NIGERIAN JOURNAL OF FAMILY PRACTICE

ORIGINAL ARTICLE

COHORT STUDY OF THE IMPACT OF MATERNAL PACKED CELL VOLUME AT ANTENATAL CARE BOOKING ON THE BIRTH WEIGHT OF BABIES AT BAPTIST MEDICAL CENTRE, OGBOMOSO, NIGERIA.

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Contribution of each author
Ayoson EO: Conceptualization, literature review, design of methodology, data collection; data analysis and presentation of findings; discussion of findings.
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Keywords: Maternal PCV at Booking, Antenatal, Infant birth weight, retrospective cohort study, Ogbomoso, Nigeria

ABSTRACT

Background: Extremes of poverty resulting from political instability in conjunction with infections, infestations and some armful cultural practices in some parts of Nigeria may make pregnant women to enter pregnancy with less than optimal Packed Cell Volume. The aim of this study was to determine the impact of maternal PCV at booking on the foetal birth weight and to identify other possible confounding factors that impact on foetal birth weight among pregnant women attending Antenatal care at BMCO, Nigeria.
Method: Statistical analyses were performed using the STATA 13 software package. The data were controlled for maternal age, parity, birth interval, maternal educational level, gestational age at delivery and pre-pregnancy BMI. Anonymized secondary data was analysed using descriptive statistics, chi square, Fisher exact, t-test and univariate and multivariate logistic regression analysis. A 2x2 categorical table and ***chi*** square (or Fisher exact test where cell values are less than 5) were used to test the association between the outcome variable-birth weight and maternal PCV with PCV less than 33% as measure of exposure and PCV greater than 33% as non-exposure. Logistic regression analysis was used to examine the association between maternal PCV and birth weight of the babies. Unadjusted and adjusted Odds ratios (OR) and their 95% CI were calculated from the logistic regression coefficients.
Results: Prevalence of low Packed Cell Volume among pregnant mothers at entrance in ANC was 55.45% while the prevalence of Low Birth Weight was 16.50%. Only estimated gestational age was found to be associated with birth weight {(OR 11.79, 95% CI (2.1545 – 64.4749) and p-value 0.004)}. All other confounding factors examined did not show any significant association with birth weight. The maternal age at booking ranged between 15 and 40 years. The mean age of the women was 30.61 ± 4.67 years. The mean maternal PCV at booking was 32.02% with 23% being the smallest PCV while the highest PCV was 43%. The median booking PCV of mothers who delivered a baby weighing less than 2500gm was 31% while the median booking PCV of mother who delivered a baby weighing between 2500gm and 4500gm was 32%.
Conclusion: The prevalence of low PCV and Low Birth Weight was 55.45% and 16.50% respectively. Women should be encouraged to attend ANC early in pregnancy and measures to prevent premature delivery should be instituted during ANC.

INTRODUCTION

"Birth weight can be classified as normal or abnormal. Abnormal birth weight could be classified as low birth weight and macrosomia (too much weight)" [1]. Several authors defined Low Birth Weight as either the birth of a live baby weighing less than 2500g or the birth of a live baby weighing below the 10th percentile of the reference population [2,3,4,5,6].

Globally, about 23.8% of babies are born weighing less than 2500kg or below the 10th percentile for the reference population and of these LBW babies 90% are born in developing countries of Africa, Asia and Latin America[2]. Malholtra et al, working in India reported the prevalence of LBW to be 54.8% and intrauterine growth restriction 12%[7].

Studies done in the last 3 decades examined the relationship between maternal anaemia and birth weight and pregnancy outcomes[8-16] and showed variation in maternal PCV.

Globally, a greater proportion of pregnant mothers (50 – 66%) are anaemic when compared with the non-pregnant population 32.9%[3,8, 9, 10, 17, 18]. The highest prevalence of anaemia in pregnancy was seen in South Asia, Central, West and East sub-Sahara Africa [16,18]. Viveki et al found a prevalence of 82.9% in India sub-continent [16].

