

Prevalence, spatial distribution, and predictors of low birth weight among newborns in Ghana: A Cross-Sectional Analysis of the 2022 Demographic and Health Survey

MARTIN KWAME Ntiakoh¹

martinntiakoh75@gmail.com

University of Health and Allied Sciences

Collins Nyerebereh Poribo Dery¹

University of Health and Allied Sciences

Samuel Kwame Agyei Boateng¹

University of Health and Allied Sciences

Wisdom Alikor¹

University of Health and Allied Sciences

Edinam Abra Ofori¹

University of Health and Allied Sciences

Nathaniel Annang Armah¹

University of Health and Allied Sciences

Alex Korankye¹

University of Health and Allied Sciences

Wisdom Tawiah¹

University of Health and Allied Sciences

Solomon Abomabiik¹

University of Health and Allied Sciences

Wisdom Kwami Takramah¹

University of Health and Allied Sciences

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Abstract

Background

Low birth weight remains a critical public health challenge globally, particularly in low- and middle-income countries where it significantly contributes to neonatal mortality and long-term developmental complications. Despite substantial investments in maternal and child health programs, Ghana continues to experience notable rates of low birth weight. However, limited nationally representative evidence exists on its current prevalence, spatial distribution, and key determinants. This study examined the prevalence, spatial patterns, and predictors of low birth weight among newborns in Ghana using nationally representative data.

Methods

This study employed a cross-sectional design using data on 5,113 singleton live births extracted from the 2022 Ghana Demographic and Health Survey (GDHS) database. A multilevel Poisson regression analysis was employed to identify factors associated with low birth weight. Spatial autocorrelation analysis using Moran's I and choropleth mapping was applied to explore regional variations in low-birth-weight prevalence across Ghana's sixteen regions.

Results

The national prevalence of low birth weight was 7.3%. Spatial analysis revealed substantial regional variation, with the highest prevalence observed in the Northern (8.6%), Ashanti (10.7%), and Bono East (8.6%) regions, and the lowest in the Western (4.9%), Savannah (5.4%), and Greater Accra (4.9%) regions. Moran's I statistic ($I=0.31$, $p=0.064$) indicated no significant spatial clustering at the national level. In chi-square analysis, maternal age ($p<0.001$), place of delivery ($p=0.0014$), delivery mode ($p=0.0075$), and ethnicity ($p=0.036$) were significantly associated with low birth weight. Multivariable multilevel Poisson regression revealed that hospital delivery (APR=2.95, 95% CI: 1.88-4.64), female sex (APR=1.52, 95% CI: 1.24-1.87), and caesarean delivery (APR=1.44, 95% CI: 1.13-1.83) significantly increased low birth weight risk. Conversely, maternal employment (APR=0.76, 95% CI: 0.60-0.95), high gravidity (APR=0.66, 95% CI: 0.49-0.89), Ewe ethnicity (APR=0.67, 95% CI: 0.47-0.96), and malaria prophylaxis use (APR=0.67, 95% CI: 0.49-0.90) were protective factors.

Conclusion

Low birth weight prevalence in Ghana remains moderately elevated with pronounced regional and maternal disparities. Maternal age, parity, delivery setting, delivery mode, and malaria prevention emerged as key determinants. Strengthening age-specific antenatal care, promoting malaria prophylaxis during pregnancy, improving maternal nutrition programs, and enhancing obstetric care quality in high-prevalence regions could significantly reduce low birth weight incidence and improve neonatal outcomes in Ghana.

Background

Low birth weight (LBW), defined by the World Health Organization as birth weight below 2,500 grams, remains one of the most significant determinants of neonatal and infant mortality worldwide [1]. Globally, approximately 15% of all newborns are born with LBW, with over 90% of these cases occurring in developing countries, predominantly in Asia and Sub-Saharan Africa [2, 3]. LBW is not merely a marker of intrauterine growth restriction or prematurity; it represents a critical predictor of immediate survival and long-term health trajectories, including increased susceptibility to infectious diseases, developmental delays, cardiovascular complications, and reduced cognitive functioning [4, 5]. In Sub-Saharan Africa, LBW prevalence has remained persistently high over the past decade, with regional estimates ranging from 4.8% to 21.3% [6, 7]. The burden is particularly concerning given the region's limited healthcare infrastructure and high maternal mortality rates. Multiple factors contribute to LBW in this context, including maternal malnutrition, adolescent pregnancies, inadequate antenatal care utilization, infectious diseases (particularly malaria), and socioeconomic deprivation [8, 9]. The complex interplay of these determinants underscores the need for comprehensive, context-specific interventions.

Ghana, despite notable progress in maternal and child health indicators over recent decades, continues to face challenges related to LBW. The 2014 Ghana Demographic and Health Survey reported that 10% of newborns had LBW [10]. However, more recent nationally representative data are limited, and the extent to which regional disparities, sociodemographic factors, and maternal health conditions influence LBW outcomes remains inadequately characterized. Furthermore, previous studies in Ghana have predominantly focused on facility-based samples or specific geographic areas, limiting generalizability and comprehensive understanding of national patterns [11, 12]. Understanding the spatial distribution of LBW is crucial for targeted resource allocation and intervention planning. Geographic variations in LBW prevalence often reflect underlying disparities in healthcare access, socioeconomic conditions, nutritional status, and disease burden [13]. Spatial analysis techniques can identify high-risk areas requiring prioritized attention and inform evidence-based policymaking. However, few studies have comprehensively examined the spatial patterns of LBW across Ghana's diverse geographic and socioeconomic landscape. Identifying modifiable risk factors for LBW is essential for developing effective prevention strategies. Previous research has implicated maternal age, educational attainment, parity, antenatal care utilization, nutritional status, malaria exposure, and obstetric complications as significant determinants of birth weight [14, 15, 16]. However, the relative importance and interaction of these factors may vary across different populations and settings. In the Ghanaian context, there is limited recent evidence on how these factors collectively influence LBW risk, particularly using nationally representative data that accounts for the hierarchical structure of health outcomes.

