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Determinants of Low Infant Birth Weight in the Tamale Metropolis, Ghana

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Author's contribution

This work was carried out solely by the author.

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ABSTRACT

Aim: This study was conducted to assess the determinants of low infant birth weight in the Tamale metropolis of Ghana.
Study Design: Descriptive cross-sectional study.
Place and Duration of Study: Postnatal and child welfare clinics of the Tamale Central, West and Seventh Day Adventist Hospitals from January to June 2016.
Methodology: Structured questionnaire was used to collect data on socio-demographic characteristics of mothers and infants, maternal lifestyle activities, clinical variables and anthropometric measurements of 201 mothers who delivered singleton babies at the three-health facilities. These variables were assessed to determine their effect on birth weight outcome of infants. A multivariate logistic regression analysis was used to assess determinants of infant birth weight.
Results: The prevalence of low birth weight (LBW), normal birth weight and high birth weight (HBW) among infants delivered by respondents was 11.9%, 77.6% and 10.5% respectively. Haemoglobin concentration (9.9 ± 1.3 g/dL: P<.001), underweight mothers (aOR = 2.3, 95% CI = 1.0-5.0), mothers with no education (aOR = 3.9, 95% CI = 1.6-9.7) and mothers with more than 4 children (aOR = 6.5, 95 % CI = 1.5-28.0) are significant determinants associated with low birth

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weight.
Conclusion: Early pregnancy haemoglobin concentration (<10 g/dL), not educated, multiparity (>4) and being underweight are significantly associated with low birth weight outcomes. Mothers with more than 4 children, with early pregnancy heamoglobin and underweight should be given special clinical attention to avert low birth weight outcomes. Furthermore, sociodemographic data should be evaluated so attention can be given to uneducated pregnant women in a language they can understand.

Keywords: Infants; birth weight; early pregnancy; haemoglobin; Tamale; Ghana.

1. INTRODUCTION

Birth weight is the first weight of the baby measured within the first twenty-four hours after birth and it is an important indicator of the health of the foetus, neonate and infant and by extension the individual as well as the population. Birth weight is strongly associated with the survival of infants [1]. In most countries infants are not able to meet the normal birth weight range of 2.5-3.5 kg as defined by the World Health Organization [2] due to some influencing factors such as poor maternal nutrition and health before pregnancy and restricted foetal (intrauterine) growth during pregnancy. As a result of the birth weight deficit, the proportion of neonatal deaths has increased from 37% in 1990 to 44% in 2012 making some countries challenged in their attempt to achieve the set Sustainable Development Goal (SDG) 4 goal on Good Health and Well-being [3,4].

Elevated population mean birth weight has been linked to good maternity care and healthy living [5]. Abnormal birth weight has been known to have profound consequences on the health and productivity level of a given population with low birth weight (LBW) which serves as an indicative measure of intrauterine malnutrition been a risk factor of foetal and neonatal morbidity and mortality [2]. Low birth weight has been identified also as a risk factor for chronic diseases which occur later in life such as Type 2 diabetes, hypertension, and cardiovascular diseases which are responsible for deficits in growth and neurocognitive development [6,7]. Excessive birth weight (HBW) also known as macrosomia has been implicated in obstetric complications such as delayed labour, increased need for caesarean delivery, postpartum hemorrhage, birth injuries and for the baby, increased risk of development of cancer in adulthood [8-10]. Both LBW and macrosomia have been linked to obesity later in life of infants [10], with low birth weight believed to be associated with increased abdominal fat accumulation whereas macrosomia is believed to be concomitant with increased BMI [11]. Both pre-pregnancy body mass index (BMI) and gestational weight gain (GWG) outside of the recommended ranges have been associated with low birth weight and macrosomic births [11]. Overweight and obese women are at an increased and decreased risks of giving birth to too heavy and too low weighted neonates respectively [12].

Birth weight has emerged as the leading indicator of infant health and welfare and the central focus of infant health policy. In Ghana, these issues have not been comprehensively evaluated in part due to lack of or limited empirical data. In an era where neonatal death is still high in a developing country like Ghana that is also struggling to provide equal medical care for all its citizens, knowing the factors that influences birth weight outcomes will be crucial not only for the survival of the infant but for the overall development of the nation. This study was therefore aimed at assessing the determinants of low birth weight among neonates delivered within the Tamale metropolis.

