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CLINICAL DETERMINANTS OF LOW BIRTH WEIGHT IN NEONATES AT A COUNTY REFERRAL HOSPITAL IN NAIROBI
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ABSTRACT

Background: **One third of all Low Birth Weight neonates are delivered in Africa. In 2021, Low Birth Weight was the leading cause of infant hospital admissions in Kenya. Furthermore, in 2022, neonatal deaths made up to 66% of all infant deaths and 51% of under-five deaths in the country, with Low Birth Weight implicated as the primary contributing factor.**
Objectives: **This cross-sectional study sought to investigate the clinical determinants of Low Birth Weight in neonates at a county referral hospital in Nairobi, Kenya.**
Methods: **Data were collected between January 2024 and August 2024 using a semi-structured questionnaire and data abstraction tool. Statistical methods such as frequencies, chi square tests and logistic regression were employed to analyse the predictors of Low Birth Weight.**
Results: **A total of 216 mother-neonate dyads were included in the study. Most babies, (65.7%, n=142) had Low Birth Weight (LBW, 1500–2499g), and nearly half (46.8%, n=101) were born at 32 weeks or more gestation. The largest group of mothers (47.2%, n=102) were aged 26–35 years. Bivariate analysis revealed that early initiation of antenatal care clinics (ANC), regular ANC attendance, and antenatal supplement use were linked to reduced odds of Extremely Low Birth Weight (ELBW) and Very Low Birth Weight (VLBW). Conversely, alcohol use and smoking during pregnancy increased the risk. However, on logistic regression analysis the use of antenatal supplements remained significantly protective against Low Birth Weight (OR = 0.52, 95% CI: 0.29–0.94, p = 0.030) whereas alcohol consumption: (OR = 1.98, 95% CI: 1.02–3.83, p = 0.040) and smoking during pregnancy: (OR = 3.14, 95% CI: 1.07–9.19, p = 0.037) were significantly associated with an increased risk of Low Birth Weight.**

Conclusion: **Antenatal supplements significantly lowered the odds of Low Birth Weight delivery, whereas alcohol consumption or smoking during pregnancy was associated with significantly increased odds.**
Key Words: **Clinical determinants, Low Birth Weight, Antenatal Supplements, Antenatal care Clinic (ANC), Alcohol, Smoking**
Abbreviations: **Antenatal Care (ANC), Extremely Low Birth Weight (ELBW), Low Birth Weight (LBW), Sustainable Development Goals (SDG), Very Low Birth Weight (VLBW),**

INTRODUCTION

Low Birth Weight is defined as a birth weight of less than 2500 grams, regardless of the gestation[1]. It is further classified into: Low Birth Weight (LBW, 1500 to 2499 grams), Very Low Birth Weight (VLBW, 1000 to 1499 grams) and Extremely Low Birth Weight (ELBW < 1000g)[2]. Globally, approximately 20 million neonates are born with Low Birth Weight annually, with Eastern and Western Africa accounting for one-third of these cases[3,4]. In Kenya, the distribution of Low Birth Weight ranges between 12% and 32%[5-7]. Moreover, it is the leading cause of all infant hospital admissions in Kenya and the most common cause of under-five mortality[8,9]. The main determinants of Low Birth Weight differ widely across different settings. In more developed regions of the world, Low Birth Weight is associated with prematurity because of high maternal age, smoking and caesarean section. In less developed regions, Low Birth Weight is primarily caused by poor foetal growth linked to poor maternal nutrition before and during pregnancy[4]. In Kenya, the factors attributed to increased odds of having a baby with Low Birth Weight include: intimate partner violence experience, a low number of antenatal care clinic visits, a history of a previous Low Birth Weight delivery, premature birth, maternal anaemia and maternal hypertension[5–7].Compared to babies born with normal birth weights, Low Birth Weight babies are at a higher risk for morbidity and mortality[10]. These neonates are more vulnerable to peripartum complications, neonatal infections, prolonged hospital stays and readmissions in early childhood which are all associated with poor neurodevelopmental outcomes[11-13]. Low Birth Weight is also associated with impaired physical growth and an increased risk for developing cardiovascular diseases and obesity later in life[14-16].

In 2012, the 65th World Health Assembly (WHA) endorsed a goal of 30% reduction in Low Birth Weight globally by 2025 as part of global nutritional targets[17]. However, the current Annual Average Rate of Reduction (AARR) is still too low to achieve the 10.5% target by 2030. Additionally, the scope of Low Birth Weight is poorly understood and underestimated due to underreporting among at-risk communities. In 2021, Africa was home to 50.1%(22.7million) of newborns without a recorded birthweight[4].

