Maternal risk factors and neonatal outcomes associated with low birth weight in a secondary referral hospital in Ghana

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ABSTRACT

Introduction: Over the past decade, the incidence of low birth weight (LBW) in sub-Saharan Africa has not seen any decline and this is a matter of grave concern for healthcare providers, policymakers, and researchers. Therefore, this study aimed to assess the incidence of LBW and related maternal risk factors (during pregnancy or delivery) as well as neonatal outcomes.

Methods: An institutional-based retrospective cross-sectional study design was employed to select 1,017 mothers who delivered in the study hospital from January to December 2017 with singleton newborn babies without congenital diseases. Data were analysed using STATA version 14.1 (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: Stata Corp LP). Chi-square test of independence was used to test the association between the dependent variable (LBW) and risk factors of LBW. Bivariate and multivariable unconditional logistic regression was used to determine the factors associated with LBW.

Results: The incidence of LBW was 23.7%. The findings show that being married has a protective effect on LBW [AOR = 0.60 (95% CI: 0.40–0.90), p = 0.013] compared to single mothers. Neonates born between gestational age of 37–42 weeks had 85% lower odds of LBW [AOR = 0.15, (95% CI: 0.10–0.24), p < 0.001]. Neonates with LBW had a higher risk of low Apgar score in the first minute compared to neonates with normal birth weight [AOR = 0.52 (95% CI: 0.37–0.73), p < 0.001]. Female neonates had 64% higher odds of LBW compared to their male counterparts [AOR = 1.64 (95% CI: 1.19–2.24), p = 0.002].

Conclusion: This study revealed a high incidence of LBW. Women’s marital status (single mothers), gestational age (<37 weeks), neonatal sex (female), are independent risk factors associated with LBW, while a higher risk of an Apgar score of less than 7 in the first minute was an independent outcome of low birth weight births. The current study findings contribute to the growing literature on the influence of maternal and neonatal factors on LBW in resource-constrained settings. These findings could guide healthcare providers, hospital administrators, stakeholders, and policymakers to develop and implement appropriate clinical and public health strategies aimed at reducing LBW.
1. Introduction

Birth weight is critical in determining a neonate’s survival, health, and development [1]. Low birth weight (LBW) defined as birth weight less than 2500 g irrespective of gestational age is considered a major health concern of newborns [2]. It is a contributing cause of death in 40–60% of newborns around the globe [3], particularly in sub-Saharan Africa (SSA), where most LBW babies are born [2]. It has been estimated that 15%–20% of all births worldwide are LBW, which corresponds to more than 20.5 million births a year. Almost all (95%) of these occur in low- and middle-income countries [2]. Over the past decade, the incidence of LBW in SSA has not seen any decline [4]. This is a matter of grave concern for healthcare providers, policymakers, and researchers. Babies born with LBW are at risk of developing many health problems including; hypothermia, hypoglycaemia, cognitive disabilities, malnutrition, low intelligence quotient, among others [4, 5]. Consequently, infants with LBW are 20 times more likely to die from complications compared with their counterparts with normal birth weight [1].

Various factors are associated with LBW; of which many are attributed to low socio-economic standing [6]. In SSA, maternal malaria infection is an important predictor of adverse birth outcomes, including LBW or premature birth. Studies from Congo [7] and Malawi [8] indicated that 94.5% and 28.5% of LBW babies were born to mothers who had malaria respectively. Other factors within the prenatal period [9, 10], and delivery outcomes [11], as well as parasitic related factors [12, 13], have been found in previous studies to be associated with LBW. The incidence of LBW is rising and continue to be a major challenge across the globe despite the numerous strategies aimed at addressing it [14]. The UNICEF-WHO 2019 report indicates slow progress on the reduction of the incidence of LBW with a decline of the annual rate of progress in the 2010–2015 period compared with the 2000–2009 period around the globe, thus, threatening the global efforts aimed at ending preventable neonatal mortalities and reducing the number of children suffering from stunting and wasting [15]. If the current trend is allowed to continue, the 2025 WHA low birth weight target may not be achieved. This will subsequently impede the attainment of the 2030 Sustainable Development Goals. The United Nations Children's Fund (UNICEF) report indicated that most LBW infants die in the neonatal period [3]. It has also been reported that most of these LBW babies are born in informal delivery settings, without being weighed, thereby resulting in underestimation of the magnitude of the problem [15]. Despite these challenges, data on LBW in the sub-Saharan African continent including Ghana is limited. An understanding of the incidence and influencing factors of LBW deliveries are important to health care providers, hospital administrators, stakeholders, and policymakers as the feedback garnered could be used to design and implement appropriate strategies relevant for the prevention and/or reduction of LBW. Therefore, this study aimed to assess the incidence of LBW and related maternal risk factors (during pregnancy or delivery) as well as neonatal outcomes.