Ayoya and Colleagues reported the prevalence of maternal anaemia in all Countries of West Africa to be higher than 50%[8]. They reported the highest prevalence of 70% from the Republics of Benin, The Gambia, Mali and Senegal while the lowest rate of 51% was observed in Cameroon[10]. Bordaeu-Livine working in Republic of Benin reported the prevalence of severe and moderate anaemia among pregnant women to be 3.9% and 64.7% during the first and second trimesters respectively and 3.7% and 64.1% during the second and third trimesters respectively[10]. Mockenhaupt et al, working in Ghana, found a prevalence of anemia among pregnant women to be 54%[19]. These report points to the importance of continue surveillance of anaemia among pregnant mothers.

No study specifically directly studied the relationship between maternal PCV at booking and birth weight of the infant at birth. Theoretically, the rate of growth of babies in utero has serious and deleterious effect on the baby during intra-uterine life [6,11, 14,15]. Many factors including maternal PCV during pregnancy has been identified as having important impact on the intra-uterine **growth of the foetus**[15].

The causes and degree of anaemia vary widely depending on socio-economic, age and physiological conditions of the patient[20]. Single status, divorce, primi-parity, multi-parity, birth interval of less than 1 year were found to be positively associated with low maternal PCV[20]. Women with higher educational status were less likely to be anaemic in pregnancy[21]. They also found that women who booked early in pregnancy were less likely to have low PCV in pregnancy. Dietary factors, poor intestinal absorption and blood loss arising from several causes such as hookworm infestations, frequent malaria infection both before and during pregnancy, repeated and short interval births and prolonged menstruation contributes to the incidence of anaemia in pregnancy [21,22].

Research Question

Does the maternal packed cell volume have any effect on the baby's birth weight and are there other factors that might have effect on the baby's birth weight?

Research Hypothesis

Null Hypothesis

There is no relationship between maternal PCV and the baby's birth weight.

Alternative Hypothesis

Low maternal PCV at entry into antenatal care would be associated with low birth weight.

Aim and Objectives

The aim of the study was to evaluate the impact of low maternal packed cell volume (PCV) and other confounding factors at entrance into ANC on the birth weight of babies

Objectives

1. To determine the prevalence of low PCV among women who booked for ANC and deliver at BMCO
2. To determine the influence of confounding factors on birth weight
3. To determine the relationship between maternal packed cell volume at booking and the baby birth weight at birth.

METHODOLOGY

A cohort study was undertaken to evaluate the impact of maternal packed cell volume at booking and other maternal factors on the birth weight of infants born to women attending antenatal clinic (ANC) at Baptist Medical Centre, Ogbomoso, Nigeria.

The study was conducted at BMCO, 200 bed, mission hospital serving a town with a population of about 300,000 people and its agrarian environs.

Data was collected from consecutive patients until sample size was reached. All the study participants who met the study criteria were included in the analysis.

The exclusion criteria were preterm babies delivered before 35 completed weeks, macrosomia, congenital malformation, and multiple gestations, hypertension in pregnancy, gestational diabetes, maternal sickle cell anaemia, maternal aged less than 18 years and refusal to give consent.

The data were collected at ANC between June 2003 and December 2004. The data consists of maternal packed cell volume at entrance into ANC and infant birth weight and socio-demographic characteristics of both spouses such as maternal age, parity, BMI, gestational age in weeks, marital status, birth interval, and maternal education.

Ogbomoso, the second largest city in Oyo State of Nigeria was chosen to conduct the research. About 3.0% of the population of the state and 0.12% (166,000) of the Nigeria population resides in the city (NPC 2006).[23] Given that the Population growth rate in 2004 was 2.6% it implies that 2.6% of women (4316) are likely to be pregnant and 58% (2503) of them are likely to attend ANC (NPC 2006).[23] This formed the study population from which the participants were derived.

Two hundred and seven pregnant women with normal, uncomplicated singleton gestations, who booked and delivered at Baptist Medical centre, Ogbomoso between June 2003 and December 2004 were recruited into the study. To identify the number of participants the sample size was calculated by using Raosoft Sample size Calculator [24](Raosoft, n.d) with α level kept at 95%, margin of error at 5%, and the response distribution at 58% [24]. The sample size of 207 was obtained.

Ethical Considerations and Approval

Ethical clearance was obtained from the Bowen University Teaching Hospital (BUTH) Research Ethics Committee.