This study addresses these critical knowledge gaps by utilizing data from the 2022 Ghana Demographic and Health Survey to (1) determine the current national and regional prevalence of LBW; (2) conduct spatial analysis to identify geographic clustering and high-risk areas; and (3) identify sociodemographic and maternal factors associated with LBW using advanced multilevel modeling techniques. The findings provide updated, evidence-based insights to inform targeted maternal and child health interventions,

guide resource allocation, and support policy development aimed at reducing LBW and improving neonatal outcomes across Ghana.

Methods

Study Design and Data Source

This study employed a cross-sectional analytical design using secondary data from the 2022 Ghana Demographic and Health Survey (GDHS). The GDHS is a nationally representative household survey conducted periodically to collect comprehensive data on population, health, nutrition, and demographic indicators. The 2022 GDHS covered all sixteen administrative regions of Ghana and employed a two-stage stratified sampling design to ensure representativeness at national, regional, and urban-rural levels. The 2022 GDHS utilized a stratified two-stage cluster sampling design based on the 2021 Population and Housing Census sampling frame. In the first stage, enumeration areas (EAs) were selected with probability proportional to size. These EAs were stratified by region and urban-rural classification to ensure balanced geographic representation. In the second stage, systematic sampling was used to select 30 households from each EA. A total of 617 clusters were selected, yielding 18,450 households. All women aged 15–49 years who were usual residents or had spent the night before the survey in selected households were eligible for interviews. The final sample included 11,406 completed interviews with women of reproductive age.

Study Setting

Ghana is located on the Gulf of Guinea in West Africa and shares borders with Côte d'Ivoire to the west, Burkina Faso to the north, and Togo to the east. The country covers approximately 238,535 km² and is administratively divided into sixteen regions. According to the 2021 Population and Housing Census, Ghana had a population of about 30.8 million people. The country has diverse ecological zones, including coastal, forest, and savannah belts, which influence socioeconomic activities and health outcomes. Healthcare services are delivered through a decentralized health system comprising teaching hospitals, regional hospitals, district hospitals, health centres, Community-based Health Planning and Services (CHPS) compounds, and private facilities. Despite improvements in maternal and child health indicators, substantial regional disparities remain in healthcare access, utilization, and quality.

Study Population and Sample Size

For this analysis, the study population comprised singleton live births occurring within five years preceding the survey (2017–2022) to women aged 15–49 years. Multiple births were excluded due to their inherently different risk profiles. After applying exclusion criteria and accounting for missing birth weight data, the final analytical sample consisted of 5,113 weighted singleton live births with complete information on birth weight and relevant covariates.

Inclusion and Exclusion Criteria

Inclusion criteria:

The study included singleton live births that occurred within five years preceding the survey among women aged 15–49 years with valid birth weight information obtained from either health facility records or maternal recall. Multiple births, stillbirths, births with missing or implausible birth weight data, and births occurring outside the maternal age range of 15–49 years were excluded from the analysis.

Exclusion criteria:

Newborns with missing, unknown, or implausible birth weight data were excluded from the analysis. In addition, observations with incomplete information on key explanatory variables included in the study were excluded from the final analytical sample.

Study Variables

Based on theoretical frameworks and previous literature, we examined sociodemographic, maternal, and healthcare-related factors potentially associated with LBW:

Variable	Type	Categories/ Measurement
OUTCOME VARIABLE		
Low birth weight	Binary	LBW (< 2,500g) = 1; Normal birth weight (≥ 2,500g) = 0
SOCIODEMOGRAPHIC FACTORS		
Maternal age	Categorical	< 20 years; 20–34 years; ≥35 years
Maternal education	Categorical	No Education; Primary; Secondary; Higher
Wealth index	Categorical	Poor; Middle; Rich
Ethnicity	Categorical	Akan; Ewe; Mole-Dagbani; Others
Religion	Categorical	Christianity; Islam, Traditional, and None
Place of residence	Categorical	Urban; Rural
Region	Categorical	16 administrative regions of Ghana
Maternal employment	Categorical	Working; Not working
MATERNAL AND HEALTHCARE-RELATED FACTORS		
Parity	Categorical	1–4; 5–9; ≥10
Gravidity	Categorical	Low (primigravida); High (multigravida)
ANC visits	Categorical	< 4 visits; ≥4 visits
Place of delivery	Categorical	Home; Hospital/health facility
Mode of delivery	Categorical	Vaginal; Caesarean section
Health insurance	Categorical	Yes; No
Malaria prophylaxis	Categorical	Yes; No
Sex of child	Categorical	Male; Female

Statistical Analysis

Data analysis was conducted using Stata version 17.0 (StataCorp LLC, College Station, TX, USA) and ArcGIS version 10.8 (ESRI, Redlands, CA, USA) for spatial analyses. Survey sampling weights, clustering, and stratification were incorporated in all analyses to account for the complex survey design and ensure nationally representative estimates.