2. Methods

2.1. Study design, population, and sampling method

An institutional-based retrospective cross-sectional study design was employed. The target population was mothers who delivered in the hospital from January to December 2017 with singleton newborn babies without congenital conditions. We used a convenience sampling method per retrospective chart review research [16] to select 1,017 mothers and singleton newborn babies for the study.

2.2. Study setting

The Trauma and Specialist Hospital (TSH), Winneba, was the centre for this study. The TSH is a specialised secondary referral health facility that is now upgraded to the Central Regional General Hospital. It is located at Winneba, in the Effutu Municipality. It serves as the last referral point for the other Hospitals, Health Centres, and Clinics in the municipality and beyond. The study was carried out at the Neonatal Intensive Care Unit (NICU) located in the paediatric ward and the maternity ward of the hospital. At the time of this study, the NICU had five beds, four baby cots, four functioning incubators, and five functioning phototherapy machines. Due to the national phenomenon of acute shortage of specialist neonatologists, routine care of neonates in many NICUs in Ghana is rendered by medical officers and paediatric nurses or general nurses with additional training in neonatal care.

2.3. Outcome variable

Birth weight was considered as the outcome variable. Singleton-live-babies with birth weight (<2500g) without any congenital diseases and irrespective of the gestational age was considered LBW while singleton live babies with birth weight equal to or more than 2500g were considered normal birth weight. The outcome variable was extracted based on this criterion and coded as a dichotomous variable: 1 “normal birth weight (≥2500g)” and 0 “LBW (<2500g)”.

2.4. Explanatory variables

A structured data extraction questionnaire was designed based on related literature review [6, 17, 18, 19, 20, 21] and by also adopting portions of a previous study by WHO in South East Asian region in order to suit the study setting and the purpose of the study. The data extraction tool was categorised into two sections; namely; maternal & neonatal sociodemographic characteristics, and prenatal and obstetric characteristics. The sociodemographic characteristics included; mothers’ age which was categorised into three groups; <20yrs, 21–30yrs, and 31–46years. The marital status of mothers was classified as single, married, and widowed. Educational level was categorized as; no formal education & formal education. Occupation of mothers was categorised as housewife, civil servant, trader, and student. The prenatal and obstetric characteristics consisted of the following; gravidity (primigravida and multi-gravida); parity (primiparity and multipara); foetal presentation (cephalic, breech, transverse, oblique and longitudinal); gestational age (<37 weeks, 37–42weeks & >42 weeks); mode of delivery (spontaneous vaginal delivery, caesarean section delivery & vacuum delivery); Antenatal care (ANC) visit (yes/no); Hypertensive disorder (yes/no); Bleeding disorder (yes/no); UTI/STI (yes/no); PROM (yes/no) and Pre-eclampsia (yes/no). Neonatal factors were; neonatal sex, Apgar score in the first minute, Apgar score in the fifth minute, meconium urine, resuscitated, and cried at birth. Neonatal sex was classified as male and female. Apgar scores in the first minute and fifth minute were categorised into two (<7 & ≤7). Meconium was categorised into meconium passed and none. Urine was classified as passed and none. Resuscitation of the neonate at birth was classified as yes and no. Neonate cried at birth was classified as yes and no.

2.5. Data collection

Four research assistants were recruited for data extraction. They were nurses trained on how to review maternal and neonatal medical records for related information. After administrative approval to review maternal records, retrospective data extraction commenced. The medical records of the neonates and mothers were retrieved from the Records Department and the Maternity registry. The hospital records personnel were involved in the search and retrieval of maternal and neonatal folders. These medical records were handed over to the research assistants for record validation and extraction of relevant neonatal, prenatal, and obstetrical medical history.

An average of 60 maternal and neonatal medical records was retrieved each day for four weeks. The inclusion criteria required all medical records to have an institutional number for easy linkage of the records.
neonates with the respective mothers. Maternal and neonatal records were considered valid if they had no missing information needed for the study. We excluded all women with unknown child status (i.e. whether dead or alive), stillbirths, and missing birth weight. Mothers that had twin deliveries were also excluded based on the assumption that they had different risks and aetiology for LBW and preterm delivery [22]. The research assistants were constantly monitored and data extracted were compared to the information in the maternal and neonatal medical record books to avoid errors. Data abstractors had scheduled meetings to resolve data conflicts and ensure clarity.

