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Original Article

Obstetric Determinants of Birth Weight Status of Babies Born at Jaramogi Oginga Odinga Teaching and Referral Hospital, Kenya

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Newborn, Birth Weight, Low Birth Weight, Prevalence, Obstetric Determinants.

ABSTRACT

Background: Low birth weight (LBW) is a serious public health problem, especially in developing countries. Globally, 15.5% of all births are born LBW and 95.6% of them are in developing countries. In Kenya, 8% of babies are born LBW and at Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH), it is 11.1%. Despite several efforts such as antenatal care services put in place to improve the quality of maternal and child health, the rates of LBW are still high. LBW is a major cause of mortality and morbidity in infants. **Objective**: The objective of this study was to assess obstetric determinants of the birth weight status of babies born at JOOTRH, Kenya. **Materials and Methods**: This was a cross-sectional study with a sample size of 131 babies plus their mothers from a total population of 538 deliveries during the study period. Systematic random sampling was used to select the respondents. Data was collected using a questionnaire and record review checklist. Data analysis was done using descriptive statistics and inferential statistics, specifically logistic regression. **Result**: The study results showed that the prevalence of LBW was 13.7%. LBW was strongly associated with a birth interval of < 24 months (AOR = 13.722), hypertension (AOR = 11.753), previous history of LBW (COR = 14.0), and gestation at birth (COR = 3.75). Gravidity, previous history of miscarriage and gestation at which antenatal visits started had no association with LBW. **Conclusion**: The prevalence of LBW is 13.7%, higher than the national rate of 8% and statistically significant with a Z score of 2.398, p = 0.016. The birth interval of < 24 months, hypertension, previous history of LBW, and gestation at birth influenced the occurrence of LBW. Focused antenatal care to ensure early detection and management of high-risk pregnancies and educate pregnant mothers on the birth spacing of more than two years between two successive pregnancies to allow replenishment of nutrient stores is important in reducing LBW.

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INTRODUCTION

Birth weight is the first weight of the newborn obtained after birth and it should be measured within the first hour after delivery of a newborn at least before significant weight loss has occurred. Low birth weight (LBW) is the weight of a newborn at birth less than 2,500 grams regardless of gestational age (WHO, 2004). This is based on epidemiological observations that infants weighing less than 2,500 g are at greater risk of dying than babies born with normal birth weight (UNICEF/WHO, 2004). LBW can further be subdivided into very low birth weight {< 1,500 g} and extremely low birth weight {< 1,000 g} (WHO, 2004). LBW results from either preterm birth before 37 weeks of gestation or intrauterine growth restriction (Sharma & Mishra, 2015) which mostly occurs due to interference with placental circulation resulting in alteration of the mother-placenta-foetus interchange and therefore causing intrauterine malnutrition (Bernabe´a *et al.,* 2004). Obstetric factors such as high-risk pregnancy and ≤2 years of the birth interval are good predictors of LBW (Patel *et al.,* 2015).

Birth weight is an important indicator of a child's growth, vulnerability to illnesses and chances for survival; thus, children born with LBW have impaired growth resulting in increased morbidity and higher mortality rate (Shashikantha & Sheethal, 2016). Babies born with LBW are at a higher risk of developing diseases such as cerebral palsy, visual problems, learning disabilities, and respiratory problems (Singh *et al.,* 2009). Such babies remain a burden on the government economy in developed countries and a permanent problem for their families in developing countries (Badshah *et al.,* 2008). Neonatal mortality accounts for 41% of all deaths among children less than five years (Black *et al.,* 2010). About 50% of all neonatal deaths occur due to LBW. It is estimated that 4 million babies die every year in the first four weeks of life (Sharma & Mishra, 2015). In Kenya, data for mortality estimation showed that the national under-five mortality was 52 deaths per 1,000 live births, while in Nyanza, it was 72 deaths per 1,000 live births; thus, a child born in the Nyanza Region was at greater risk of dying before age five. The neonatal mortality rate was 22 deaths per 1,000 live births (KNBS & ICF International, 2015).

