# MATERNAL RISK FACTORS ASSOCIATED WITH ADVERSE PREGNANCY OUTCOME: LOW BIRTH WEIGHT - A RETROSPECTIVE STUDY

**Bright Owhondah Ogbondah[1*], Kenneth Okagua[2], Golden Owhonda[1], Ishmael D Jaja[1], Larry Nsirim[3]**

[1]Department of Community Medicine, Faculty of Clinical Sciences, College of Medicine, Rivers State University, Port Harcourt, Nigeria; [2]Department of Obstetrics and Gynaecology, Faculty of Clinical Sciences, College of Medicine, Rivers State University, Port Harcourt, Nigeria; [3]Directorate of Public Health, Ministry of Health, Rivers State.

[*]**Corresponding Author:** Bright Ogbondah; Email: brightogbonda@yahoo.com

***ABSTRACT***

***Background****: Low birth weight (LBW) affects mostly developing countries and is a leading cause of maternal and perinatal morbidity and mortality. It is significantly associated with maternal variables as age, height, mean arterial blood pressure (MAP), and gestational age (GA)*

***Method****: The study is a retrospective descriptive study conducted at general hospital Bonny, Rivers State. The study involved data collection from the records of participants kept at the records department of the hospital. Study population included all eligible pregnant women who presented for antenatal care (ANC) and also had their babies delivered at the hospital from 1st January 2015 to 31st December 2020. Records were scrutinized for completeness and records without complete data on variables required were excluded. Also excluded, were records which revealed medical condition which could affect fetal growth. Multiple regression analysis was done with SPSS version 23.0 to determine variables which were significant at p value less than or equal 0.05 level.*

***Results****: The mean age of participants was 29.3±5.8 with women within the age grade 21 – 30 years as the most predominant in the study. Most women were employed; 274 (68.5%) while 283 (70.8%) were partnered. There was a statistically significant association between maternal MAP, height, age and GA with birth weight of infants.*

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***Conclusion:*** *Maternal variables such as age, MAP, height and GA of newborn were significant predictors of LBW.*

***Key Words****: maternal, height, mean arterial blood pressure, age, gestational age, birth weight.*

**INTRODUCTION**

Low Birth Weight (LBW) in newborn, defined as weight below 10th percentile of sex specific population-based birth weight reference curve for gestational age (GA)[1] or weight of newborn less than 2500g[2]. LBW could result from preterm delivery or intrauterine growth retardation (IUGR) or both[3]. Infants with LBW are 25 times more at risk of dying and also develop long term consequences such as low intelligence quotient, poor school performance and cognitive dysfunctions compared with counterparts who weigh 2500g and above[4,5,6]. It is a major public health issue which affects mostly developing countries. Birth weight (BW) of newborn depends primarily on maternal factors which is single most important factor determining survival and development of newborn[7]. Unfavorable biological, social and environmental factors which affects the mother before and during pregnancy plays a vital role as risk factors of LBW[8]. Therefore, mothers need good, effective and efficient health care delivery services. It requires that they receive adequate social environment, responsive political structure and acceptable cultural value to ensure improved maternal health care and reduce adverse consequences. It is in this light that World Health assembly nutrition, target to reduce LBW by 30% between 2012 and 2025[9]. Over 20 million (15-20% of all births globally) infants are born with LBW, which contributes about 80% of all neonatal mortality[10]. In 2019, Lancet reported a global prevalence of between 14% - 17% with over 90% from low- and middle-income countries (LMIC) with sub-Saharan Africa contributing about 24% of global burden[11]. It was also estimated that global incidence was 16%[12].

Consequences of LBW impacts negatively on the community both on short and long- term basis. It was shown that LBW could predispose children to stunting in childhood, develop markers of metabolic risk factors at later age, affect male and female reproductive capacities and a risk factor for

suboptimal growth until adulthood and could lead to intergenerational assaults of malnutrition[13]. Evidence further reveals the impact of LBW as it could cause mental impairment and non-communicable chronic disease later in life[14]. It is therefore important to understand maternal risk factors associated with adverse pregnancy outcome such as LBW as to institute public health and maternal health care services to curb these conditions.