2. METHODOLOGY

2.1 Study Site and Design

This cross-sectional study was conducted at the postnatal clinics of three (3) conveniently selected health facilities within the Tamale Metropolis from January to June 2016. These are the Tamale Central, West and Seventh Day Adventist Hospitals which serve as the three-main secondary public health facilities within the metropolis. The postnatal clinics are established by statutory requirements as promulgated by the Ghana Health Service in conjunction with The Ministry of Health, Ghana and are manned by professionally trained and certified midwives and nurses. Two clinic sessions in a week (Tuesdays and Thursdays) with about fifty (50) clients being attended to per week. All mothers who gave birth to singleton babies aged ≤ 3 months seeking postnatal and child welfare care at the postnatal clinics of the various health facilities were eligible to participate in the study. Written permission was obtained from the facility directors and the heads of the various postnatal and child welfare clinics to assess the study participants and their medical records. Participation was voluntary and informed consent was obtained from all the participants. Using the formula proposed by Daniel and Cross [13] and a LBW prevalence of 12% [14] a sample size of 158 was determined for which an additional 52 was added to account for attrition. In all a total of two hundred and ten (210) participants were contacted using convenient sampling of which 201 participants with complete medical records agreed to take part in the study giving a response rate of 96%. Ethical approval for the study was obtained from the Ethical Review Board of the School of Medicine and Health Sciences, University for Development Studies, Tamale, Ghana.

2.1.1 Exclusion criteria

Mothers who gave birth to babies with congenital defects, those with incomplete medical records, mothers without antenatal records and mothers who delivered at home were excluded from the study.

2.2 Data Collection and Definition of Variables

A self-designed structured questionnaire was used to collect data from participants. The items on the data collection tool were pretested on 20 participants to evaluate their comprehension and understanding of the items. The pretest results were not included in the analysis of the final results. Information about respondents and infants' sociodemographic characteristic, maternal lifestyle activities, gestational age, clinical data and anthropometric measurements were collected. Sociodemographic characteristics such as maternal age, marital status, religious affiliation, educational status, employment status, gender of infant, parity of the mother and number of antenatal visits were extracted from the maternal antenatal records.

Clinical variables such as gestational age, early pregnancy haemoglobin level, systolic and diastolic blood pressures, illness during pregnancy, birth weight of baby, the type of reproductive health such as family planning practice and the number of times respondents visited the antenatal clinic were also collected. Respondents with early pregnancy haemoglobin level of <12.0 g/dL were classified as anaemic and normal if their haemoglobin level was between ≥12.0 g/dL as defined by the WHO [15]. Systemic hypertension was defined as systolic blood pressure of ≥140 mmHg and/or diastolic blood pressure of ≥90 mmHg [16]. Illness of respondents was based on maternal medical condition as diagnosed and written in the antenatal health record book. Birth weight of < 2500 g was classified as low birth weight (LBW), 2500 to 4000 g as normal birth weight (NBW) and >4000 g as High birth weight (HBW) [2].

Anthropometric measurements such as weight and height of the mothers during early pregnancy were taken. Weight was measured to the nearest 0.1 kilograms using a weighing scale (Seca, Germany) and height was measured to the nearest 1 centimetre using a stadiometer (Seca, Germany). The early pregnancy weight of respondents was used as the maternal weight at conception because of the unavailability of prepregnancy weight, also self-reported prepregnancy weight has been noted to vary by sociodemographic factors and despite these variations among individuals weight gain during the first trimester of pregnancy is small (1-2 kg) [17,18]. Maternal height at first antenatal visit was taken and categorized into short stature defined as a height of <155 cm and normal height ≥155 cm [19]. Participants were made to stand in the anatomical position and their arms by their side with an evenly distributed body weight while the measurements were done. Maternal body mass index (BMI) was calculated as weight over height squared and expressed as kg/m^2.

2.2.1 Definition of variables

Educational status was defined as no education, basic education, secondary level and above. Employment status was categorized into employed and unemployed. Maternal lifestyles activities such as undertaking some form of physical activity, drinking of beverages, craving for food and non-food substances were obtained through direct interview. Gestational age was defined as premature if baby was delivered before 37 weeks of gestation, term if birth occurred within 37 weeks to 42 weeks of gestation and post-term if birth occurred after 42 weeks of gestation as defined by the American College of Obstetricians and Gynaecologists (ACOG) [20]. Maternal BMI of <18.5 kg/m^2, 18.5–24.9 kg/m^2, >25.0–29.9 kg/m^2 and >30.0 kg/m^2

were used to define underweight, normal weight, overweight and obesity respectively according to the current WHO reference [13].