Although a few studies have been carried out over the years at various Kenyan hospitals to explore the determinants of Low Birth Weight, there are no current studies focusing on the clinical and sociodemographic determinants of Low Birth Weight in neonates born in informal populations in Nairobi, Kenya. Consequently, this study aimed to identify the clinical determinants of Low Birth Weight among neonates born at hospitals serving informal populations in Nairobi County, Kenya.

METHODS

Study Design

This study employed a facility-based cross-sectional analytical design at Mama Lucy Kibaki Hospital in Nairobi, Kenya from January 2024 to August 2024. A purposive sampling technique was utilized to identify and select participants from the Birth Register. Recruitment was conducted across the hospital's Newborn Unit and Maternity Units. This purposive sampling approach ensured the selection of a highly relevant sample, specifically aligned with the study's research objectives, thereby enhancing the focus and depth of the findings.

Study Setting

The study was conducted at Mama Lucy Kibaki Hospital located in the densely populated Embakasi sub-county within Nairobi County. Embakasi is the most populous sub-county in Nairobi, with an estimated population of nearly 1 million residents. This constitutes approximately 22% of Nairobi County's total population[18]. The area is predominantly residential and is home to numerous informal settlements. The hospital offers both inpatient and outpatient neonatal care, with the newborn unit having an estimated 35 bed capacity, inclusive of cots and incubators. Hospital records indicate that, on average, 190 neonates are admitted to the newborn unit each month, of which approximately 37% (n=70) are diagnosed with Low Birth Weight.

Study Variables

The independent variables in this study were neonatal determinants and maternal clinical determinants that act as risk factors for Low Birth Weight deliveries. The dependent variable was Low Birth Weight.

Study Population

The study population comprised mother-neonate dyads with neonates born weighing less than 2,500 grams, irrespective of gestational age, during the study period. Participants were recruited from the Newborn Unit and Maternity Units of the Hospital. Mothers of these neonates who provided informed consent were interviewed at a suitable time using a semi-structured questionnaire.

Inclusion Criteria and Exclusion Criteria

The study included only neonates born at the study hospital between January 2024 and August 2024, with a birth weight of less than 2,500 grams, and whose mothers provided informed consent to participate.

Participants were excluded from the study if the mother experienced a stillbirth, maternal death shortly after childbirth, or severe illness rendering her unresponsive. Additionally, neonates or mothers who were promptly referred for urgent medical attention following delivery were not included.

Sample Size Determination

The Fischer et al (1998) formula[19], was used to determine the sample size, employing a 17.5% prevalence rate of Low Birth Weight, with a 95% confidence interval and a 5% margin of error. This calculation resulted in a sample size of 216 mother-neonate dyads.

Data Collection Tools

An eligibility screening form was used to identify participants who met the inclusion criteria for the study. The primary data collection tool was an interviewer-administered questionnaire, which was conducted by the principal investigator and a trained research assistant. The questionnaire was semi-structured, containing both open-ended and close-ended questions related to the study objectives. It was available in both English and Swahili, the two widely spoken languages in Kenya. Additionally, a data extraction tool was used to gather information from the delivery records, the birth register, and the Mother and Child Health booklet.

Data Collection Procedures

Data was collected at the hospital's New Born Unit and Maternity Units using the questionnaire and data abstraction forms. Participants were identified using the Eligibility Screening Form, and after obtaining informed consent, data was collected through interviewer-administered questionnaires. Additional data was extracted from participant files and Mother and Child Health (MCH) booklets. The data was then entered into Microsoft Excel in a coded format for analysis. To ensure confidentiality and prevent double participation, each data collection form was manually assigned a unique serial number (ranging from 1 to 300).

Data Analysis

Data were automatically uploaded into an Excel database from the electronic data extraction forms. Thereafter, the data was cleaned, exported and then analysed on Statistical Package for Social Sciences (SPSS) version 29.0[20]. Baseline characteristics were summarized in tables, and frequencies and percentages were calculated for categorical variables. Bivariate analysis with Chi-square test or Fisher's exact test (Fischer's exact test was used for categorical values below 5), was used to determine the relationship between the independent and dependent variables. Factors with a p value of < 0.05 were included in multivariable logistic regression to determine independent predictors of Low Birth Weight.