Several maternal factors have been associated with LBW. Anaemia in pregnancy have been implicated as a determinant of LBW and defined as maternal blood haemoglobin concentration below 10g/dl[15]. It was implicated as the most common nutritional disorder in pregnancy[16]. The enormity of the problem is evidenced by prevalence high as 46%, 41.8% and 56.0% respectively[17,18,19] Environmental and social factors which could predispose to this problem include malaria, intestinal parasite and low intake of iron rich foods[17], maternal under nutrition with poor calorie intake resulting in low absorption of essential micronutrients[18]. Effects of Anaemia in pregnancy have been controversial. It is believed that anaemia in pregnancy could predispose to LBW[17,18,13]. However, some studies found no significant association between LBW and Anaemia in pregnancy[19]. It was shown that Maternal Anaemia affects placental vascularization by altering angiogenesis during early pregnancy[20].

Maternal weight at term was noted as the best predictor of infant birth weight[21]. Studies have shown significant association between maternal weight and LBW[22,23,24]. It is an established fact that adequate nutrition and good calorie intake predicts maternal weight in pregnancy.

Maternal height has shown strong positive correlation with infant birth weight[24,25]. LBW infants are at an additional risk of stunting and poor linear growth if born to short mothers[26]. An infant with LBW is more likely to have stunting in childhood and develop markers of metabolic risk factors at his later age. Low birth weight is a risk factor for inter-generational assault of malnutrition and a risk factor for suboptimal growth until adulthood[13]. LBW causes stunting and other long lasting health effects[14].

Preterm delivery is a strong factor which predicts LBW. Previous studies have shown significant association between GA and LBW[22]. Gestational age below 37 weeks have also been shown to have a

strong positive correlation with LBW[27]. Birth weight depends on GA and fetal growth which are both products of internal (genetic) and environmental factors variation in different population of fetuses due to different environmental factors[28].

The objective of this study is to determine the effect of maternal predictors such as maternal weight, height, blood haemoglobin concentration, MAP and GA on birth weight of newborn. The rationale behind this work lies in the fact that, no work of this kind has been done in this study area and result obtained will be used as a tool to plan an evidence-based community tailored mitigation measures in the island where this study was carried out. Note that there have been conflicting results concerning the effect of these maternal variables and LBW. Further justification comes from the 2012 lancet every newborn series which called for more research into LBW infants[29].

## METHOD

### Study Area and Population

The study was a descriptive retrospective study conducted at general hospital Bonny, in Bonny Island Rivers State, Nigeria. The study involved retrospective data collection from the records of participants kept at the records department of the hospital. The study population included all eligible pregnant women who presented for antenatal care (ANC) and also had their babies delivered at the hospital from 1st January 2015 to 31st December 2020. Records were scrutinized for completeness and records without complete data on variables required were excluded. Also excluded, were records which revealed multiple pregnancy and other medical condition which could affect fetal growth such as diabetes mellitus, HIV, cardiovascular diseases except hypertension etc. Participants for the study were enlisted based on their records until the required sample size was achieved. A total sample size of 400 was achieved after making adjustment for attrition using sample size determination for descriptive study[30].

**Data Collection and Analysis**

Data were collected on socio-demographic, independent variable such as maternal height, weight, mean arterial blood pressure, blood haemoglobin concentration and GA while output variable was infant birth weight. Results were presented in simple frequency distribution table. Correlation coefficient was used to determine variables that were significantly associated with dependent variable while multiple regression analysis was done to determine continuous variables which were significant at p value less than or equal 0.05 level. Also, bivariate analysis with chi-square test was done for categorical data with level of statistical significance set at less than or equal 0.05.

Data collected was coded and entered into excel work book and was transported into statistical package for social sciences (SPSS) version 23.0 standard edition for statistical analysis.

**Ethical Considerations**

Permission for the study was granted by the management of Rivers State Hospital management board while ethical approval for the study was given by the ethical review committee of Rivers State Hospital Management Board.

**RESULTS**

**SOCIO-DEMOGRAPHIC CHARACTERISTICS**

The most predominant age group were women aged 21-30 years, 200 (50%) while 6(1.5%) of women were aged 41 years and above. The mean age was 29.3±5.8 with minimum and maximum age 17 and 44 years respectively.

Most women were employed; 274 (68.5%) while 126 (31.5%) were unemployed. Majority of the women were partnered 283 (70.8%) with 126 (29.2%) not partnered.