2.6. Data analysis

Data were analysed using STATA version 14.1 (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: Stata Corp LP). Descriptive statistics were used for categorical data. Chi-square test of independence was used to test the association between the dependent variable (LBW) and risk factors of LBW. Bivariate and multivariable unconditional logistic regression was used to determine the factors associated with LBW. A p-value of 0.05 or less and a confidence level of 95% was considered statistically significant. Variables that showed significance in the bivariate logistic regression were used for the multivariable logistic regression; however, Apgar score at the fifth minute was excluded from the final model due to its high Variance Inflation Factor (VIF) after multicollinearity diagnostic test. All variables were included in the logistic regression analysis, although the results are presented under three categories: socio-demographic, maternal and obstetric factors, and neonatal outcomes.

2.7. Ethical consideration

The University of Health and Allied Sciences Research Ethics Committee (UHAS-REC/A.3 [8] 17-18) approved the study. Permission to commence the study was obtained from the management of Trauma and Specialist Hospital. Since this study was retrospective by design, there was no verbal nor written informed consent from participants whose data was used. Anonymous data entry was done to ensure confidentiality.

3. Results

3.1. Socio-demographic characteristics

The study showed that 23.7% of the newborns had LBW less than 2500g. The majority, 58.2% of the mothers were aged 21–30 years, and 83.6% were married. A majority, 87.7% of the mothers had ever been educated, and most, 59.9% engaged in trading (Table 1). From Table 3, neonates who were males (50.9%) were slightly higher than the females (49.1%).

3.2. Maternal sociodemographic factors associated with low birth weight

Bivariate logistic regression analysis revealed that mothers who were married were 31% less likely to have neonate with low birth weight compared to single mothers [COR = 0.69, (95%CI: 0.47–1.00), p = 0.049] (Table 1).

3.3. Prenatal and obstetric factors associated with low birth weight

Chi-square test of independence showed that gestational age was significantly associated with LBW (χ² = 102.0, p < 0.001). Hypertensive disorder was also significantly associated with LBW (χ² = 5.76, p = 0.016). Bivariate logistic regression analysis further revealed that the odds of LBW was 85% lower in gestational age 37–42 weeks [COR = 0.15 (95%CI: 0.10–0.22), p < 0.001] and 83% lower in gestational age above 42 weeks [COR = 0.17 (95%CI: 0.08–0.34), p < 0.001] compared to gestational age less than 37 weeks. Mothers with hypertensive disorder had 76% higher odds of having a neonate with LBW [COR = 1.76, (95%CI: 1.10–2.81), p = 0.018] (Table 2).

3.4. Estimates of risks for neonatal outcomes according to birthweight

Chi-square test of independence showed that LBW was associated with neonatal sex (χ² = 6.86, p = 0.009), Apgar score in the first minute (χ² = 27.06, p < 0.001) and fifth minute (χ² = 21.81, p < 0.001), resuscitation (χ² = 5.12, p = 0.024) and crying at birth (χ² = 7.11, p = 0.008). Bivariate logistic regression analysis also revealed that neonates who were female had 47% higher odds of LBW compared to their male counterparts. LBW neonates had a higher risk of having Apgar scores less than 7 in the first and fifth minute as compared with neonates with normal weight. LBW neonates had 52% higher odds of being resuscitated compared to the normal birth weight neonates [COR = 1.52 (95%CI: 1.06–2.19), p = 0.024]. LBW neonates had 40% lower odds of crying immediately after birth than normal birth weight neonates [COR = 0.60 (95%CI: 0.60–0.87), p = 0.008] (Table 3).