Statistical Analysis

The cases were LBW babies born weighing less than 2500gm while the comparison groups were babies with weight between 2500 - 4500gm at birth. A low PCV of less than 33% was the measure of exposure while mothers with a PCV greater than 33% as measure of no exposure. Confounding factors were maternal age, parity, maternal education, BMI, gestational age in weeks, marital status and birth interval in months.

The exposure variable and outcome variable were categorized into low and normal PCV and LBW and normal birth weight respectively. A cross tabulation was created for these categorical variables and the association were tested using Chi square. The odds ratios (OR) of LBW among mothers with PCV less than 33% and mothers with PCV greater 33% were calculated. A 2x2 categorical table and ***chi*** square (or Fisher exact test where cell values are less than 5) were used to test the association between the outcome variable and maternal PCV with PCV less than 33% as measure of exposure and PCV greater than 33% as non-exposure. This was repeated for maternal education and BMI. A 2x2 table could not be constructed for marital status because there was only 1 single mother among the participants. Descriptive statistics histogram and normal distribution plots, scatter plots and box plots were used to explore the distribution of the continuous variables listed above. Also skewness and kurtosis test were conducted to further explore normality of maternal age at booking, birth interval, PCV, parity and birth weight.

Logistic regression analysis was used to examine the association between maternal PCV and birth weight of the babies. Unadjusted and adjusted Odds ratios (OR) and their 95% CI were calculated from the logistic regression coefficients. The alpha was kept at 0.05. Differences were considered significant if P <0.05 and the CI did not include 1. Binary logistic regression was used to model the association between birth weight and PCV while controlling for confounding factors. Other variables entered into the model include maternal age, estimated gestational age, parity, birth interval, pre-pregnancy BMI, maternal education. Chi square test was used as the test of hypothesis and Hosmer-Lemeshow goodness-of-fit was used to test the fit of the model.

RESULTS

Normal probability plots of maternal age at booking, maternal PCV at entrance into ANC, birth weight of babies and maternal BMI showed that they were normally distributed while same plots showed that maternal educational level, parity, estimated gestational age at delivery and marital status were not normally distributed.

Table 1: Showing normally distributed maternal characteristics and corresponding means and standard deviations

Maternal Characteristics	Means ± SD
Maternal age at booking (Years)	30.61 ± 4.67
Maternal PCV	32.02 ± 4.26
Body Mass Index (Kg/m^2)	24.22 ± 4.84
Birth weight	3082 ± 675.42

Table II: Showing non-normally distributed maternal characteristics and corresponding median and Inter-quartile ranges

Maternal Characteristics	Median	Interquartile Range
Birth Interval (number)	24.0	38
Estimated gestational age (weeks)	40.0	1
Parity (Number)	1	2
Maternal Educational Level (Years)	2	1
Marital Status	1	0