**TABLE 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS**

| VARIABLES<br>AGE (YEARS) | N =400<br>FREQ. (%) | MEAN | MINIMUM | MAXIMUM | RANGE |
|---|---|---|---|---|---|
| ≤20 | 36 (9.0) | | | | |
| 21 – 30 | 200 (50.0) | 29.3±5.8 | 17 | 44 | 270 |
| 31 -40 | 158 (39.5) | | | | |
| ≥41 | 6 (1.5) | | | | |
| **OCCUPATION** | | | | | |
| Unemployed | 60 (15.0) | | | | |
| Student | 74 (18.5) | | | | |
| Business woman | 182 (45.5) | | | | |
| Public servant | 84 (21.0) | | | | |
| **RELIGION** | | | | | |
| Christian | 390 (97.5) | | | | |
| Islam | 8 (2.0) | | | | |
| Others | 2(0.5) | | | | |
| **TRIBE** | | | | | |
| Igbo | 74 (18.5) | | | | |
| Ijaw | 260 (65.0) | | | | |
| House | 12 (12.0) | | | | |
| Efik | 48 (12.0) | | | | |
| Others | 6 (1.5) | | | | |
| **MARITAL STATUS** | | | | | |
| Single | 115(28.7) | | | | |
| Married | 281(70.3) | | | | |

| | |
|---|---|
| Cohabitation | 2 (0.5) |
| Divorced | 2 (0.5) |

**MATERNAL PREDICTORS AND LBW 1**

Women whose blood haemoglobin concentration above 11g/dl were the most predominant; 336(84.0%), while women with height 166-170cm constituted 140 (35.0%) of the study.

**TABLE 2: MATERNAL PREDICTORS AND LBW 1**

| **VARIABLE (N=400)** | | | | | |
|---|---|---|---|---|---|
| **HAEMOGLOBIN CONC.(g/dl)** | **FREQ. (%)** | **MEAN** | **MINIMUM** | **MAXIMUM** | **RANGE** |
| <7.9 | 0(0) | | | | |
| 7.9 – 8.9 | 6(1.5) | 12.2±1.5 | 8.3 | 19.3 | 11 |
| 9.0 – 10.9 | 58(14.5) | | | | |
| ≥11 | 336(84) | | | | |
| **MATERNAL WEIGHT(Kg)** | | | | | |
| <65 | 52(13.0) | | | | |
| 65 – 79 | 166(41.5) | 78.3±13.7 | 50 | 115 | 65 |
| 80 – 94 | 126(31.5) | | | | |
| 95 – 110 | 52(13.0) | | | | |
| ≥110 | 4(1) | | | | |
| **MATERNAL HEIGHT(CM)** | | | | | |
| <160 | 80(20.0) | | | | |
| 160 – 165 | 120(30.0) | 165±0.01 | 150 | 178 | 28 |
| 166 – 170 | 140(35.0) | | | | |

| | | | | | |
|---|---|---|---|---|---|
| ≥171 | 60(15.0) | | | | |
| **MEAN ARTERIAL PRESSURE (mmHg)** | | | | | |
| ≤70 | 144(36.0) | | | | |
| 71 – 100 | 235(58.8) | 71.24±19.2 | 33.3 | 123.3 | 90 |
| ≥101 | 21(5.2) | | | | |
| **BIRTH WEIGHT (Kg)** | | | | | |
| <2.5 | 24(6) | 3.2±0.6 | 1.0 | 4.6 | 3.6 |
| ≥2.5 | 376(94) | | | | |
| **GESTATIONAL AGE(WEEKS)** | | | | | |
| <37 | 182(45.5) | 37.05±2.1 | 26 | 42 | 16 |
| ≥37 | 218(54.5) | | | | |

**MATERNAL PREDICTORS AND LBW 2**

Women who were partnered had 16 (25.8%) LBW babies while unemployed women had 14 (22.6%) of infants with LBW

**TABLE 3: MATERNAL PREDICTORS AND LBW 2**

| **MARITAL STATUS** | **BIRTH WEIGHT** | | | | |
|---|---|---|---|---|---|
| | **<2.5** | **≥2.5** | **TOTAL** | **CHI SQUARE TEST** | **P VALUE** |
| **NOT PARTNERED** | 16 | 101 | 117 | | |
| **PARTNERED** | 46 | 237 | 283 | 0.4 | 0.52 |

| | | | | | |
|---|---|---|---|---|---|
| **TOTAL** | 62 | 338 | 400 | | |
| **OCCUPATION** | | | | | |
| **UNEMPLOYED** | 14 | 112 | 126 | | |
| **EMPLOYED** | 48 | 226 | 274 | 2.7 | 0.1 |
| **TOTAL** | 62 | 338 | 400 | | |

**MATERNAL PREDICTIONS AND LBW 3**

There was a strong significant positive correlation between GA and infant birth weight. There was a statistically significant association between maternal predictor as height, mean arterial pressure, and gestational age of infant with birth weight of newborn.