### Table 1. Maternal socio-demographic factors associated with low birth weight.

| Variables          | NBW n= (%) | LBW n= (%) | Total n= (%) | χ²       | p-value | COR [95% CI] | p-value |
|--------------------|------------|------------|--------------|---------|---------|-------------|---------|
| Age                |            |            |              |         |         |             |         |
| ≤20 years          | 40 (5.1)   | 20 (8.3)   | 60 (5.9)     | 1       |         |             |         |
| 21–30 years        | 454 (58.5) | 138 (57.2) | 592 (58.2)   | 0.61    | [0.34–1.07] | 0.087      |         |
| 31–40 years        | 273 (35.2) | 79 (32.8)  | 352 (34.6)   | 0.58    | [0.32–1.05] | 0.070      |         |
| >40 years          | 9 (1.2)    | 4 (1.7)    | 13 (1.3)     | 3.80    | 0.284   | 0.89 [0.24–3.24] | 0.858  |
| Marital status     |            |            |              |         |         |             |         |
| Single             | 115 (14.6) | 48 (19.9)  | 161 (15.8)   | 6.56    | 0.011   |             |         |
| Married            | 658 (84.8) | 192 (79.7) | 850 (83.6)   | 0.69    | [0.47–1.00] | 0.049      |         |
| Widowed            | 5 (0.6)    | 1 (0.4)    | 6 (0.6)      | 4.07    | 0.130   | 0.47 [0.05–4.14] | 0.497  |
| Religion           |            |            |              |         |         |             |         |
| Christian          | 670 (86.3) | 203 (84.2) | 873 (85.8)   | 0.08    |         |             |         |
| Muslim             | 106 (13.7) | 38 (15.8)  | 144 (14.2)   | 0.67    | 0.412   | 1.18 [0.79–1.77] | 0.413  |
| Educational level  |            |            |              |         |         |             |         |
| Educated           | 675 (87.0) | 217 (90.0) | 892 (87.7)   | 1       |         |             |         |
| Not educated       | 101 (13.0) | 24 (10.0)  | 125 (12.3)   | 1.59    | 0.207   | 0.74 [0.46–1.18] | 0.208  |
| Occupation         |            |            |              |         |         |             |         |
| Civil servant      | 145 (18.7) | 39 (16.2)  | 184 (18.1)   | 1       |         |             |         |
| Housewife          | 106 (13.6) | 40 (16.6)  | 146 (14.4)   | 1.40    | [0.84–2.33] | 0.191      |         |
| Trader             | 467 (60.2) | 143 (59.3) | 610 (59.9)   | 1.14    | [0.76–1.70] | 0.525      |         |
| Student            | 58 (7.5)   | 19 (7.9)   | 77 (7.6)     | 1.80    | 0.614   | 1.22 [0.65–2.28] | 0.538  |

NBW: Normal Birth Weight. LBW: Low Birth Weight.
3.5. Multivariable logistic regression showing factors associated with low birth weight

Table 4 shows a multivariable logistic regression analysis of factors associated with LBW. Neonates whose mothers were married had 40% lower odds of LBW compared with single mothers [AOR = 0.60 (95%CI: 0.40–0.90), p = 0.013]. The odds of LBW were 85% and 81% lower in 37–42 weeks and above 42 weeks’ gestational age compared to below 37 weeks’ gestational age [AOR = 0.15, (95%CI: 0.10–0.22), p < 0.001; AOR = 0.19 (95%CI: 0.09–0.38), p < 0.001] respectively. Female neonates had 64% higher odds of LBW compared with their male counterparts [AOR = 1.64 (95%CI: 1.19–2.24), p = 0.002]. Neonates with LBW...
Table 4. Multivariable logistic regression showing factors associated with low birth weight.

| Variables                  | AOR     | 95% CI     | p-value |
|----------------------------|---------|------------|---------|
| Marital status             |         |            |         |
| Single                     | 1       |            |         |
| Married                    | 0.60    | 0.40–0.90  | 0.013   |
| Widowed                    | 0.46    | 0.05–4.15  | 0.487   |
| Gestational Age            |         |            |         |
| <37                        | 1       |            |         |
| 37–42                      | 0.15    | 0.10–0.24  | <0.001  |
| >42                        | 0.19    | 0.09–0.38  | <0.001  |
| Hypertensive Disorder      |         |            |         |
| No                         | 1       |            |         |
| Yes                        | 1.42    | 0.85–2.38  | 0.182   |
| Neonatal sex               |         |            |         |
| Male                       | 1       |            |         |
| Female                     | 1.64    | 1.19–2.24  | 0.002   |
| Apgar score 1<sup>st</sup> min. |         |            |         |
| <7                         | 1       |            |         |
| ≥7                         | 0.52    | 0.37–0.73  | <0.001  |
| Resuscitated at birth      |         |            |         |
| No                         | 1       |            |         |
| Yes                        | 0.61    | 0.34–1.10  | 0.100   |
| Cried at birth             |         |            |         |
| No                         | 1       |            |         |
| Yes                        | 0.65    | 0.36–1.19  | 0.162   |

had a higher risk of low Apgar score in the first minute compared with the normal birth weight neonates \[AOR = 0.52 \ (95\% CI : 0.37–0.73), p < 0.001\].