Ethical Consideration

Approval to conduct the study was sought from the Jomo Kenyatta University of Agriculture and Technology Institutional Scientific and Ethical Review Committee (Reference Number: JKU/ISERC/02316/1069). Additional approvals were sought from the National Commission for Science Technology and Information (Reference Number: NACOSTI/P/23/31936), Nairobi County (NCCG/HWN/REC/487) and the hospital (Reference Number: MLKH/ADM/RES/2). Informed consent also was sought out from those willing to participate, in a language that they could comprehend and there was no coercion or inducement. Any confidential information given was not disclosed. All records were anonymized and de-identified before analysis and during presentation.

RESULTS

Neonatal Characteristics

A total of 216 babies were included in the analysis, yielding a 100% response rate. Of these, 65.7%, (n=142), were Low Birth Weight (LBW, 1500-2499 grams) and the majority (46.8%, n=101 were delivered at 32 weeks of gestation or later. Birth weight distribution varied across gestational age categories. Among infants with Extremely Low Birth Weight (ELBW, <1000 grams), over half (53.3%, n = 8) were delivered before 28 weeks, while 64.4% (n = 38) of those with Very Low Birth Weight (VLBW) were born between 28 and <32 weeks. Notably, two-thirds (66.2%, n = 94) of LBW infants were born at or beyond 32 weeks' gestation. (Table 1).

Table 1:
Birth Weight Distribution and Correlation with Gestational Age at Birth

Variable		ELBW (< 1000 grams)	VLBW (1000 to 1499 grams)	LBW (1500 to 2499 grams)
Baby's gestational age at birth (weeks)	< 28 weeks	8 (28.6)	14 (50.0)	6 (21.4)
	28 to < 32 weeks	7 (8.0)	38 (43.7)	42 (48.3)
	32 weeks or more	0 (0.0)	7 (6.9)	94 (93.1)
Total (%)		**15 (6.9)**	**59 (27.4)**	**142 (65.7)**

Maternal Characteristics

The majority of mothers, 47.2% (n = 102), were aged between 26 and 35 years, while 8.8% (n = 19) were over 35. In terms of education, 57.4% (n = 124) had completed secondary school, and 16.7% (n = 36) had only primary education. Notably, only 15.3% (n = 33) of the mothers were employed. (Table 2).

Table 2:
Maternal Characteristics

Variables		Frequency (n)	Percent (%)
Age	18-25 years	95	44.0
	26-35 years	102	47.2
	>35 years	19	8.8
	Total	216	100.0
Highest level of education	Primary	36	16.7

	Secondary	124	57.4
	Tertiary	56	25.9
	Total	216	100.0
Employment status	Employed	33	15.3
	Self-employed	67	31.0
	Unemployed	116	53.7
	Total	216	100.0

Clinical Determinants of Low Birth Weight

The research explored ANC attendance and its potential association with Low Birth Weight. Findings revealed that 72.7% (n=157), of participants attended ANC. Among those attending, the majority (79.6%, n=125) began visits during the second trimester (14–26 weeks), with only 19.1% (n=30) initiating care in the first trimester (0–13 weeks). Compared to their counterparts, mothers who attended ANC clinics had significantly lower odds of delivering a baby weighing less than 1500 grams (OR = 0.559, 95% CI: 0.302–0.902, p = 0.009). While those who initiated ANC in the first trimester (0–13 weeks) had reduced odds of delivering babies with ELBW or VLBW compared to those who began after 26 weeks (OR = 0.417, 95% CI: 0.148–0.870, p = 0.046). Mothers who started ANC between 14–26 weeks also showed lower odds (OR = 0.517, 95% CI: 0.224–0.892, p = 0.049).

A majority (69.0%, n=149) of respondents reported using antenatal supplements. Mothers who took antenatal supplements had significantly lower odds of delivering a baby with ELBW and VLBW as compared to those who did not (OR = 0.517, 95% CI: 0.285–0.938, p = 0.017).

The study explored maternal risky behaviour in pregnancy including alcohol and smoking intake to determine their association with Low Birth Weight. Of the mothers interviewed, 47 (21.8%) reported a positive history of alcohol consumption in pregnancy. Additionally, 15 (6.9%) of the participants reported a history of smoking during pregnancy. Mothers who consumed alcohol during pregnancy had nearly twice the odds of delivering a baby with ELBW and VLBW as compared to non-drinkers (OR = 1.980, 95% CI: 1.024–3.829, p = 0.040). Moreover, mothers who smoked had over three times the odds of delivering a baby with ELBW and VLBW as compared to non-smokers (OR = 3.138, 95% CI: 1.072–9.191, p = 0.032). (Table 3).