Descriptive statistics were computed to characterize the study population. Categorical variables were presented as weighted frequencies and percentages, while continuous variables were summarized using weighted means and standard deviations or medians and interquartile ranges as appropriate. Chi-square tests were performed to examine associations between each independent variable and LBW. Variables showing statistically significant associations ($p < 0.05$) in bivariate analysis were considered for inclusion in multivariable models. Given the hierarchical structure of DHS data (individuals nested within clusters/communities), multilevel Poisson regression with robust variance estimation was employed to identify independent predictors of LBW while accounting for clustering effects. This approach provides adjusted prevalence ratios (APRs) with 95% confidence intervals, which are more appropriate than odds ratios for common outcomes. Variables significant in the chi-square analysis and those theoretically important were included in the adjusted model. Model fit was assessed using the Akaike Information Criterion (AIC), and the intraclass correlation coefficient (ICC) was calculated to quantify the proportion of variance attributable to community-level factors. [32]

Spatial autocorrelation was assessed using Global Moran's I statistic to determine whether LBW prevalence exhibited spatial clustering at the national level. The null hypothesis of spatial randomness was tested at the $\alpha = 0.05$ significance level. Given the non-significant spatial autocorrelation (Moran's I = 0.31, Z-score = 1.85, $p = 0.064$), hotspot analysis was not conducted. Instead, a choropleth map was created to visualize regional variations in LBW prevalence across Ghana's sixteen regions. Regional prevalence rates were categorized using natural breaks classification to illustrate geographic patterns.

Ethical Considerations

The 2022 GDHS received ethical approval from the Ghana Health Service Ethics Review Committee and the ICF Institutional Review Board. Written informed consent was obtained from all participants before data collection. For this secondary data analysis, authorization to access and use the dataset was obtained from the DHS Program through their standard data request protocol. All data used were de-identified, and no personally identifiable information was accessed or reported. This study received additional ethical clearance from the University of Health and Allied Sciences Research Ethics Committee (UHAS-REC B.10 [100]24–25).

Results

Sociodemographic Characteristics of Study Population

A total of 5,113 weighted singleton live births were included in the analysis. Most mothers were aged 20–34 years (62.3%), while 5.1% were adolescents (<20 years) and 23.6% were aged 35 years or older (Table 1). Nearly half (49.1%) had secondary education, 20.5% had no formal education, 13.9% had primary education, and 8.5% had higher education. The predominant religion was Christianity (64.0%), followed by Islam (22.4%). Regarding ethnicity, Akan comprised 35.0% of the sample, followed by Mole-Dagbani (26.9%) and Ewe (12.5%). Approximately 44.1% of mothers resided in urban areas, while 47.9% lived in rural settings. The majority (71.7%) were employed at the time of the survey. Regional distribution

showed the Ashanti region contributing the highest proportion of births (16.1%), followed by the Northern region (10.3%) and Greater Accra (11.3%).

Prevalence of Low Birth Weight

The total national prevalence of LBW was 7.3% (95% CI: 6.6-8.0%), representing 369 out of 5,113 births. This indicates that 92.7% of newborns had normal birth weight ($\geq 2,500$ grams).

Spatial Distribution of Low Birth Weight

The spatial autocorrelation test produced a Moran's I value of 0.31 with a Z-score of 1.85 and a p-value of 0.064, indicating that the spatial pattern of low birth weight (LBW) across Ghana was not statistically significant at the 5% level. Since the p-value was greater than 0.05, we failed to reject the null hypothesis of spatial randomness, meaning there was no strong evidence of spatial clustering of LBW. Consequently, a hotspot analysis was not conducted. Instead, a choropleth map was used to visually illustrate the spatial distribution of LBW prevalence across regions, providing a clearer descriptive understanding of the geographic variation.

Table 1 Global Moran's I statistic

Statistic	Value
Year	2022
Moran's I	0.31
Z-score	1.85
p-value	0.064
Pattern	Not random

The map displays LBW prevalence categorized into three groups using natural breaks: Low (4.9-6.4%), Moderate (6.4-8.6%), and High (8.6-10.7%). The highest prevalence was observed in the Ashanti region (10.7%), followed by the Northern region (8.7%) and the Bono East region (8.6%). Moderate prevalence rates (6.4-8.6%) were found in the Central (8.7%), Eastern (8.4%), Ahafo (7.7%), and Western North (9.0%) regions. The lowest prevalence was recorded in Western (6.3%), Greater Accra (4.9%), Savannah (3.9%), Upper West (6.2%), Upper East (8.8%), and Oti (5.8%) regions.

Figure 1: Spatial analysis revealed substantial regional variation in LBW prevalence across Ghana.

Model Performance

The multilevel model demonstrated improved fit compared to the null model (AIC = 2593.17 vs 2707.99). The community-level variance was 0.34 (SE=0.08), with an intraclass correlation coefficient indicating

that 8.4% of the variance in LBW was attributable to community-level factors. This justified the application of multilevel modeling to determine factors associated with low birth weight.

Multilevel Poisson Regression Analysis of Factors Associated with Low Birth Weight

Table 3 presents results from the multilevel Poisson regression analysis adjusting for potential confounders and accounting for cluster-level variation.

