53 ± 0.05		-2.459^{t}	0.014*
Range	0.40 – 0.60	0.30 – 0.60			
Median (IQR)	0.50 (0.50 – 0.51)	0.50 (0.50 – 0.60)		10984.000^{U}	0.111

χ^2: Chi square test; ^{Y}: Yates corrected; t: Independent samples T test; U: Mann Whitney U test; *: *p* value < 0.05 (statistically significant)

NB: 6 study participants that were lost to follow up not included

Table 7 showed maternal postnatal clinic evaluation: The mean temperature of the group I and group II participants were 36.92±0.21°c vs 36.95±0.30°c (P=0.299) which was not statistically significant. The range of the temperature were 36.00-37.40 vs 36.00-38.20. Only 4(1.3%) participants had fever and they were group II participants (P=0.128). There was no statistically significant difference in pallor; 11(3.5%) had pallor, 3(1.9%) were in group I while 8(5.2%) in group II (P= 0.120). Abdominal tenderness was found in 2(1.3%) participants in group II while non in group I had the sign; (P=0.473). Also; 3(1.9%) participants in group II had foul-smelling lochia while such was not observed in group I participants; (P=0.241). The mean haematocrit levels of the participants were not statistically significant; 31.83±2.31% vs 31.29±2.70%;

(P=0.059). 7(2.3%) participants had anaemia; 1(0.6%) from group I while 6(3.9%) from group II (P=0.122).

Table 7: Maternal postnatal clinic evaluation

Variable	Group I	Group II	Total	χ^2/t	*p* value
	n (%)	n (%)	n (%)		
Temperature					
Mean ± SD	36.92 ± 0.21	36.95 ± 0.30		-1.040	0.299
Range	36.00 – 37.40	36.00 – 38.20			
Fever					
Yes	0 (0.0)	4 (2.6)	4 (1.3)	2.319^{Y}	0.128
No	156 (100.0)	150 (97.4)	306 (98.7)		
Pallor					
Yes	3 (1.9)	8 (5.2)	11 (3.5)	2.424	0.120
No	153 (98.1)	146 (94.8)	299 (96.5)		
Abdominal tenderness					
Yes	0 (0.0)	2 (1.3)	2 (0.6)	0.516^{Y}	0.473
No	156 (100.0)	152 (98.7)	308 (99.4)		
Foul smelling lochia					
Yes	0 (0.0)	3 (1.9)	3 (1.0)	1.373^{Y}	0.241
No	156 (100.0)	151 (98.1)	307 (99.0)		
Haematocrit					
Mean ± SD	31.83 ± 2.31	31.29 ± 2.70		1.894^{t}	0.059
Range	27 – 40	23 - 36			
Anaemia					
Yes	1 (0.6)	6 (3.9)	7 (2.3)	2.392^{Y}	0.122
No	155 (99.4)	148 (96.1)	303 (97.7)		

χ^2: Chi square test; ^{Y}: Yates corrected; t: Independent samples T test; *: *p* value < 0.05 (statistically significant)
NB: 6 study participants that were lost to follow up not included

Table 8 showed neonatal postnatal clinic evaluation: The mean temperature of group I and group II babies showed no statistically significant difference, 36.76±0.23^{o}C vs 36.80±0.25^{o}C; (P=0.153). There was no statistically significance difference in fever; only 2(0.7%) babies had fever and they belong to group II mothers (P= 0.419). The mean haematocrit levels of group I babies were higher compared to that of group II; 39.54±2.42% vs 32.68±3.17% (P< 0.001) which was statistically significant. Anaemia was found in 21(7.2%) babies and these babies were delivered by the group II mothers (P<0.001). There was no statistically significance difference in jaundice; only 1(0.7%) baby who was delivered by group II mother developed jaundice (P= 0.944).

Table 8: Neonatal postnatal clinic evaluation

Variable	Group I	Group II	Total	χ^2/t	*p* value
	n (%)	n (%)	n (%)		
Temperature					
Mean ± SD	36.76 ± 0.23	36.80 ± 0.25		-1.433^{t}	0.153
Range	26.80 – 37.00	36.00 – 37.00			
Fever					
Yes	0 (0.0)	2 (1.5)	2 (0.7)	0.654^{Y}	0.419
No	156 (100.0)	134 (98.5)	290 (99.3)		
Haematocrit					
Mean ± SD	39.54 ± 2.42	32.68 ± 3.17		20.816^{t}	<0.001*
Range	31 – 45	27 – 40			
Anaemia					
Yes	0 (0.0)	21 (15.4)	21 (7.2)	25.955	<0.001*
No	156 (100.0)	115 (84.6)	271 (92.8)		
Jaundice					
Yes	0 (0.0)	1 (0.7)	1 (0.3)	0.005^{Y}	0.944
No	156 (100.0)	135 (99.3)	291 (99.7)		