Table 3:
Maternal Clinical Determinants of Low Birth Weight

Variable	Measure	Birth Weight n (%)			Odds Ratio	95% CI		P value
		ELBW	VLBW	LBW		Lower	Upper	
Did you attend antenatal care clinics	Yes	6 (3.8)	42 (26.8)	109 (69.4)	0.559	0.302	0.902	0.009
	No	9 (15.3)	17 (28.8)	33 (55.9)	1			
Gestation during your first ANC visit (in weeks)	0-13 weeks	0 (0.0)	5 (16.7)	25 (83.3)	0.417	0.148	0.870	0.046
	14-26 weeks	5 (4.0)	37 (29.6)	83 (66.4)	0.517	0.224	0.892	0.049
	>26 weeks	1 (50.0)	0 (0.0)	1 (50.0)	1			
Did you take Antenatal Supplements	Yes	6 (4.0)	38 (25.5)	105 (70.5)	0.517	0.285	0.938	0.017
	No	9 (13.4)	21 (31.3)	37 (55.3)	1			
Did you drink alcohol in pregnancy	Yes	5 (10.6)	17 (36.2)	25 (53.2)	1.980	1.024	3.829	0.040
	No	10 (5.9)	42 (24.9)	117 (69.2)	1			
Did you smoke in pregnancy	Yes	3 (20.0)	6 (40.0)	6 (40.0)	3.138	1.072	9.191	0.032
	No	12 (6.0)	53 (26.3)	136 (67.7)	1			

Multivariate Analysis

A logistic regression analysis was conducted to examine the relationship between several variables and the likelihood of Low Birth Weight. The final model revealed significant findings for several predictors. All variables which had a p-value less than 0.05 were included in the model. These included ANC attendance, gestational age at first ANC attendance, use of antenatal supplements, and history of alcohol consumption and smoking in pregnancy. The final model showed that only three factors were independently associated with Low Birth Weight; Taking antenatal supplements (OR = 0.52, 95% CI: 0.29 - 0.94, p = 0.030), Alcohol consumption in pregnancy (OR: 1.98, 95% CI: 1.02 - 3.83, p = 0.042) and Smoking in pregnancy (OR: 3.14, 95% CI: 1.07 - 9.19, p = 0 .037). (Table 4).

Table 4:
Multivariate Analysis

Variable	**OR (Exp(B))**	**95% CI for OR**	**p-value**
Antenatal Supplements	0.517	[0.285, 0.938]	0.030
Whether you drink alcohol	1.980	[1.024, 3.829]	0.042
Whether you smoke	3.138	[1.072, 9.191]	0.037

DISCUSSION

Low Birth Weight remains a significant public health concern, particularly in low- and middle-income countries. One of the most consistent and well-documented predictors of Low Birth Weight is gestational age. Numerous studies have demonstrated a strong inverse relationship between gestational age and birth weight, with preterm infants being significantly more likely to be born with Low Birth Weight[21]. This study also highlights gestational age as a key determinant of Low Birth Weight, with majority of the neonates born preterm. This relationship is primarily attributed to the reduced duration available for foetal growth and development in preterm births[22]. As the gestational period shortens, critical phases of intrauterine growth - particularly in the third trimester when fat and muscle mass are rapidly accumulated are truncated, resulting in lower birthweight outcomes. These findings underscore the importance of strategies aimed at preventing preterm birth, as even modest increases in gestational duration can significantly improve neonatal health outcomes.

Maternal age has been extensively studied for its potential impact on Low Birth Weight. For instance, a 2018 study conducted in Southeast Asia reported a higher incidence of Low Birth Weight among younger mothers, largely attributed to inadequate prenatal care and limited nutritional knowledge[23]. Despite this well-established link in existing literature, the present study did not find a statistically significant association between maternal age and Low Birth Weight. This finding suggests that maternal age alone may not be a strong independent predictor in this population, potentially due to other influencing factors such as access to antenatal care, nutritional support, or health-related behaviours that could mitigate age-related risks. Another possible explanation is the limited variation in maternal age within the study sample, with a large proportion of participants (44%) aged between 18 and 25 years. This narrow age range may have constrained the ability to detect meaningful differences in birth outcomes. It is also plausible that the sample size lacked sufficient power to detect subtle age-related effects. Furthermore, advancing maternal age has also been implicated as a factor influencing Low Birth Weight[24]. However, this study included a relatively small number of participants aged above 35 years (n = 19, f = 8.8%), which limited the ability to thoroughly examine the association between Low Birth Weight and advanced maternal age. This represents a potential area for further research, particularly within this demographic.