After adjustment, Ewe ethnicity was significantly protective against LBW compared to Akan ethnicity (APR=0.67, 95% CI: 0.47-0.96, $p=0.028$). Maternal employment remained protective in the adjusted model (APR=0.76, 95% CI: 0.60-0.95, $p=0.017$). Other ethnic groups and sociodemographic factors, including maternal age, education, wealth index, religion, and place of residence, did not show significant independent associations with LBW in the adjusted model.

Several obstetric factors emerged as significant independent predictors of LBW. Hospital delivery was associated with nearly a three-fold increased prevalence of LBW compared to home delivery (APR=2.95, 95% CI: 1.88-4.64, $p<0.001$). The female sex of the infant was associated with 52% higher LBW prevalence compared to males (APR=1.52, 95% CI: 1.24-1.87, $p<0.001$). Caesarean delivery increased LBW risk by 44% compared to vaginal delivery (APR=1.44, 95% CI: 1.13-1.83, $p=0.003$).

Protective factors included high gravidity (multigravida), which was associated with 34% lower LBW prevalence compared to primigravida (APR=0.66, 95% CI: 0.49-0.89, $p=0.006$). Use of malaria prophylaxis during pregnancy significantly reduced LBW risk (APR=0.67, 95% CI: 0.49-0.90, $p=0.009$).

Health insurance coverage, number of ANC visits, parity, and maternal self-reported health status did not show significant independent associations with LBW after adjustment.

Discussion

The prevalence of low birth weight (7.3%) observed in this study was lower than the 10% reported in the 2014 Ghana Demographic and Health Survey (GDHS) [10], suggesting potential improvements in maternal and child health over the past eight years. This prevalence is lower than facility-based studies from other Sub-Saharan African countries, including Ethiopia (14.3%) [17], the Democratic Republic of Congo (9.13%) [18], and South Sudan (11.4%) [19], but higher than some high-income countries. The relatively moderate LBW rate in Ghana may reflect several factors: improvements in antenatal care coverage and quality, enhanced nutrition programs, better malaria prevention strategies, and total socioeconomic development [10]. However, it is important to note that the estimate includes both facility and home births across diverse geographic and socioeconomic contexts, whereas many cited studies focused on hospital populations that may over-represent high-risk pregnancies. Additionally, Ghana's maternal health programs, including free antenatal care, nutrition supplementation, and malaria prevention initiatives, may have contributed to the observed moderate LBW prevalence. Nevertheless, a

7.3% prevalence still translates to thousands of vulnerable newborns annually, underscoring the continued need for targeted interventions.

The substantial regional variation in LBW prevalence (3.9%-10.7%) highlights important geographic inequities in maternal and child health outcomes. The higher prevalence in Ashanti, Northern, and Bono East regions compared to Greater Accra, Western, and Savannah regions will reflect underlying differences in healthcare infrastructure, socioeconomic conditions, maternal nutrition, and disease burden. These findings align with previous spatial analysis by Boateng et al. [13], who similarly identified LBW hotspots in Ghana's middle and northern zones using 2017 data.

The absence of significant spatial autocorrelation (Moran's $I = 0.31$, $p = 0.064$) suggests that LBW prevalence does not exhibit strong geographic clustering at the national level in a statistical sense. However, the visual pattern in the choropleth map indicates regional concentration that may be driven by localized factors rather than spatial diffusion. This pattern is consistent with international evidence showing that LBW clustering often reflects underlying socioeconomic and healthcare disparities rather than purely geographic proximity [20, 21]. The regional disparities have important policy implications. High-prevalence regions require targeted interventions addressing specific local determinants, such as enhanced prenatal nutrition programs in areas with high food insecurity, strengthened malaria prevention in endemic zones, and improved obstetric care quality in underserved regions. Geographic targeting of resources can maximize intervention efficiency and equity.

Contrary to expectations and previous literature [22, 23], maternal education, household wealth, and urban-rural residence were not significantly associated with LBW in our adjusted models. This finding differs from studies in other settings where socioeconomic factors strongly predicted LBW [24]. Several explanations are plausible. First, Ghana's universal health insurance scheme and free maternal health services may have reduced socioeconomic disparities in access to quality antenatal care. Second, national nutrition programs and health education campaigns may have reached women across socioeconomic strata, mitigating the traditional education-health gradient. Third, the complex interplay of factors in multivariable models may have attenuated the crude associations observed in bivariate analyses [14]. The protective effect of maternal employment (APR = 0.76) is noteworthy and may reflect several mechanisms. Working mothers have been shown to exercise greater agency in health decision-making and to benefit from workplace social networks that facilitate health-seeking behavior. However, this finding should be interpreted cautiously, as employment type, working conditions, and work-related stress were not assessed.

The significantly lower LBW prevalence among Ewe mothers (APR = 0.67) compared to Akan mothers requires further investigation. Differences in maternal nutritional practices, household support systems, health-seeking behaviors, and sociocultural norms across ethnic groups have been documented to influence pregnancy outcomes and birth weight.