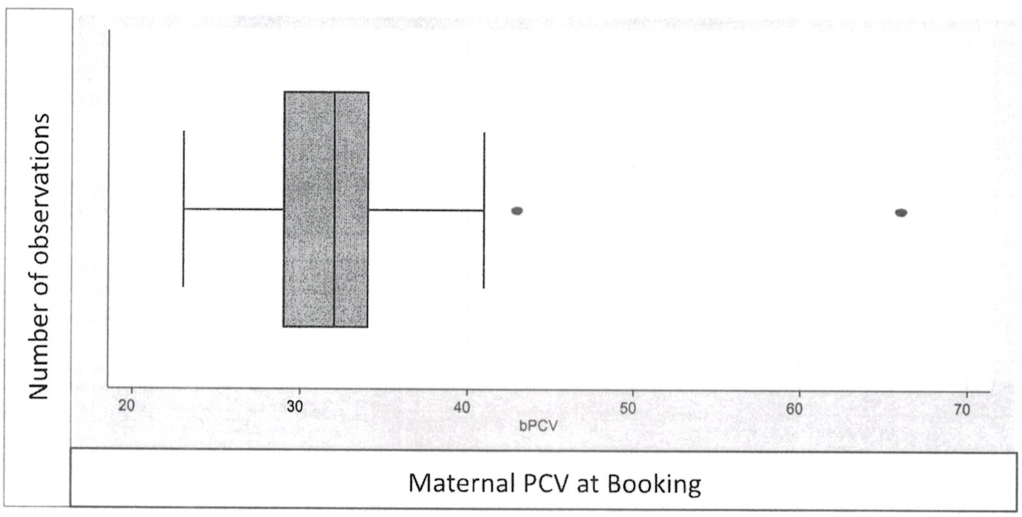

Figure 1: Boxplot of maternal PCV at booking PCV

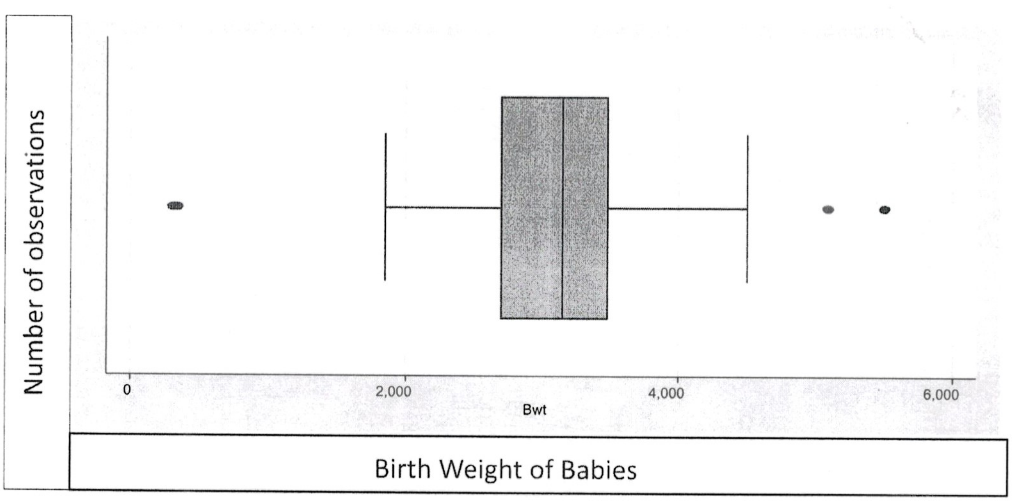

Figure 2: Boxplot of birth weight of babies

Table III: Frequency distribution table for maternal characteristics

Maternal Characteristics		N (Percentage)
Maternal age at booking (Years)	<=25 years	24 (11.76)
	26 – 35 years	141 (69.12)
	35 years & above	39 (19.12)
Maternal Educational level (years)	No formal education	3 (1.55)
	< 6 years of education	25 (12.95)
	6 – 12 years of education	103 (53.37)
	>12 years of education	71 (32.12)
Parity (Number)	Primigravida (0)	83 (40.69)
	1 - 2	66 (32.35)
	3 – 4	40 (19.61)
	>4	15 (7.35)
Birth Interval (months)	Less 24	87 (42.65)
	24 – 48	66 (32.35)
	Greater 48	51 (25.00)
Marital status	Married	203 (99.5)
	Single	1 (0.5)
Birth weight (gm)	LBW	33 (16.50)
	NBW	167 (83.50)
Booking PCV (%)	Low PCV	112 (55.45)
	Normal PCV	90 (44.55)
Body Mass Index (Kg/m^2)	Underweight	9 (4.40)
	Normal weight	105 (51.47)
	Over weight	59 (28.92)
	Obese	31 (15.20)
Estimated gestational age at delivery (Weeks)	< 37 weeks	33 (16.5)
	>=37 weeks	167 (83.5)