**TABLE 4: MATERNAL PREDICTORS AND LBW 3**

| **VARIABLE** | **PEARSON CORRELATION** | **T TEST** | **P VALUE** | **95% CI** | |
|---|---|---|---|---|---|
| | | | | **LOWER** | **UPPER** |
| **AGE** | - 0.022 | 0.337 | 0.736 | - 0.009 | 0.012 |

| | | | | | |
|---|---|---|---|---|---|
| **HAEM.CONC.** | 0.013 | 1.025 | 0.306 | - 0.016 | 0.051 |
| **MAP** | -0. 051 | 2.061 | 0.040 | 0.000 | 0.006 |
| **WEIGHT** | 0.132 | 1.707 | 0.089 | - 0.001 | 0.007 |
| **GEST. AGE** | 0.382 | 7.844 | 0.000 | 0.083 | 0.138 |
| **HEIGHT** | 0.075 | 1.958 | 0.05 | - 0.003 | 1.558 |

**MATERNAL PREDICTIONS AND LBW4**

Maternal age 21-30 years, mean arterial pressure above 100, maternal height-above 110cm and below 165cm and gestational age were significantly associated with infant birth weight.

**TABLE 5: MATERNAL PREDICTORS AND LBW 4**

| **VARIABLES** | **BIRTH WEIGHT(KG)** | | **T TEST** | **P. VALUE** | **PEARSONS** | **95% CI** | |
|---|---|---|---|---|---|---|---|
| | **<2.5** | **>2.5** | | | **CORR.** | **LOWER** | **UPPER** |
| **AGE(YEARS)** | | | | | | | |
| <20 | 19.0±1.31 | 19.1±1.6 | - 0.180 | 0.862 | - 0.080 | - 1.76 | 1.15 |
| 21 – 30 | 28.3±1.3 | 25.75±3.4 | 2.22 | 0.04 | - 0.35 | 0.021 | 5.15 |
| >31 | 33.3±2.73 | 22.67±3.07 | 0.278 | - 0.79 | 0.49 - 3.42 | 2.76 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **HAEM. CONC. g/dl** | | | | | | | |
| 9.0 -10.9 | 9.9±0.39 | 9.96±0.36 | - 0.28 | 0.79 | -0.42 | - 0.59 | 0.47 |
| ≥11 | 13.02±1.15 | 12.86±1.65 | 0.49 | 0.62 | - 0.19 | -0.51 | 0.84 |
| **MAP (mmHg)** | | | | | | | |
| <71 | 62.19±13.6 | 59.31±15.1 | 0.68 | 0.51 | 0.32 | -6.11 | 11.84 |
| 71 – 100 | 82.68±7.75 | 83.05±8.2 | - 0.16 | 0.88 | - 0.187 | - 5.34 | 4.59 |
| >100 | 112.9±7.93 | 104.43±5.16 | 3.21 | 0.01 | 0.23 | 2.51 | 14.52 |
| **WEIGHT(Kg)** | | | | | | | |
| <65 | 60.81±4.23 | 61.50±5.84 | - 0.44 | 0.67 | 0.25 | - 4.05 | 2.67 |
| 65 – 79 | 72.92±3.85 | 73.25±4.37 | - 0.29 | 0.77 | 0.09 | - 2.68 | 2.02 |
| 80 – 94 | 87.25±4.80 | 85.38±3.25 | 0.81 | 0.44 | -0.29 | - 3.58 | 7.34 |
| 95 – 110 | 102.17±5.09 | 99.83±3.07 | 1.09 | 0.30 | 0.64 | - 2.4 | 7.07 |
| **GESTATIONAL AGE(WEEKS)** | | | | | | | |
| <37 | 34.64±3.13 | 35.94±0.42 | -2.89 | 0.006 | - 0.063 | - 2.20 | -0.40 |
| ≥37 | 38.60±1.08 | 37.07±0.68 | 2.58 | 0.03 | 0.277 | 0.11 | 1.69 |
| **HEIGHT(CM)** | | | | | | | |
| <165 | 156.2±2.8 | 153.5±2.3 | 3.83 | 0.001 | 0.04 | 0.01 | 0.04 |
| 65 – 79 | 163.5±0.5 | `162.2±1.4 | 3.32 | 0.004 | - 0.50 | 0.004 | 0.02 |
| 80 – 94 | 167.5±1.58 | 1.67±0.63 | - 0.56 | 0.59 | 0.000 | - 0.02 | 0.009 |
| 95 – 110 | 170.5±0.53 | 172.3±3.23 | - 1. 68 | 0.12 | 0.23 | - 0.04 | 0.01 |
| >110 | 115.0±00 | 111.5±2.42 | 4.58 | 0.001 | 0.000 | 1.772 | 5.23 |

## DISCUSSION

The prevalence of LBW in this study was 15.5%. The study also discovered a statistically significant association between maternal predictors such as height, mean arterial blood pressure and GA with LBW. The prevalence recorded in this study was low compared to prevalence recorded in other studies conducted in Africa and Asia; 15.6%, 18.0%, 29.0%, 29.1% respectively[27,10,31,32].