4. Discussion

The incidence of LBW among neonates in this study was 23.7%. Our finding is lower than studies conducted in the northern region of Ghana that reported incidence rates of 26% [17] and 29.6% [18] but higher than the national prevalence rate of 10% [23]. The present study finding is also higher than several previous studies conducted in different parts of Ghana, which reported 13.8% in the Upper East region [19], 9.69% in the Volta region [20], and 10% in the Brong Ahafo region [21]. The disparities in the prevalence rates across different regions of Ghana may be due to methodological differences. Also, the higher rates observed in the northern region might be due to the high poverty level in this part of the country than the current study region. The national study was a Multiple Indicator Cluster Survey and a household survey programme developed by UNICEF. The difference in the incidence rate of the present study and the national figure could be due to the population differences. The target population for the national survey was households whiles the present study involved hospital deliveries. The higher incidence rate in this study is likely to be due to the higher proportion of complicated pregnancies and deliveries that referral hospitals do receive with a higher proportion of the referrals likely to be LBW. Though the national incidence of LBW is low, this study found a double fold of the national figure. In order to contribute as a country to the commitment of achieving the WHA low birthweight target by 2025 and the Sustainable Development Goals (SDGs) by 2030, we recommend a regional assessment of the incidence rates of LBW and its specific causes. This will further inform policymakers and health professionals on critical areas/high-risk approaches that need to be implemented to improve women's health before, during, and after pregnancy.

The study found a positive association between marital status and LBW in the logistic regression model. It was observed that women that were married had 40% lower odds of having a neonate with LBW. This finding is consistent with a study conducted in the upper east region of Ghana where the married woman was found to be protective against LBW [19]. In the Ghanaian setting, most men (husbands) are the heads of their families and assume important roles of providing for the needs of the wife, including making decisions regarding seeking the services of skilled care during pregnancy [24]. A recent study conducted by Bougangue and Ling [25] in Ghana found that Ghanaian men were involved in some maternity care at the household and community settings where husbands bore the cost of healthcare [25] and also supported their wives to utilise antenatal and post-natal care. Another study in Ghana revealed that most Ghanaian men want to be part of the pregnancy and delivery process and to see what happens to their wives and babies during this critical stage of the woman's life [26]. Married women having the lower odds of giving birth to a LBW neonate could be due to the husbands' support both financially and physically, placing the women in a good psychological state during pregnancy and childbirth.

The study found neonatal gender to be positively associated with LBW, where female neonates had 64% higher odds of LBW compared with their male counterparts. This finding is consistent with a study conducted by Agorinya et al. [19] and Manyeh, et al. [27], in the Northern and Southern parts of Ghana respectively, where female neonates had increased odds of LBW. Also, Abubakari, Kynast-Wolf, and Jahn [17] found that being a male neonate was protective against LBW in the northern part of Ghana. A study conducted in the Tshwane District of South Africa also revealed a similar finding with the current study [6], however, a contrary finding was reported in Zimbabwe where female neonates were found to be protective of low birth weight [28]. The similarities and disparities in the study findings above with neonatal gender as a risk factor of LBW can be clarified by further studies to establish the variation of neonatal gender as a risk factor of LBW.

This study observed a significant association between gestational age and LBW. Neonates who were born at term (37 weeks of gestation and more) were 85% less likely to have LBW compared with preterm babies \[AOR = 0.15, \ (95\% CI: 0.10–0.24), p < 0.001\]. The current study finding is similar to findings reported in Ethiopia. It was further revealed that neonates born before the gestational age of 37 weeks were more likely to have LBW compared to their full-term counterparts [29]. Also, the current study result is in line with another study conducted in Tigray, Northern Ethiopia where gestational age was independently associated with the incidence of LBW: it was observed that neonates born at a gestational age of 37 weeks or more were protective against LBW [30, 31]. It is evident that if the gestational age of the fetus falls below the normal range of time (37 weeks of gestation), there is a dramatic reduction of the bodyweight of the fetus due to prematurity [32]. To prevent premature birth, it is imperative to timely manage any gynecological, medical, or other conditions that may be the possible cause of premature delivery during pregnancy.