2.3 Data Analysis

All data were entered and analyzed using the IBM SPSS v 23 (www.ibm.com, USA) and Graphpad prism version 6 (GraphPad Software, Inc, USA). Descriptive statistics including means and standard deviations (S.D.) were computed for continuous variables and frequency distributions for categorical variables. Continuous variables were compared using the t-test and one-way ANOVA, whilst categorical variables were compared using the Chi-square test. A logistic regression analysis was conducted to assess risk factors associated with birth weight as the dependent variable. Independent variables were stratified by maternal and infant variables. For all statistical tests, *P*-value < .05 was considered statistically significant.

3. RESULTS

3.1 Birth Weight of Infants Stratified by Maternal and Infant Socio-Demographic Characteristics

Table 1 summarizes maternal characteristics stratified by infant birth weight. A total of 201 mothers with singleton babies with overall mean infant birth weight of 2.97 (0.52) kg took part in the study. The mean age of the mothers was 27.4 (5.7) years. No significant differences were observed in the mean maternal ages of the study respondents when stratified by infant birth weight. The mean haemoglobin concentration (9.9 ± 1.3 g/dL; *P* < .001) for mothers with low birth weight babies was significantly lower when compared with the haemoglobin concentration of mothers with normal (10.7 ± 1.2 g/dL) and high (11.3 ± 1.0 g/dL) birth weight babies respectively.

3.2 The Percentage Distribution of Infant Birth Weight Stratified by Gender

The prevalence of LBW, NBW and HBW among the infants delivered by the respondents was 11.9%, 77.6% and 10.5% respectively. Fifty-two percent (115/201) of the infants delivered were males. A greater percentage of males 58% (14) delivered had low birth weight compared to females who had higher percentage being high birth weight babies (Table 2).

3.3 Multivariate Analysis of Study Variables and Their Effect on Infant Birth Weight

Multivariate logistic regression analysis was conducted to assess maternal and infant socio-demographic characteristic as risk factors for low birth weight. From Table 3, it was observed that respondents who were not married were three times more likely to deliver infants with low birth weight (aOR = 3.1, 95% CI = 1.2-7.7, *P*-value = .02). Educational status was found to be a significant factor associated with infants' birth weight with mothers who have had no education being 4 times more likely to deliver low birth weight infants (aOR = 3.9, 95% CI = 1.6-9.7, *P*-value = .03). Unemployment status of respondents though significant was less likely to be associated with low birth weight of infants (aOR = 0.43, 95% CI = 0.2-0.9, *P*-value = .02). Mothers who have delivered 4 or more children were approximately 7 times more likely to give birth to infants with low birth weight. (aOR = 6.5, 95% CI = 1.5-28.0, *P*-value = .01). Mothers who did not engage in any form of physical activity

Table 1. Maternal characteristics stratified by birth weight

Variable	Total (n=201)	LBW (n=40)	NBW (n=153)	HBW (n=8)	*P-value*	F
Age	27.4 ± 5.7	26.9 ± 7.2	27.5 ± 5.3	28.3 ± 5.8	0.78	0.25
Hb (g/dL)	10.6 ± 1.3	9.9 ± 1.3***	10.7 ± 1.2	11.3 ± 1.0	<.001	8.44
DBP (mmHg)	70.8 ± 12.1	70.3 ± 10.1	70.9 ± 12.8	70.5 ± 8.4	.96	0.04
SBP (mmHg)	116.9 ± 21.8	120 ± 23.8	117 ± 21.5	107 ± 11.4	.35	1.07
Height (cm)	162.2 ± 8.4	162.0 ± 8.6	162 ± 8.4	162 ± 9.9	.97	0.04
BMI (kg/m^2)	23.3 ± 4.8	22.5 ± 5.5	23.5 ± 4.7	23.4 ± 3.5	.53	0.63
Gestational age (wks)	37.8 ± 2.7	37.1 ± 3.8	37.9 ± 2.4	38.6 ± 2.6	.17	1.80