The substantially elevated LBW prevalence among hospital deliveries (APR = 2.95) and caesarean deliveries (APR = 1.44) likely reflects referral bias rather than causation. Complicated pregnancies,

preterm labor, fetal distress, and maternal morbidities necessitating medical intervention are more likely to result in both facility-based/operative deliveries and LBW outcomes. This interpretation aligns with the understanding that LBW often results from obstetric complications requiring skilled care [26]. Rather than indicating that hospital delivery causes LBW, this finding highlights that high-risk pregnancies appropriately receive facility-based care. It emphasizes the need for strengthened obstetric services to optimize outcomes for these vulnerable pregnancies. The protective effect of malaria prophylaxis (APR = 0.67) is particularly significant given malaria's substantial burden in Ghana and well-documented impact on birth weight [27]. This finding provides strong support for scaling up intermittent preventive treatment in pregnancy (IPTp) programs. Malaria infection during pregnancy causes placental inflammation, anemia, and impaired nutrient transfer, all contributing to fetal growth restriction [25]. The results of the current study align with previous research in Ghana showing birth weight increases with IPTp-SP uptake [28]. Ensuring universal access to and adherence with IPTp-SP should be a policy priority, particularly in high-transmission areas. Surprisingly, the number of ANC visits was not significantly associated with LBW. This may suggest that mere attendance is insufficient without quality care addressing specific risk factors. Focused antenatal care emphasizing risk assessment, nutrition counseling, early detection of complications, and appropriate interventions may be more important than visit frequency alone. This finding supports shifting from a quantity-focused approach to quality-focused ANC delivery.

The 52% higher LBW prevalence among female infants (APR = 1.52) is consistent with biological evidence that male fetuses tend to be larger and heavier at birth [29]. However, female infants generally have better survival outcomes despite lower birth weights due to biological advantages in lung maturation and metabolic adaptation. This finding has limited direct intervention implications but contributes to understanding normal variation in birth weight distributions.

Conclusion

Low birth weight prevalence in Ghana stands at 7.3%, below the WHO threshold but representing a persistent public health challenge affecting thousands of newborns annually. Substantial regional variation exists, with highest prevalence in Northern, Ashanti, and Bono East regions. Multiple maternal and obstetric factors independently predict LBW, including delivery setting, delivery mode, gravidity, ethnicity, employment status, and malaria prophylaxis use. Notably, socioeconomic factors traditionally associated with LBW showed limited independent effects, possibly reflecting Ghana's progress in reducing health inequities through universal programs.

These findings underscore the need for multifaceted, targeted interventions. Priority actions include strengthening geographically targeted maternal health programs in high-prevalence regions; scaling up malaria prevention through universal IPTp-SP coverage; providing enhanced support for primigravid and adolescent mothers; improving maternal nutrition programs; ensuring quality antenatal and obstetric care; and promoting women's economic empowerment. Implementation of these evidence-based

strategies could significantly reduce LBW incidence, improve neonatal survival, and advance Ghana's progress toward Sustainable Development Goal targets for maternal and child health.

Future research should employ prospective designs to establish causality, incorporate detailed clinical variables, explore mechanisms underlying observed associations, and evaluate intervention effectiveness. Such evidence will further refine strategies for eliminating preventable LBW and ensuring all Ghanaian children have the healthiest possible start to life.

Strengths and Limitations

This study has several notable strengths. First, use of nationally representative DHS data ensures generalizability to Ghana's population and enables robust prevalence estimates. Second, the large sample size (5,113 births) provides adequate statistical power for detecting associations. Third, application of multilevel modeling appropriately accounts for the hierarchical data structure and clustering effects. Fourth, incorporation of spatial analysis identifies regional disparities to inform targeted interventions. Fifth, comprehensive assessment of multiple sociodemographic, maternal, and healthcare factors provides a holistic understanding of LBW determinants.

However, important limitations must be acknowledged. The cross-sectional design precludes causal inference; associations do not confirm causation. Critical clinical variables including gestational age at delivery, maternal BMI, anemia status, hypertensive disorders, gestational diabetes, and detailed infection history were unavailable in the dataset but are known LBW determinants [30, 31]. Birth weight data, particularly for home deliveries, may be subject to recall bias or measurement error, though DHS employs standardized protocols to minimize such errors. The intentional geographic displacement of DHS cluster coordinates for confidentiality protection may slightly affect spatial analysis precision. Additionally, unmeasured confounders including dietary intake quality, micronutrient supplementation, environmental exposures, and healthcare quality could influence observed associations.

Public Health and Policy Implications

These findings have several important implications for Ghana's maternal and child health programs. First, regional disparities necessitate geographically targeted interventions. High-prevalence regions (Ashanti, Northern, and Bono East) require strengthened maternal nutrition programs, enhanced antenatal care quality, improved facility-based delivery services, and scaled-up malaria prevention efforts. Resource allocation should reflect geographic burden to maximize impact and promote equity. Second, the strong protective effect of malaria prophylaxis supports universal IPTp-SP implementation. Ensuring all pregnant women receive recommended doses through community outreach, facility-based services, and supply chain strengthening is critical, particularly in high-transmission areas. Third, targeted support for high-risk groups is essential. Primigravid women and adolescent mothers require enhanced antenatal surveillance, nutritional supplementation, health education, and preparation for potential complications. Employment and economic empowerment programs for women may yield maternal health benefits beyond direct economic impacts.

Fourth, while facility delivery rates should continue to increase for safety reasons, quality of obstetric care must be ensured. The concentration of LBW among facility births underscores the need for skilled management of complicated pregnancies, appropriate referral systems, and adequate equipment and supplies.

Fifth, shifting from quantity-focused to quality-focused ANC is warranted. Rather than merely increasing visit numbers, emphasis should be on comprehensive risk assessment, individualized care planning, nutrition and lifestyle counseling, early complication detection, and appropriate interventions during each contact.