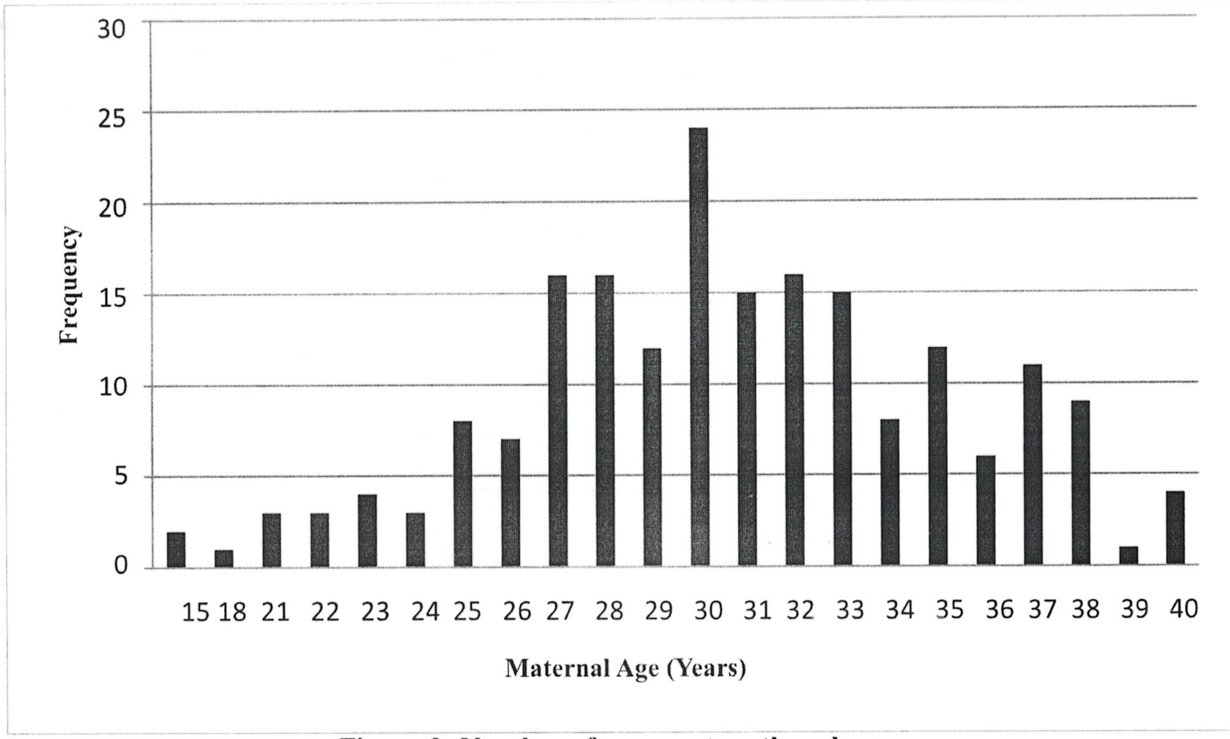

Figure 3: Number of pregnant mothers by age

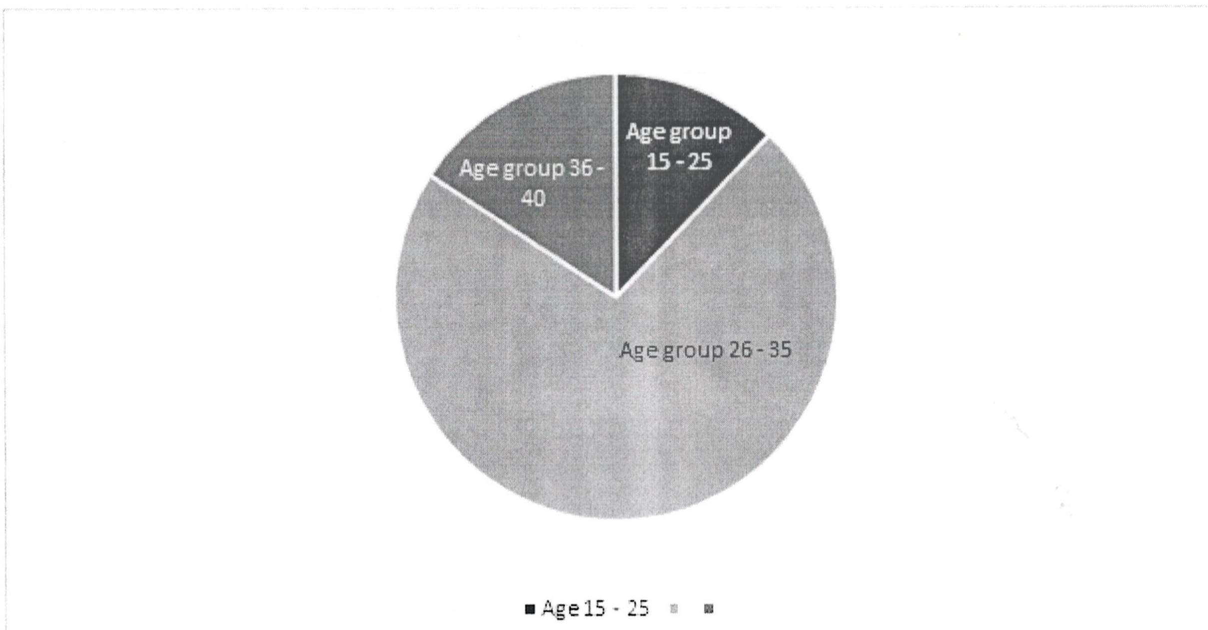

Figure 4: Proportion of sample by age group

Table IV: Relationship between Birth weight and maternal Characteristics

Variables	LBW (%)	NBW (%)	X^2 (P-value)/Fisher
Maternal PCV at booking			
Low PCV	22 (46.67)	86 (53.33)	1.98 (0.16)/0.18
Normal	11 (33.33)	77(66.67)	
Maternal age group at booking			
26 – 35	23 (69.70)	114 (69.46)	
15 – 25	7 (21.21)	17 (10.18)	Fisher exact 0.15
>35	3 (9.09)	33 (20.36)	
Maternal Educational level			
Tertiary	10 (30.30)	59 (35.33)	
Completed Secondary school	20 (60.61)	83 (49.70)	Fisher exact 0.80
Primary education	3 (9.09)	22 (13.17)	
No formal education	0 (0.00)	3 (1.80)	
Parity (Number of children)			
3 - 4	4 (12.12)	35 (20.96)	
1 -2	8 (24.24)	56 (33.53)	Fisher exact 0.09
0	21 (63.64)	61 (36.53)	
4	0 (0.00)	15 (8.98)	
Gestation at delivery (weeks)			
<37	5 (15.15)	28 (84.85)	Fisher exact 0.00
>= 37	3 (1.80)	164 (98.20)	
Birth Interval (months)			
>=24 - <=48	9 (27.27)	55 (32.93)	
> 48	3 (09.09)	47 (28.14)	Fisher exact 0.13
<24	21 (63.64)	65 (38.92)	
Body Mass Index			
18.50 – 24.99	25 (75.76)	90 (53.89)	
25.00 – 29.99	5 (15.15)	49 (29.34)	Fisher exact 0.09
>30	3 (9.09)	28 (16.77)	

Table V: Relationship between maternal characteristics and birth weight using univariate and multivariate logistic analysis

Variables	Univariate analysis		Multivariable analysis	