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Globally, more than 20 million infants are born with LBW, representing 15.5% of all births and 95.6% of them in developing countries, out of which 22% in developing countries are born in Africa. The estimation further indicated that in sub-Saharan Africa, around 15% of babies are born LBW (UNICEF/WHO, 2004). In Kenya, 8% of babies are born with LBW, while in Nyanza Region, the prevalence is 4% (KNBS & ICF International, 2015). The current data at JOOTRH show that 11.1% of babies are born with LBW (DHIS, 2016). This prevalence rate of LBW at JOOTRH, which is a referral hospital in the Western Kenya Region, is higher than the national rate, but there is limited data available on the factors influencing LBW. Therefore, this study assessed the obstetric determinants of the birth weight status of babies born at JOOTRH.

MATERIALS AND METHODS

Study Design

This was a cross-sectional study conducted at Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH), the major referral hospital in Western Kenya Region. It is located in Kisumu City, Kenya, between Kondele and Kibuye along the Kisumu-Kakamega highway. The coordinates for the hospital are 0°15'08.0 "N-34°45'01.0" E.

Study Population

The study population comprised newborn babies delivered at the JOOTRH plus their mothers.

Inclusion Criteria and Exclusion Criteria

All mothers who had live birth at JOOTRH and were willing to consent were included in the study. Mothers who delivered babies with congenital abnormalities were excluded.

Sample Size Determination

The appropriate sample size was determined using the formula recommended by Fisher *et al.* (1991), 11.1% prevalence of LBW babies at JOOTRH (DHIS, 2016), correction for the finite population was done and added 10% non-response rate giving a total sample size of 131.

Sampling Procedure

Five hundred thirty-eight deliveries were conducted at JOOTRH during the study period and systematic random sampling was used to select the study respondents. The mother who had her first live delivery on 7th November 2018 was the first respondent in the study; every 4th live delivery after the first delivery that occurred at JOOTRH during the period from 7th November – 6th December 2018 were included in the study until the desired sample size of 131 was achieved.

Data Collection Instruments

A Questionnaire and anthropometric measurement form were used to collect data. The questionnaire was prepared and pretested among ten conveniently selected mothers who delivered at JOOTRH to check for relevancy and detect any errors before being used in the main study. The baby's weight was measured within one hour upon delivery using a digital beam balance (SECA Model 354). A sterile light paper was placed on the weighing scale to prevent the baby's skin from coming into contact with the weighing scale then zeroing was done and a baby was placed on the weighing scale naked. Weight was recorded to the nearest 100 g, a baby weighing less than 2500 g was considered a low birth weight. To minimize errors in measurements, standardization of the weighing scale was done by measuring a standard weight (1 kg) twice a day in the morning and in the evening and was zeroed before weighing.

Data on obstetric characteristics was collected by interviewing the mothers within 24 hours after delivery on a one-on-one basis and review of records from delivery notes and the mother-child health booklet.

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Ethical approval was sought from Maseno University Ethics Review Committee (Ref No.-MSU/DRPI/MUERC/00569/18) and National Commission for Science, Technology, and Innovation (Ref No - NACOSTI/P/18/11529/26439).

Study Variables

Independent variables comprised information on gestational age at birth, parity, birth interval, Antenatal Clinic (ANC) initiation time, ANC visits, bad obstetric history, and maternal hypertension. Gestational age was defined as the period from conception up to delivery in weeks and was determined using the reported last normal menstrual period; in any instance that the respondent was not able to recall, then an ultrasound was conducted to determine the gestational age. Parity was the number of times the mothers have previously become pregnant (gravidity), the birth interval was the number of completed months between the previous and current pregnancy, ANC visits as the number of attendances to ANC clinic during the current pregnancy, bad obstetric history as a previous high-risk pregnancy and maternal hypertension as elevated blood pressure during pregnancy where a mother having blood pressure of above 140/90 was considered to be having maternal hypertension. The information collected was used to facilitate the assessment of the obstetric characteristics of the mother that influenced foetal growth and gestation of the current pregnancy, thus influencing the birth outcome.