Infants with LBW had a higher risk of a low Apgar score in the first minute compared with the normal birth weight infants. Similarly, a study conducted in Tanzania reported that babies born with LBW had an increased risk of a low Apgar score in the first and fifth minutes [33]. Another study by Countinho, et al. [34] found a significant association
between neonates born with LBW and a low Apgar score in the first and fifth minutes. This similarity in the study findings confirms that the incidence of low Apgar scores is inversely proportional to birth weight [35, 36].

The current study did not find an association between hypertensive disorders in pregnancy (HDP) and LBW. Even though there was no association between HDP and LBW, several studies across the globe have reported that the odds of LBW among women with HDP were higher when compared to normotensive women [37, 38, 39, 40, 41]. Their findings are in line with the WHO secondary analysis survey conducted in LMICs, confirming that the risk of having LBW babies among women with HDP was double [42]. Empirical evidence confirms that, in pregnancy-induced hypertension, the trophoblast invasion into the spiral arteries that supply the placenta is reduced [43, 44]. Due to this decreased utero-placental blood flow, it leads to small for gestational age, preterm birth, and intraventricular growth restriction which predispose the neonate to LBW [44]. It is, therefore, imperative that timely and effective care to women with HDP is necessary to reduce its complications and LBW.

5. Limitation of the study

A key limitation of this study was the lack of information on maternal haemoglobin level, maternal smoking, malaria status, alcohol, and nutritional habits during pregnancy. Most of these factors have been found to be causally associated with the risk of LBW and intraventricular growth restriction [21, 45, 46, 47]. Also, the study was carried out on mothers who delivered in a secondary referral hospital, and this may not be representative of the population of mothers as a whole.

6. Conclusion

This study revealed a high incidence of LBW. Women's marital status (single mothers), gestational age (<37 weeks), neonatal sex (female), are independent risk factors associated with LBW, while a higher risk of an Apgar score of less than 7 in the first minute was an independent outcome of low birth weight. The current study findings contribute to the growing literature on the influence of maternal and neonatal factors on LBW in resource-constrained settings. These findings could guide healthcare providers, hospital administrators, stakeholders, and policymakers to develop and implement appropriate clinical and public health strategies aimed at reducing LBW.

Declarations

Author contribution statement

Ethel Agbinku, and Eric Agyabeng-Fandoh Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Agani Afaya and Richard Adongo Afaya: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Thomas Bavo Azongo, Vida Nyagre Yakong, Kennedy Diema Konlan, Renna Akokre, Jebuni Fuseini Karim, Solomon Mohammed Salia, Robert Alhassan Kaba, and Martin Amogre Ayanore Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

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Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