Finally, continued surveillance and research are needed. Routine monitoring of LBW prevalence and determinants through health information systems and periodic surveys will enable timely identification of emerging issues and intervention impact assessment.

Abbreviations

AIC	
Akaike Information Criterion	
ANC	
Antenatal Care	
APR	
Adjusted Prevalence Ratio	
BMI	
Body Mass Index	
CHPS	
Community-Based Health Planning and Services	
CI	
Confidence Interval	
DHS	
Demographic and Health Survey	
EA	
Enumeration Area	
GDHS	
Ghana Demographic and Health Survey	
GHS	
Ghana Health Service	
ICC	
Intraclass Correlation Coefficient	
IPTp	
Intermittent Preventive Treatment in Pregnancy	
LBW	

Low Birth Weight
OR
Odds Ratio
SP
Sulfadoxine-Pyrimethamine
SSA
Sub-Saharan Africa
UHAS
University of Health and Allied Sciences
WHO
World Health Organization

Declarations

Ethics Approval and Consent to Participate

The 2022 Ghana Demographic and Health Survey received ethical approval from the Ghana Health Service Ethics Review Committee and the ICF Institutional Review Board. Written informed consent was obtained from all participants prior to data collection. Authorization to access and analyze the de-identified dataset was obtained from the DHS Program. This secondary data analysis received ethical clearance from the University of Health and Allied Sciences Research Ethics Committee (UHAS-REC B.10 [100]24-25).

Consent for Publication

Not applicable (no individual person's data are presented).

Availability of Data and Materials

The datasets analyzed during the current study are publicly available from the DHS Program repository upon reasonable request at <https://dhsprogram.com/data/available-datasets.cfm>.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

NMK conceived the study, performed data analysis, and drafted the manuscript. DCNP contributed to study design, data interpretation, and manuscript revision. SKAB contributed to the spatial analysis, interpretation of results. AW contributed to the literature review, data cleaning, and drafting of the manuscript. EAO participated in data cleaning, statistical analysis support, and manuscript revision. NAA participated in data interpretation, review of the literature, and final approval of the manuscript. KA contributed to the spatial analysis and manuscript revision. TW contributed to the review of the literature and critical revision of the manuscript., SA contributed critical revision of the manuscript WKT supervised the study, provided critical intellectual input, and revised the manuscript. All authors read and approved the final manuscript.

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Tables

Table 2. Sociodemographic characteristics and association with low birth weight (N=5,113)

Variable	Normal Birth Weight n (%)	Low Birth Weight n (%)	χ^2	p-value
Mother's age			9.79	<0.001
<20 years	235.7 (5.1)	26.4 (0.6)		
20-34 years	2916.0 (62.7)	266.7 (5.7)		
≥35 years	1132.0 (24.3)	76.5 (1.6)		
Sex of child			18.51	0.001
Male	2233.0 (47.9)	151.6 (3.3)		
Female	2051.0 (44.1)	218.0 (4.7)		
Maternal education			7.10	0.279
No education	951.5 (20.5)	62.2 (1.3)		
Primary	648.8 (13.9)	54.9 (1.2)		
Secondary	2286.0 (49.1)	217.3 (4.7)		
Higher	397.4 (8.5)	35.2 (0.8)		
Religion			4.66	0.415
None	86.4 (1.9)	7.5 (0.2)		
Christianity	2995.0 (64.4)	266.3 (5.7)		
Islam	1056.0 (22.7)	90.4 (1.9)		
Traditional	147.2 (3.2)	5.4 (0.1)		
Wealth index			5.04	0.305
Poor	1886.0 (40.5)	164.7 (3.5)		
Middle	838.5 (18.0)	86.9 (1.9)		
Rich	1560.0 (33.5)	118.0 (2.5)		
Ethnicity			14.67	0.036
Akan	1620.0 (34.8)	166.8 (3.6)		
Ewe	604.9 (13.0)	31.9 (0.7)		
Mole-Dagbani	1263.0 (27.1)	111.3 (2.4)		
Others	795.7 (17.1)	59.6 (1.3)		
Place of residence			0.19	0.745
Urban	2058.0 (44.2)	181.7 (3.9)		

Variable	Normal Birth Weight n (%)	Low Birth Weight n (%)	χ^2	p-value
Rural	2226.0 (47.8)	187.9 (4.0)		
Currently working			7.69	0.029
Not working	921.7 (19.8)	101.5 (2.2)		
Working	3362.0 (72.3)	268.1 (5.8)		

Table 3. Maternal and obstetric factors associated with low birth weight (N=5,113)

Variable	Normal Birth Weight n (%)	Low Birth Weight n (%)	χ^2	p-value
Place of delivery			21.49	0.001
Home	673.7 (14.5)	26.4 (0.6)		
Hospital	3610.0 (77.6)	343.1 (7.4)		
Health insurance			6.88	0.007
No	4065.0 (87.4)	361.5 (7.8)		
Yes	218.7 (4.7)	8.1 (0.2)		
Total children born			3.38	0.292
1-4	3358.0 (72.2)	301.4 (6.5)		
5-9	900.5 (19.4)	67.8 (1.5)		
≥10	25.7 (0.6)	0.4 (0.0)		
ANC visits			0.09	0.660
<4	571.0 (12.3)	47.0 (1.0)		
≥4	4168.0 (89.6)	327.0 (7.0)		
Delivery type			18.67	0.008
Vaginal	3951.0 (84.9)	279.0 (6.0)		
Caesarean	788.0 (16.9)	95.0 (2.0)		
Gravidity			1.35	0.386
Low (primigravida)	476.5 (10.2)	48.1 (1.0)		
High (multigravida)	3807.0 (81.8)	321.4 (6.9)		
Malaria prophylaxis			17.78	0.440
No	943.8 (20.3)	73.5 (1.6)		
Yes	914.4 (19.7)	93.3 (2.0)		