Data are presented as means ± SD. LBW - Low birth weight, NBW - Normal birth weight, HBW - High birth weight. Hb – Early haemoglobin, DBP - diastolic blood pressure, SBP - Systolic blood pressure, BMI - Body mass index. P-value defines the level of significance when LBW and NBW were compared to NBW as the control (ANOVA with Dunnets post-hoc test) were observed to be approximately three times more likely to give birth to low birth weight infants, though this was not significant (aOR = 2.8, 95% CI = 1.3-5.9, *P*-value = .07). Other maternal lifestyle and reproductive health activities were found to have no significant effect on birth weight outcomes in the multivariate analysis. It was observed that underweight respondents were two times more likely to deliver underweight infants though marginally significant (aOR = 2.3, 95% CI = 1.0-5.0, *P*-value = .046). Other maternal anthropometric characteristics, gestational age and clinical variables were not significantly associated with birth weight outcomes.

Table 2. Percentage distribution of infant birth weight stratified by gender

Birth weight	Total N=201 (n/N%)	Male N=115 (n/N%)	Female N=86 (n/N%)
LBW	24 (11.9)	14 (58.3)	10 (41.7)
NBW	156 (77.6)	90 (57.7)	66 (42.3)
HBW	21 (10.5)	11 (52.4)	10 (47.6)

Data are presented as absolute values and percentages. LBW - Low birth weight, NBW - Normal birth weight, HBW - High birth weight.

Table 3. Multivariate analysis of study variables and their effect on birth weight

Variable	aOR (95% CI)	*P*-value
Age at birth		
26-35	*Ref*	
15-25	1.8 (0.9-4.0)	.12
>35	1.7 (0.6-4.7)	.29
Religion of mother		
Christian	*Ref*	
Muslim	1.4 (0.5-4.4)	.54
Marital status		
Married	*Ref*	
Single	3.1 (1.2-7.7)	.02
Educational status		
≥2^{o} education	*Ref*	
No education	3.9 (1.6-9.7)	.03
Basic education	1.5 (0.6-3.6)	.36
Employment status		
Employed	*Ref*	
Unemployed	0.43 (0.2-0.9)	.02
Gender of child		
Male	*Ref*	
Female	0.76 (0.4-1.5)	.45
Parity		
1	*Ref*	
2 to 4	0.5 (0.2-1.0)	.04
>4	6.5 (1.5-28.0)	.01
Undertook some physical activity		
Yes	Ref	
No	2.8 (1.3-5.9)	.07
Intake of beverage		
No	Ref	
Yes	1.6 (0.8-3.3)	.17
Food craving		
No	Ref	
Yes	0.8 (0.4-1.7)	.64
Practiced family planning		
No	Ref	
Yes	1.3 (0.5-2.9)	.54
No. of ANC visits		
≥4	Ref	

Variable	**aOR (95% CI)**	***P*-value**
<4	0.4 (0.1-3.5)	.43
Early-pregnancy BMI		
Normal	*Ref*	
Underweight	2.3 (1.0-5.0)	.046
Overweight	1.1 (0.4-3.3)	.85
Obese	0.9 (0.2-3.4)	.88
Height (cm)		
Normal stature	*Ref*	
Short stature	0.9 (0.4-2.4)	0.86
Early pregnancy heamoglobin concentration		
Normal	*Ref*	
Anaemic	2.1 (0.5-9.5)	.34
Gestational age		
Term	*Ref*	
Pre-term	1.2 (0.5-2.8)	.64
Post-term	1.1 (0.1-9.7)	.97
Hypertension		
No	*Ref*	
Yes	1.0 (0.3-3.2)	.99

aOR-Adjusted odds ratio. CI – Confidence interval, 2^o – secondary, Ref – Reference variable

4. DISCUSSION

This study was aimed at assessing the determinants of birth weight in the Tamale metropolis of Ghana. Prevalence of LBW, NBW and HBW among infants delivered by the respondents was 11.9%, 77.6% and 10.5% respectively. The mean ± SD birth weight of the infants delivered by the respondents was 2.97 ± 0.52 kg. Maternal early pregnancy haemoglobin concentration, maternal educational and employment status, parity and early pregnancy BMI were identified as major determinants of infant birth weight outcome within the Tamale metropolis.

The mean birth weight of infants identified in this study (3.0 kg) was found to be within the World Health Organization (WHO) recommended normal birth weight of 2.5 kg to 4.0 kg [2], however, it was noted to be higher than the mean birth weight of 2.9 ± 0.5 kg reported by Saaka in 2013 within the same geographical set up.