	OR (95% CI)	**P-value**	**OR (95% CI)**	**P-value**
PCV				
Normal (ref)				
Low PCV	1.75 (0.7976 – 3.8395)	0.16	1.46 (0.8595 – 3.6216)	0.41
Maternal age group a t booking (years)				
26 – 35 (ref)				
>35	0.45 (0.1259 – 1.5726)	0.21	0.77 (0.1991 – 2.9374)	0.77
15 – 25	2.07 (0.7737 – 5.5742)	0.15	1.33 (0.4245 – 4.1350)	0.63
Edelev				
Tertiary (Ref)	1.42 (0.6204 – 3.2579)		1.62 (6167 – 4. 2365)	0.33
Secondary School level	0.81 (0.2024 – 3.1979	0.41	1.27 (0.2791 – 5.8050)	
Primary Sch Level				0.76
No formal education	Omitted because a cell contain 0	0.76	Omitted because a cell contain 0	
Parity (number)				
3 – 4 (ref)	1.25 (0.3502 – 4.4616)	0.73	1.07 (0.2664 – 4. 2906)	0.93
1 - 2	3.01 (0.9565 – 9.4866)	0.06	3.03 (0.6198 – 14.8334)	0.17
0	Omitted because a cell contain 0		Omitted because a cell contain 0	
>4				
Gestation at delivery (weeks)				
37 – 42 (ref)				
<37	9.76 (2.2080 – 43.1590)	0.003	11.79 (2.1545 – 64.4749)	0.004
BI (months)				
24 – 48 (Ref)				
<24	0.39 (0.0998 – 1.5250)	0.17	0.41 (0.0906 – 1.8807)	0.25
>48	1.98 (0.8359 – 4.6633)	0.12	0.71 (0.1754 – 2.9040)	0.65
BMI				
25 – 29.99 (ref)				
>30	1.05 (0.2332 . 4.7283)	0.95	1.02 (0.2009 – 5.1863)	0.98
18.50 – 24.99	2.72 (0.9804 – 7.5590	0.06	1.82 (0.5802 – 5.7320)	0.30

Hosmer-Lemeshow goodness-of-fit (X^2 4.39, p-value 0.82) showed that the model fit pretty well. With Chi^2 4.39 and p-value of 0.82 one cannot reject this model.