References

[1] S.R. Sharma, S. Giri, U. Timalsina, S.S. Bhandari, B. Baysal, K. Wagle, L. Sherstha, Low birth weight at term and its determinants in a tertiary hospital of Nepal: a case-control study, PloS One 10 (4) (2015), e0123962.
[2] World Health Organization, Global Nutrition Targets 2025: Low Birth Weight Policy Brief, World Health Organization, 2014.
[3] UNICEF, United Nations Children's Fund (UNICEF). The State of the World's Children 2009: Maternal and Newborn Health, Unicef, 2008.
[4] M.B. Bekela, M.S. Shimbire, T.F. Gebabo, M.B. Geta, A.T. Tonga, E.A. Zeleke, N.B. Sidemo, A.B. Getnet, Determinants of low birth weight among newborns delivered at public hospitals in Sidama zone, South Ethiopia: Unmatched case-control study, J. Pregnancy (2020) 2020.
[5] A. Endalamaw, E.H. Engeda, D.T. Eskubagaweries, G.M. Belay, M.A. Tefera, Low birth weight and its associated factors in Ethiopia: a systematic review and meta-analysis, Ital. J. Pediatr. 44 (1) (2018 Dec 1) 141.
[6] L. Tshomtesi, L. Dzikiti, P. Hajijon, S. Feresu, Maternal factors contributing to low birth weight deliveries in Tsawhane District, South Africa, PloS One 14 (3) (2019), e0213058.
[7] R.D. Wumba, L. Zanga, M.N. Aloni, K. Mbuyanzu, A. Kahindo, M.N. Mandina, M.B. Ekila, O. Mouri, E. Kendjo, Interactions between malaria and HIV infections in pregnant women: a first report of the magnitude, clinical and laboratory features and predictive factors in Kinshasa, the Democratic Republic of Congo, Malar. J. 14 (1) (2015) 82.
[8] N.B. van den Broek, R. Jean-Baptiste, J.P. Neilson, Factors associated with preterm, early preterm and late preterm birth in Malawi, PloS One 9 (3) (2014 Mar 3), e90128.
[9] H.B. Olaideinde, O.B. Olaideinde, R. Omogeegbe, A.A. Onifade, Prevalence and determinants of low birth weight: the situation in a traditional birth home in Benin City Nigeria, Afr. Health Sci. 15 (4) (2015) 1123–1129.
[10] S.A. Feresu, S.D. Harlow, G.B. Woelk, Risk factors for low birthweight in Zimbabwean women: a secondary data analysis, PloS One 10 (6) (2015), e0129705.
[11] O.M. Muchemi, E. Echoka, A. Makokha, Factors associated with low birth weight among neonates born at Oikalou District hospital, central region, Kenya, Pan Afr. Med. J. 20 (1) (2015).
[12] I. Sadinou, T. D’Almeida, G. Gottelli, A. Luty, I. Kwewcie-Radanne, A. Massougbodji, et al., High plasma levels of HLA-G are associated with low birth weight and an increased risk of malaria in infancy, Malar. J. 13 (1) (2014) 312.
[13] G. Mombo-Ngoma, J. Honkpedji, A. Barra, J.R. Mackanga, R.M. Zoleko, J. Zinsou, et al., Urogenital schistosomiasis during pregnancy is associated with low birth weight delivery: analysis of a prospective cohort of pregnant women and their offspring in Gabon, Int. J. Parasitol. 47 (1) (2017) 69–74.
[14] N. Maysyn, N. Peer, R. English, A. Padarath, P. Bouron, C.E. Day, District Health Barometer 2015/16, Health systems trust, Durban, 2016.
[15] World Health Organization, UNICEF-WHO Low Birthweight Estimates: Levels and Trends 2000-2015, World Health Organization, 2019.
[16] R.E. Gearing, L.A. Mian, J. Barber, A. Ickovics, A methodology for conducting retrospective chart review research in child and adolescent psychiatry, J. Can. Acad. Child Adolesc. Psychiatr.e 15 (3) (2006) 126.
[17] A. Abubakari, G. Kynast-Wolf, A. Jahn, Maternal determinants of birth weight in Northern Ghana, PloS One 10 (8) (2015 Aug 17), e015641.
[18] A. Abubakari, G. Kynast-Wolf, A. Jahn, Prevalence of abnormal birth weight and related factors in Northern region, Ghana, BMC Pregnancy Childbirth 15 (1) (2015) 1–8.
[19] I.A. Agorinya, E.W. Kamiki, E.A. Nonterah, F. Tediosi, J. Akazili, P. Welaga, D. Azongo, A.B. Oduro, Socio-demographic determinants of low birth weight evidence from the Kassena-Nankana districts of the upper east region of Ghana, PloS One 13 (11) (2018), e0206207.
[20] F. Agbozo, A. Abubakari, J. Der, A. Jahn, Prevalence of low birth weight, macroomia and stillbirth and their relationship to associated maternal risk factors in Hooho Municipality, Ghana, Midwifery 40 (2016) 200–206.
[21] S. Mohammed, I. Boning, I. Yakubu, W.P. Wondong, Maternal obstetric and socio-demographic determinants of low birth weight: a retrospective cross-sectional study in Ghana, Reprod. Health 16 (1) (2019) 70.
[22] A. Afaile-Munsuz, P. Bravevan, Pregnancy intention and preterm birth: differential associations among a diverse population of women, Perspect. Sex. Reprod. Health 40 (2) (2008 Jun) 66–73.
[23] Ghana Statistical Service, Ghana Multiple indicator cluster survey with an enhanced malaria module and biomarker, in: Final Report. Accra, Ghana: Ghana Statistical Service, 2011. Available from: http://www.unicef.org/ghana/Ghana_MICS_Final.pdf.

[24] E. Sakeah, S. Okawa, A. Rexford Oduro, A. Shibanuma, E. Ansah, K. Kikuchi, L.D. Hailu, D.L. Kebede, Determinants of low birth weight among deliveries at a referral Hospital in Northern Ethiopia, BioMed Res. Int. 2018 (2018).

[25] M. Mitao, R. Philemon, J. Obure, B.T. Mmbaga, S. Msuya, M.J. Mahande, Risk factors and adverse perinatal outcome associated with low birth weight in Ethiopia: a registry-based retrospective cohort study, Asian Pac. J. Reprod. 5 (1) (2016) 75–79.