The prevalence of LBW identified in this study (11.9%) compared favourably with the prevalence of LBW reported by [12] in a similar setting in Ghana, it was however lower than the World Health Organization estimated global prevalence of LBW of 15.5% [2] and an earlier reported prevalence of 17.0% by Saaka in 2013 [21]. Prevalence rate of NBW and HBW identified in this study confirmed earlier reports of Abubakari et al. in 2015 [12].

Low mean maternal early pregnancy haemoglobin concentration (anaemia) as noted in earlier findings by Sekhavat et al. [22] and also Ren et al. [23] to be significantly associated with the delivery of LBW was confirmed in this study. Reduction in maternal early pregnancy haemoglobin concentration is a normal physiological response of pregnancy as a result of expansion of plasma volume and lowering of haemoglobin levels [24]. However, if there is no intervention, reduced maternal anaemic concentration can lead to stunted growth, reduced store of other essential nutrients and perinatal complications in the infant subjecting them to an increased chance of mortality in their first year of life [25,26].

Various studies across different countries has revealed the significant influence of higher maternal educational status on positive birth weight outcomes [15,27-29]. These findings were confirmed in this study as mothers with no education were observed to be more likely to deliver LBW infants. No education as noted by Muula et al. [30] has been identified to result in low income and low dietary literacy leading to a cascading negative effect on infants birth weight outcomes.

Findings from this study also revealed a strong association between maternal marital status and birth weight outcomes with married respondents more likely to deliver infants with NBW confirming earlier assertions by Shah et al. [31] in the USA, Foix-L'Hélias and Blondel [32] in

France, Phung et al. [33] in Yemen and Saaka [21] in Ghana.

The significant association of maternal unemployment status on low birth weight outcomes as established by Dooley and Prause [34] and Raisanen et al. [35] was confirmed in this study. Similar findings by Casas et al. [36] showed that employed mothers had a lower risk of delivering LBW than unemployed. Maternal unemployment status can lead to stressful situations associated with decreased or no income and these stressors increases a gamut of physiological factors linked to the delivery of LBW [37]. On the contrary, findings from Kozhimannil et al. [38] did not find any association between maternal employment status and birth weight of infants.

Earlier reports by Nazari et al. [27] in which the risk of LBW was seen to decrease significantly with increasing parity was not observed in this study. However, finding from this study confirmed Yadev and Lee [28] in which increasing parity above four (4) was strongly associated with LBW. Interestingly, respondents with 2-4 infants were less likely to give birth to LBW and this was seen to be consistent with findings of Muula et al. [30] in a national representative sample of Malawian women.

A significant finding of this study is the effect of early pregnancy BMI on birth weight outcomes. Early pregnancy BMI of mother which gives a fair indication of pre-pregnancy weight of mother [17] has been shown to influence the outcomes of birth weight of infants as noted in earlier reports [28,39]. Early pregnancy BMI below normal (underweight) was found to be significantly associated with a risk of delivering a LBW infant and mothers with normal early pregnancy BMI delivers infants with NBW. Normal BMI enhances the availability of nutrients to the growing foetus as it is affected by what the mother consumes and this ensures adequate availability of nutrients for the proper growth of the foetus [40]. The findings of reduced early pregnancy BMI being a risk factor for the delivery of LBW infant is also in agreement with previous findings by [29,41].

Gestational age which has been known to play a significant role in the birth weight of infants with previous studies finding a strong association between gestational age and birth weight outcomes [42,43] could not be confirmed in this study.

The limitation of the study was that this study was a cross-sectional study which makes it difficult to establish causality and also all the participants were from secondary and tertiary health facility and the finding cannot be generalized for all birth weight outcomes in Tamale and Ghana.

5. CONCLUSION

Findings from this study bring to bear the significant influence of age at conception, marital status of mothers, early pregnancy BMI and early pregnancy haemoglobin levels on birth weight outcomes and it emphasizes the importance of these factors in predicting birth weight outcomes in the study area. Antenatal health providers can target these factors to reduce the incidence of LBW.

CONSENT

Informed consent was obtained from all the participants and the heads of the facilities.

ETHICAL APPROVAL

Ethical approval for the study was obtained from the Ethical Review Board (ERB) of the School of Medicine and Health Sciences, University for Development Studies, Ghana.

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COMPETING INTERESTS

Author has declared that no competing interests exist

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