DISCUSSION

Low maternal PCV is currently recognized as a major contributor to poor pregnancy outcomes affecting both mother and babies with the most susceptible populations being people of poor socioeconomic background [19]. The maternal and child health policy in Nigeria focuses mainly on the child after birth. Most time the damage that result in the birth of LBW infant occurred long before the child is born [6]. Empirically optimal maternal PCV at entrance into pregnancy might be expected to improve the birth weight of babies.

As highlighted by results of the study 55.45% of the study participants entered into ANC with PCV less 33%. The result is in keeping with the findings of studies within Nigeria and other parts of sub-Sahara

Africa. It is also similar to the prevalence (58.0%) of anaemia in Pregnancy as reported by Owolabi, Owolabi & OlaOlorun working in Ogbomoso[20]. There are many studies from different parts of Nigeria which reported much lower prevalence of Low packed cell volume. For instance Gwarzo & Ugwa and Buseri et al, reported a prevalence of 24.5% and 29.9% respectively from Northern Nigeria[9]. Idowu, Mafiana & Sotiloye working in South Western Nigeria reported a much higher prevalence (75.6%) [25] and Bukar et al working in Northern Nigeria also reported a higher prevalence (67.4%) [26]. Although higher proportion of mothers aged 26 – 35 had low PCV but this had no significant association with birth weight (booking PCV less 33% OR 1.46, p-value 0.41, 95% CI 0.8595 – 3.6216)

Also the prevalence of Low Birth Weight (16.5%) in this population was lower than the global prevalence of LBW which is estimated to be 23.8% [2] but higher than the 11.7% prevalence reported in Nigeria[21]. This might be a reflection of the changing SES of the study population.

There was no association between parity and birth weight in this study (parity 1- 2 OR 1.07, p-value 0.93, 95% CI 0.2664 – 4.2906; parity 0 OR 3.03, p-value 0.17, 95% CI 0.6198 – 14.8334, parity >4 no sufficient).

This lack of association persists even after controlling for other confounding factors. The relationship between the parity of women and birth weight is highly controversial. Shah PS found in a systematic review that nulliparity was associated with LBW but grand multi-parity and great grand multi-parity (parity of 5 and 10 above respectively) was not associated with LBW[27]. Kodzi & Kravdal on the other hand did not found adverse relationship between increasing parity and birth weight [28].

Majority of the mothers delivered at term while 16.5% delivered before the 37 completed weeks of gestation or prematurely. There was a statistically significant association between birth weight and estimated gestational age at delivery (Gestational age less than 37 OR 11.79, p-value 0.004 and 95% CI 2.1545 – 64.4749). The wide CI here implies a greater uncertainty because of small cell sizes (3 and 5).

It is pretty well known that the weight of babies is dependent on the gestational aged at delivery [29]. The findings of this study conform to the findings of[29].

Study limitations

As has been noted above this is a prospective cohort study with all its associated limitations. The research was a facility based study but a population based longitudinal study would be probably more representative of the study population.

CONCLUSIONS AND RECOMMENDATIONS

Statistical analysis did not confirm any association between maternal PCV and other confounding factors; and birth weight except gestational age at delivery. Both Fisher exact test and logistic regression failed to reveal any significant association between parity, birth interval, BMI, maternal age at booking, maternal education, marital status and maternal PCV at booking. Therefore, the null hypothesis that there is no difference in the birth weight of babies born to mothers with low PCV and normal PCV at ANC booking cannot be rejected.

To improve these indices the following are recommended;

- The study suggests that preterm delivery is associated with low birth weight. Measures to prevent premature deliveries should be designed and instituted during antenatal care.
- As suggested from the literature review women should be encouraged to utilize antenatal care early in pregnancy so that risk factors could be identified early in pregnancy in order to have enough time to correct such factors.
- A longitudinal study that enrol mothers long before they became pregnant and follow them through to the time of delivery should be undertaken to take care of the limitations of this study.

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