[26] K. Adu-Bonsaffoh, M.Y. Ntumy, S.A. Obed, J.D. Seffah, Perinatal outcomes of pregnancy induced hypertension on low birth weight in Tigray, Northern Ethiopia, BMC Pregnancy Childbirth 17 (1) (2017) 1.

[27] V. Ehrenstein, Association of Appgar scores with death and neurologic disability, Clin. Epidemiol. 1 (2009) 45–53.

[28] V.L. Bilano, E. Ota, T. Ganchimeg, R. Mori, J.P. Souza, Risk factors of pre-eclampsia/eclampsia and its adverse outcomes in low-and-middle income countries: a WHO secondary analysis, PloS One 9 (3) (2014), e91198.

[29] K. Bramham, A.L. Briley, P. Seed, L. Poston, A.H. Shennan, L.C. Chappell, Adverse maternal and perinatal outcomes in women with previous pre-eclampsia: a prospective study, Am. J. Obstet. Gynecol. 204 (6) (2011), 512.e1.

[30] Y.-Y. Su, J.-Z. Zhang, F. Wang, Risk Factors and Adverse Outcomes of Preeclampsia: a Tertiary Care CentreBased study in China, 2017.

[31] T. Getaneh, A. Negesse, G. Desissie, M. Desta, The impact of pregnancy induced hypertension on low birth weight in Ethiopia: systematic review and meta-analysis, Ital. J. Pediatr. 46 (1) (2020), 1–1.

[32] M. Bridwell, E. Handzel, M. Hynes, R. Jean-Louis, D. Fitter, C. Hogue, R. Grand-Pierre, H. Pierre, B. Pearce, Hypertensive disorders in pregnancy and maternal and neonatal outcomes in Haiti: the importance of surveillance and data collection, BMC Pregnancy Childbirth 19 (1) (2019), 1–1.

[33] D.E. Akpakli, M. Gyapong, Socioeconomic and demographic determinants of birth weight in southern rural Ghana: evidence from Dodowa Health and Demographic Surveillance System, BMC Pregnancy Childbirth 16 (1) (2016) 160.

[34] M. Gyapong, S. Owusu-Agyei, J. Williams, C. Debpuur, F. Yeji, Determinants of attending antenatal care at least four times in rural Ghana: analysis of a cross-sectional survey, Glob. Health Action 10 (1) (2017) 1291879.

[35] A.G. Ampim, Men’s Involvement in Maternal Healthcare in Accra, Ghana. From Household to Delivery Room, M. Phil Thesis, Gender and Development: Universitas Bergensis, 2013.

[36] A.G. Ampim, Men’s Involvement in Maternal Healthcare in Accra, Ghana. From Household to Delivery Room, M. Phil Thesis, Gender and Development: Universitas Bergensis, 2013.

[37] V.L. Bilano, E. Ota, T. Ganchimeg, R. Mori, J.P. Souza, Risk factors of pre-eclampsia/eclampsia and its adverse outcomes in low-and-middle income countries: a WHO secondary analysis, PloS One 9 (3) (2014), e91198.

[38] K. Bramham, A.L. Briley, P. Seed, L. Poston, A.H. Shennan, L.C. Chappell, Adverse maternal and perinatal outcomes in women with previous pre-eclampsia: a prospective study, Am. J. Obstet. Gynecol. 204 (6) (2011), 512.e1.

[39] Y.-Y. Su, J.-Z. Zhang, F. Wang, Risk Factors and Adverse Outcomes of Preeclampsia: a Tertiary Care CentreBased study in China, 2017.

[40] T. Getaneh, A. Negesse, G. Desissie, M. Desta, The impact of pregnancy induced hypertension on low birth weight in Ethiopia: systematic review and meta-analysis, Ital. J. Pediatr. 46 (1) (2020), 1–1.

[41] M. Bridwell, E. Handzel, M. Hynes, R. Jean-Louis, D. Fitter, C. Hogue, R. Grand-Pierre, H. Pierre, B. Pearce, Hypertensive disorders in pregnancy and maternal and neonatal outcomes in Haiti: the importance of surveillance and data collection, BMC Pregnancy Childbirth 19 (1) (2019), 1–1.

[42] K. Adu-Bonsaffoh, M.Y. Ntumy, S.A. Obed, J.D. Seffah, Perinatal outcomes of pregnancy induced hypertension on low birth weight in Tigray, Northern Ethiopia, BMC Pregnancy Childbirth 17 (1) (2017) 1.

[43] V. Ehrenstein, Association of Appgar scores with death and neurologic disability, Clin. Epidemiol. 1 (2009) 45–53.