Table 4. Multilevel Poisson regression analysis of factors associated with low birth weight (N=5,113)

Variable	Crude PR (95% CI)	p-value	Adjusted PR (95% CI)	p-value
Maternal age				
<20 years	Ref	-	Ref	-
20-34 years	0.73 (0.50-1.06)	0.097	0.81 (0.55-1.19)	0.278
≥35 years	0.55 (0.36-0.83)	0.005	0.64 (0.40-1.03)	0.064
Maternal education				
No education	Ref	-	Ref	-
Primary	1.06 (0.75-1.49)	0.737	0.92 (0.65-1.30)	0.632
Secondary	1.34 (1.04-1.71)	0.022	1.05 (0.79-1.40)	0.722
Higher	1.47 (1.00-2.17)	0.052	1.03 (0.67-1.58)	0.886
Ethnicity				
Akan	Ref	-	Ref	-
Ewe	0.65 (0.46-0.92)	0.017	0.67 (0.47-0.96)	0.028
Mole-Dagbani	0.90 (0.71-1.15)	0.393	0.95 (0.74-1.23)	0.707
Others	0.70 (0.52-0.94)	0.016	0.82 (0.60-1.11)	0.197
Currently working				
Not working	Ref	-	Ref	-
Working	0.69 (0.55-0.86)	0.001	0.76 (0.60-0.95)	0.017
Place of delivery				
Home	Ref	-	Ref	-
Hospital	3.19 (2.05-4.95)	<0.001	2.95 (1.88-4.64)	<0.001
Sex of child				
Male	Ref	-	Ref	-
Female	1.50 (1.22-1.84)	<0.001	1.52 (1.24-1.87)	<0.001
Delivery type				
Vaginal	Ref	-	Ref	-
Caesarean	1.63 (1.29-2.06)	<0.001	1.44 (1.13-1.83)	0.003
Gravidity				
Low (primigravida)	Ref	-	Ref	-

Variable	Crude PR (95% CI)	p-value	Adjusted PR (95% CI)	p-value
High (multigravida)	0.77 (0.63-0.94)	0.012	0.66 (0.49-0.89)	0.006
Malaria prophylaxis				
No	Ref	-	Ref	-
Yes	0.74 (0.55-0.99)	0.043	0.67 (0.49-0.90)	0.009

PR = Prevalence Ratio; CI = Confidence Interval

Model AIC: 2593.17; Community-level variance: 0.34 (SE = 0.08); ICC: 8.4%.

Bold p-values indicate statistical significance at $p < 0.05$.