χ^2: Chi square test; ^{Y}: Yates corrected; t: Independent samples T test; *: *p* value < 0.05 (statistically significant)
NB: 6 study participants that were lost to follow up and 18 neonates who died not included

DISCUSSION

This study discovered that women with IPI below the WHO recommendation had lower level of education, presented for booking late and had generally poorer haematological indices and fetal outcome compared to those who satisfied the WHO recommendation. This was shown by statistically lower levels of maternal mean levels of serum ferritin and haematocrit. Their poor fetal outcomes were in terms of higher rate of preterm delivery, lower first and fifth minute APGAR scores as well as mean birth weight and higher need for neonatal resuscitation plus intensive care admissions. Neonatal morbidities were higher in SIPI and neonatal mortalities occurred only in babies of mothers with SIPI.

The serum ferritin and haematorit levels of participants within the WHO recommended IPI were higher compared to those with SIPI which was statistically significant. Studies within [2, 9] and outside Nigeria [13, 14], reported lower serum haematocrit in pregnant women with SIPI; but there was no available study on the relationship of IPI and serum ferritin. Physiologically, there is progressive fall in serum haematocrit and ferritin during pregnancy due to increase demands from the fetus though markedly reduced levels is not ideal [17]. This study showed a higher mean serum ferritin values at booking among those recruited in the first trimester compared to those of second trimester within the two study groups. This reflects the report of a study showing progressive decrease in the ferritin levels from conception as the pregnancy advances with a maximal reduction at 28 weeks of gestation. The value then stabilizes at this point or increases only when iron supplementation is administered [20]. Thus adequate IPI should be encouraged before conception while early booking and iron supplementation should be prioritised.

Antenatal follow up evaluation after commencement of iron supplementation in the participants showed no statistically significant difference in anaemia among the two groups. This agreed with studies by Sloan [21] and Yakoob [22] which concluded that routine iron supplementation increases maternal haematological status thereby correcting the significant anaemia earlier recorded at booking among the participants. Taylor *et al* [20] also reported that iron supplementation elevates serum ferritin levels during and after pregnancy although a follow up ferritin estimation was not done in this study due to its design. However; Lilungulu [6] in a prospective cohort study reported higher risk of anaemia in women with SIPI during labour but these women did not have antenatal iron supplementation to correct the deficit.

Participants with SIPI had more delivery at gestational less than 37weeks as opposed to those within the WHO recommended IPI in this study. Previous studies have reported an association of SIPI with spontaneous preterm birth [6, 7], a study in Rwanda concluded that SIPI does not give higher risk of a pregnancy loss but affects other pregnancy outcomes such as preterm birth, low birth weight, low APGAR scores and a higher neonatal death. The babies of participants with SIPI had lower first and fifth minute APGAR scores (< 7), need for neonatal resuscitation and intensive care admissions compared to babies whose mothers were within the recommended IPI. Neonatal death occurred only in babies whose mothers had SIPI. Studies have reported an association between SIPI and perinatal morbidities and mortality especially from perinatal asphyxia from prematurity [6, 7].

The birth weight was lower and the placental weight higher for babies delivered by women with SIPI compared to WHO recommended spaced babies. The low birth weight may be due to prematurity while increased mean placental weight could be a compensatory mechanism for fetal hypoxia causing placental hyperplasia to increase uteroplacental circulation. Previous studies reported an association between SIPI and low birth weight [4, 11].

Maternal postnatal clinic evaluation showed no statistically significant difference in the postpartum clinical condition of women with SIPI and the WHO recommended IPI in terms of temperature, pallor, abdominal tenderness, state of lochia, haematocrit and anaemia. This could be due to compensatory effect of antenatal supplementation and postpartum management such as perineal care and haematinics. Taylor *et al.*, [20] reported that iron supplementation elevates serum ferritin levels during and after pregnancy. However, neonatal postnatal clinic evaluation reported lower haematocrit in babies whose mothers had SIPI possibly from the preterm delivery. This was similar to the report of Atalay [23] which reported that SIPI was an independent risk factor for adverse perinatal and neonatal outcomes.

CONCLUSION

Inter-pregnancy interval below the WHO recommendation of 24months and above is associated with low maternal serum ferritin and haematocrit levels as well as adverse fetal outcome.

RECOMMENDATIONS

1. Preconception care and counselling should be made routine with emphasis on child-spacing to encourage the WHO recommended spacing.
2. Advocacy on the importance of contraception should be stepped-up to increase its uptake as a matter of priority.

3. Early booking and iron supplementation should be routine and commenced early to correct pre-pregnancy deficits.

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