Regular and adequate antenatal care (ANC) attendance is a well-established factor in improving birth outcomes and reducing the risk of Low Birth Weight. Studies have consistently shown that increased ANC visits are associated with improved birth outcomes. For example, a study conducted in sub-Saharan Africa found that mothers who attended eight or more ANC visits had a significantly lower risk of delivering Low Birth Weight infants compared to those with fewer visits[25]. However, in the present study, ANC attendance did not emerge as a statistically significant predictor of Low Birth Weight. One likely explanation is that other variables in the model, such as antenatal supplement usage or maternal health behaviours, had stronger direct associations with birth weight, thereby diminishing the independent effect of ANC attendance. Additionally, self-reported data on ANC visits may be subject to recall bias, potentially affecting the accuracy of the measure. While not statistically significant in this analysis, ANC attendance remains a critical component of maternal care, and its role in improving birth outcomes should not be understated.

Antenatal supplementation in pregnancy, particularly with iron and folic acid, has also been consistently shown to reduce the risk of Low Birth Weight. This was demonstrated in a study in rural Nepal where the use of iron–folic acid supplements in pregnant mothers lowered the incidence of Low Birth Weight from 43% to 34%, a 16% relative risk reduction[26]. In the present study, the use of antenatal supplements was similarly protective, with multivariate analysis indicating a 48% reduction in the odds of Low Birth Weight. These findings underscore the importance of targeted nutritional interventions during pregnancy, as iron prevents maternal anaemia and folic acid supports foetal growth, with their deficiencies linked to growth restriction and Low Birth Weight.

Alcohol consumption and smoking during pregnancy are well-established risk factors for Low Birth Weight. For instance, heavy alcohol consumption during pregnancy has been linked to a higher risk of Low Birth Weight, whereas light to moderate drinking appears to have no significant effect[27]. However, the dose–response relationship was not fully explored in this study, representing a potential area for future research. In utero alcohol exposure has also been associated with an increased risk of neonatal sepsis, bronchopulmonary dysplasia, and death[28]. Moreover, a 2014 cohort study in Taiwan found maternal smoking during pregnancy was associated with Low Birth Weight, preterm birth, and adverse fetal growth outcomes, such as shorter birth length, smaller head circumference, and lower brain-to-body ratios, suggesting potential harm to central nervous system development[29-31]. This study strongly supports these findings, showing that women who consumed alcohol during pregnancy had nearly double the odds of delivering a Low Birth Weight infant, while smoking increased the odds more than threefold. Therefore, given these clear and well-documented risks, it is imperative that public health efforts prioritize education, early intervention, and comprehensive support to help expectant mothers eliminate alcohol and tobacco use during pregnancy. Eliminating these entirely preventable exposures is essential to ensuring healthy foetal growth and optimal long-term developmental outcomes for children.

STUDY LIMITATIONS

The study was conducted in a hospital setting within a public facility and therefore, it was not possible to generalize the results to a wider population as compared to population-based studies. It also did not include temporal variations as it was a cross sectional study.

CONCLUSION

In conclusion, maternal support, access to healthcare and lifestyle choices play a critical role in determining the risk of delivering a Low Birth Weight baby. Mothers who took antenatal supplements had significantly lower odds of Low Birth Weight, whereas those who consumed alcohol or smoked during pregnancy had a significantly increased risk. These findings underscore the importance of maternal support and targeted healthcare interventions.

RECOMMENDATIONS

Strengthening maternal healthcare services is essential in reducing Low Birth Weight. Expanding antenatal care programs will ensure expectant mothers receive regular checkups, nutritional counseling and essential medical support. Providing universal access to antenatal supplements, including folic acid and iron, can enhance improved maternal and foetal health outcomes.

Raising public awareness on the impact of unhealthy lifestyle choices is crucial in mitigating Low Birth Weight cases. Health education campaigns should focus on the dangers of alcohol consumption and smoking during pregnancy, thus promoting informed decision-making among mothers. Community outreach programs and healthcare provider counseling can reinforce positive lifestyle changes among expectant mothers.

The findings of this study are limited to a single healthcare facility thereby limiting its scope. Future research should aim to broaden the scope by examining the determinants of Low Birth Weight across multiple hospitals and counties in Kenya to enhance the generalizability and applicability of the findings.

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Credit Authorship Contribution Statement

L. N. Mosoti: Conceptualization, Methodology, Data curation, Formal analysis, Investigation, Visualization, Writing – original draft, Project administration, Funding acquisition.

M. Maina, R. Kithuci, S. Koriata: Conceptualization, Methodology, Data curation, Formal analysis, Supervision, Writing – review & editing, Project administration.

COMPETING INTERESTS

No competing interests were disclosed.

GRANT INFORMATION

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