Figures

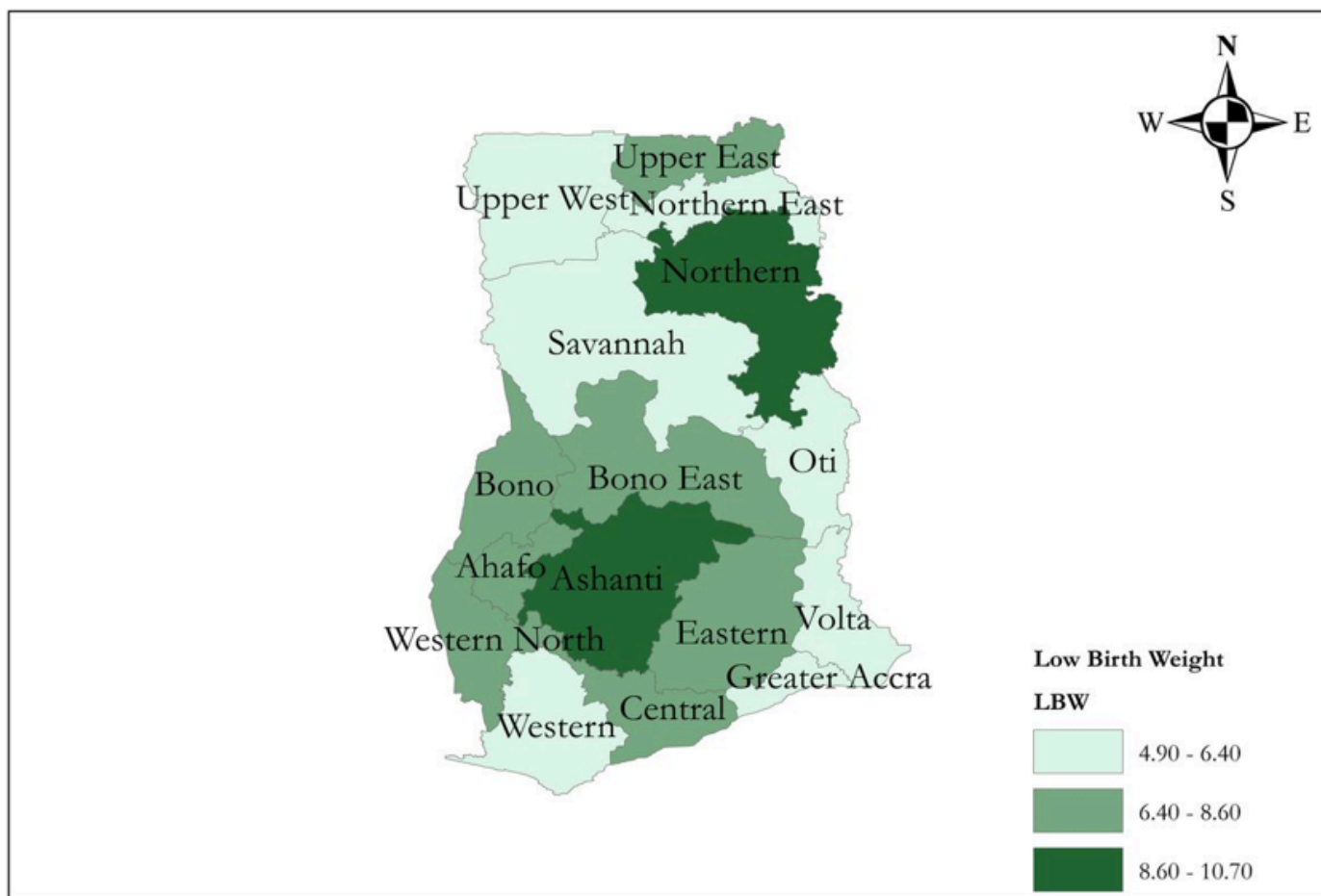


Figure 1

Spatial analysis revealed substantial regional variation in LBW prevalence across Ghana.

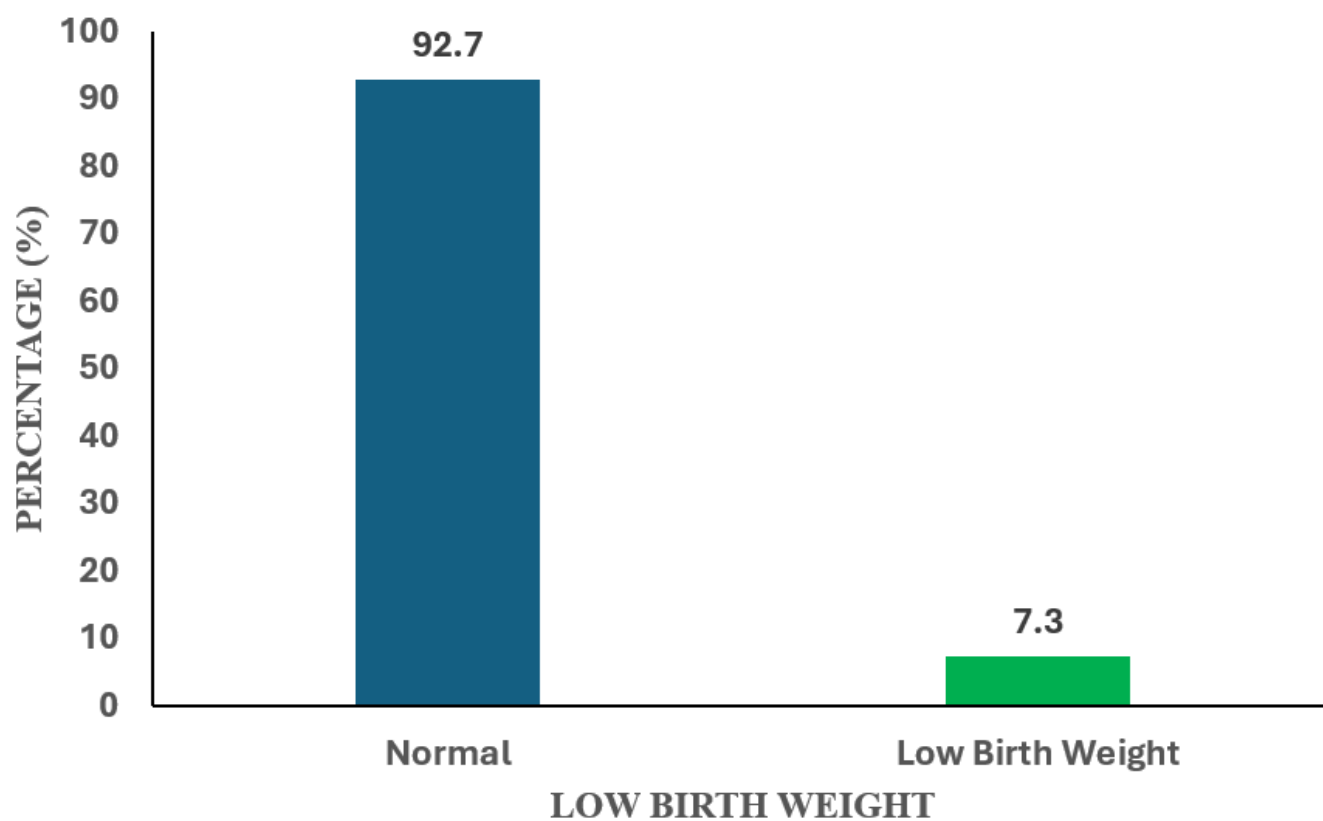


Figure 2

Unnumbered image in the Results section.