However, this figure was considered high compared to the national average of 7.2% recorded in the 2013-2018 Nigeria National demographic survey. The import of this figure is an indictment on maternal health care services which influences maternal predictors of LBW. It is believed that improving general and maternal health care services will improve maternal variables that determine LBW.

The mean age of participants was 29.3±5.8 with minimum and maximum maternal age as 17 and 44 years respectively. The mean age recorded in this study was similar to the mean age in a similar study in Ethiopia with mean age of 28.7± years[10]. The mean maternal age in this study contrasted with mean age of 24.6 years recorded in a European study[24]. The similarity and difference observed could be attributed to socio-economic and cultural factors. It is expected that the mean age for African women should be lower than that of their European counterpart considering that age at first marriage (AFM) for African women was lower than that of Europeans[37,38]. Geopolitical zone, religion and level of education affects the national average for AFM. The AFM was higher in the Southern geopolitical region, among Christians and among educated persons[33]. Therefore, the mean age of participants in the study was high considering that the study was conducted in the south-south geopolitical region of the country, among a predominantly Christian (97.5%) population and in a literate society. Multivariate Logistic Regression (MVLR) model reveals no statistically significant association between maternal age and LBW. Interestingly, univariate logistic regression analysis reveals a significant association between maternal age 21-30 years and LBW with a significant negative linear correlation. It reasons that birth weight increases as maternal age decreases from 30 up to 21 years. The findings in this study replicates the results from a study conducted in Bangladesh with LBW common with maternal age less than 20 years and above 30 years[17]. Also, other studies reviewed were in congruence with the results from this study[27,34]. It is believed that the woman's reproductive system with associated biological variable will be at their optimal functional capacity at this age grade.

LBW was significantly associated with maternal mean arterial blood pressure. The prevalence of hypertension among participants was 5.2%. However, some studies identified high maternal blood

pressures prevalence[35], while others recorded lower prevalence[36]. Literatures reviewed concur with findings in this study which reveals the effect of hypertension in pregnancy and LBW[37,35]. It was shown that a 5mmhg increase in mean 24-hour diastolic blood pressure at 28 weeks gestation is associated with a 6g decrease in birth weight. Also, a similar change was seen with diastolic blood pressure at 36 weeks gestation with an average of 76g (24g-129g) decrease in birth weights[39]. It was shown that the mechanism responsible for LBW among hypertensives involves utero placental compromise and the overall effect on newborn depends on type and degree of hypertension[40].

An important predictor of LBW identified in this survey was gestational age (GA). An increase in GA above 37 weeks was significantly associated with an increase in birth weight. There was no discordant opinion among researchers on this issue. Most studies reviewed were in concordance with the results from this study[27,24,22].

It was shown that birth weight is determined by GA and fetal growth which are both products of internal (genetic) and environmental factors[28].

Maternal height and birth weight was identified as having a statistically significant association with a positive correlation coefficient. It was shown that birth weight increase as maternal height appreciates. Other studies were also in tandem with results obtained[23,24,31,25]. However, the cut-off for which height becomes a significant predictor is still not well established. Some studies identified height less than 145cm[31] while others predicted height below 150cm[26]. Also, it was revealed that LBW infants were at an additional risk of stunting and poor linear growth if born to short mothers[26]. Other maternal variables such as maternal haemoglobin concentration, maternal weight, occupation and marital status showed no significant association with LBW in this study. In contrast some researchers identified significant association between LBW and weight[21,32], maternal haemoglobin concentration[23,15] and occupation[10].

## CONCLUSION

Maternal variables such as age, mean arterial blood pressure, height and GA of newborn are significant predictors of LBW. It is therefore recommended by the researchers that concerted effort be made by policy makers and government to put in place policies to improve maternal health care services in the health sector with a view to reducing LBW infants and its attendant consequences by promoting the above-mentioned maternal predictors.

### Limitations

Few limitations which could bias the study were encountered which includes time of measurement of maternal weight. It was recommended that data for maternal weight and haemoglobin concentration be the measured value at term while birth weight be examined within ten minutes of delivery and before neonate was fed. Records which did not meet these criteria were also excluded.

### Conflict of Interest

The authors declare no conflict of interest

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