Heliyon 7 (2021) e06962

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

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

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ARTICLE INFO

Keywords:
Low birth weight
Neonatal risk factors
Maternal risk factors
Prevalence
Ghana

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.

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https://doi.org/10.1016/j.heliyon.2021.e06962
Received 19 January 2021; Received in revised form 21 March 2021; Accepted 26 April 2021

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 SAA 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 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 ($\chi2 = 102.0, p < 0.001$). Hypertensive disorder was also significantly associated with LBW ($\chi2 = 5.76, p = 0.016$). 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 ($\chi2 = 6.86$, p = 0.009), Apgar score in the first minute ($\chi2 = 27.06$, p < 0.001) and fifth minute ($\chi2 = 21.81$, p < 0.001), resuscitation ($\chi2 = 5.12$, p = 0.024) and crying at birth ($\chi2 = 7.11$, 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	113 (14.6)	48 (19.9)	161 (15.8)			1	
	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)			1	
	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.

Table 2. Prenatal and obstetric factors associated with low birth weight.

Variables		NBW n= (%)	LBW n= (%)	Total n = (%)	χ2	p-value	COR [95% CI]	p-value
Gravidity	One	196 (25.3)	67 (27.8)	263 (25.9)			1	
	Two	224 (28.9)	68 (28.2)	292 (28.7)			0.89 [0.60–1.31]	0.549
	Three	160 (20.6)	45 (18.7)	205 (20.2)			0.82 [0.53–1.27]	0.376
	4+	196 (25.2)	61 (25.3)	257 (25.2)	0.83	0.842	0.91 [0.61–1.36]	0.645
Parity	Primiparity	418 (53.9)	141 (58.5)	559 (55.0)			1	
	Multiparous	358 (46.1)	100 (41.5)	458 (45.0)	1.60	0.206	0.83 [0.62–1.11]	0.206
ANC Visits	No	85 (11.0)	21 (8.7)	106 (10.4)			1	
	Yes	691 (89.1)	220 (91.3)	911 (89.6)	0.99	0.320	1.29 [0.78–2.13]	0.321
Gestational age	<37	45 (5.8)	71 (29.5)	116 (11.4)			1	
	37–42	678 (87.4)	156 (64.7)	834 (82.0)			0.15 [0.10–0.22]	<0.001
	>42	53 (6.8)	14 (5.8)	67 (6.6)	102.0	<0.001	0.17 [0.08–0.34]	<0.001
Presentation	Cephalic	706 (91.0)	220 (91.3)	926 (91.1)			1	
	Breech	34 (4.4)	13 (5.4)	47 (4.6)			1.23 [0.64–2.37]	0.542
	Transverse	10 (1.3)	2 (0.8)	12 (1.2)			0.64 [0.04–2.95]	0.569
	Oblique	5 (0.6)	2 (0.8)	7 (0.7)			1.28 [0.25–6.66]	0.766
	Longitudinal	21 (2.7)	4 (1.7)	25 (2.4)	1.65	0.800	0.61 [0.21–1.80]	0.372
Mode of delivery	SVD	443 (57.1)	132 (54.8)	575 (56.5)			1	
	CS	320 (41.2)	109 (45.2)	429 (42.2)			1.14 [0.85–1.53]	0.366
	Vacuum	13 (1.7)	0 (0.00)	13 (1.3)	4.91	0.086	0.12 [0.01–2.10]	0.148
CS-type	Em. CS	169 (57.3)	54 (64.3)	223 (58.8)			1	
	Elective CS	126 (42.7)	30 (35.7)	156 (41.2)	1.32	0.250	0.75 [0.45–1.23]	0.251
Hypertensive disorder	No	718 (92.5)	211 (87.6)	929 (91.4)			1	
	Yes	58 (7.5)	30 (12.4)	88 (8.6)	5.76	0.016	1.76 [1.10–2.81]	0.018
Antepartum Haemorrhage	No	626 (80.7)	198 (82.2)	824 (81.0)			1	
	Yes	150 (19.3)	43 (17.8)	193 (19.0)	0.26	0.607	0.91 [0.62–1.32]	0.607
UTI/STI	No	748 (96.4)	230 (95.4)	978 (96.2)			1	
	Yes	28 (3.6)	11 (4.6)	39 (3.8)	0.46	0.500	1.28 [0.63–2.61]	0.501
PROM	No	674 (86.9)	210 (87.1)	884 (86.9)			1	
	Yes	102 (13.1)	31 (12.9)	133 (13.1)	0.01	0.910	0.98 [0.63–1.50]	0.910
Pre-eclampsia	No	607 (78.2)	187 (77.6)	794 (78.0)			1	
	Yes	169 (21.8)	54 (22.4)	223 (22.0)	0.04	0.837	1.04 [0.73–1.47]	0.837

ANC (antenatal care); CS (caesarean section); UTI (Urinary tract infection); STI (sexually transmitted infection); PROM (premature rapture of membranes); Em. CS (emergency caesarean section).

Table 3. Estimates of risks for neonatal outcomes according to birthweight.

Variables		NBW n= (%)	LBW n= (%)	Total n = (%)	χ2	p-value	COR [95% CI]	p-value
Neonatal sex	Male	413 (53.2)	105 (43.6)	518 (50.9)			1	
	Female	363 (46.8)	136 (56.4)	499 (49.1)	6.86	0.009	1.47 [1.10–1.97]	0.009
Apgar score in the first minute	<7	207 (26.7)	107 (44.4)	314 (30.9)			1	
	≥7	569 (73.3)	134 (55.6)	703 (69.1)	27.06	<0.001	046 [0.34–0.61]	<0.001
Apgar score in the fifth minute	<7	92 (11.9)	58 (24.1)	150 (14.8)			1	
	≥7	684 (88.1)	183 (75.9)	867 (85.3)	21.81	<0.001	0.42 [0.29–0.61]	<0.001
Meconium	Passed	435 (56.1)	128 (53.1)	563 (55.4)			1	
	None	341 (43.9)	113 (46.9)	454 (44.6)	0.65	0.422	1.13 [0.84–1.51]	0.422
Urine	Passed	406 (52.3)	115 (47.7)	521 (51.2)			1	
	None	370 (47.7)	126 (52.3)	496 (48.8)	1.56	0.212	1.20 [0.90–1.61]	0.212
Resuscitated at birth	No	657 (84.7)	189 (78.4)	846 (83.2)			1	
	Yes	119 (15.3)	52 (21.6)	171 (16.8)	5.12	0.024	1.52 [1.06–2.19]	0.024
Cried immediately after birth	No	98 (12.6)	47 (19.5)	145 (14.3)			1	
	Yes	678 (87.4)	194 (80.5)	872 (85.7)	7.11	0.008	0.60 [0.41–0.87]	0.008

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: 0.10–0.24), p < 0.001; AOR = 0.19 (95%CI: 0.09–38), 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 1st 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 study 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 37weeks 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 intrauterine 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 intrauterine 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.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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.

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