The dependent variable comprised information on the birth outcome either normal birth weight or low birth weight. Normal birth weight was defined as birth weight $\geq$ 2500 g and low birth weight as birth weight < 2500 g. The information collected was used to determine the birth weight status of babies born at JOOTRH.

Data Analysis

Data analysis was done using descriptive statistics such as frequencies, mean and measures of dispersion were computed. Inferential statistics, specifically binary logistic regression, was done to determine if there was a significant association between LBW and obstetric characteristics of the mothers delivering at JOOTRH. Both the crude and adjusted odds ratios were computed based on the 95% level of significance, a p-value equal to or less than 0.05 was considered significant. A Z-score test was further conducted based on a 95% level of significance to determine whether the prevalence of the study sample differed significantly from the expected prevalence.

RESULTS

Distribution of Babies

Five hundred thirty-eight deliveries were conducted during the study period; a total of 131 babies plus their mothers were included in the study. The mean birth weight was 3111.8 g (SD 56.7) with the lowest birth weight being 1085.00 g and the highest 4800.00 g. The results showed that 86.3% (113) of the babies were born with normal weight, while 13.7% (18) were born LBW. The distribution of birth weight status is represented in *Figure 1*.

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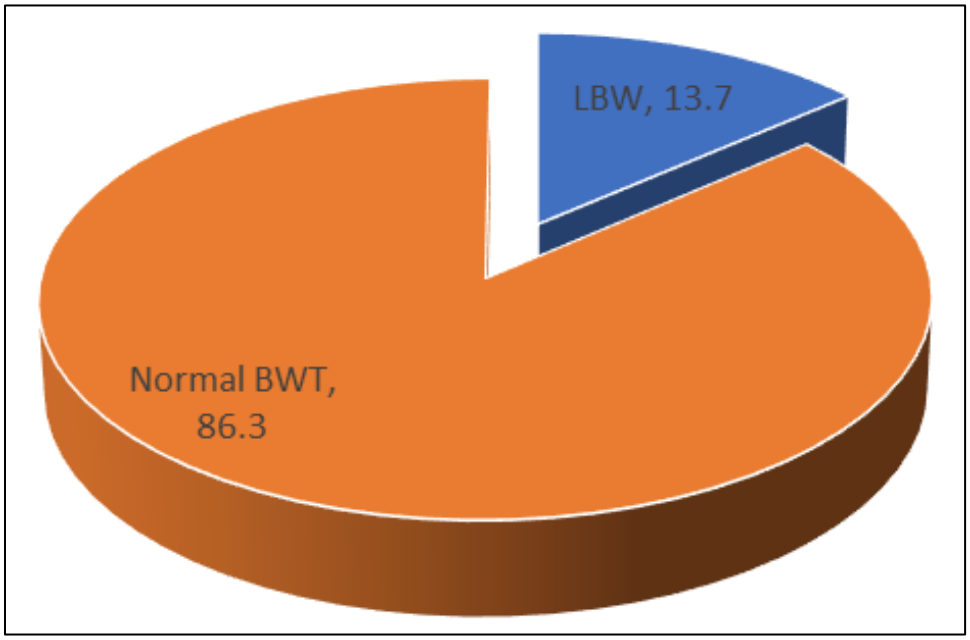
Figure 1: Distribution of Babies by Birth Weight



Further analysis using a Z score test was done to determine whether the prevalence of 13.7% differed significantly from the expected prevalence of 8% national rate. The results showed that the prevalence was statistically significant (Z score of 2.398, p=0.016, $p \leq 0.05$).

Obstetric Characteristics of the Respondents

The mean gravidity was 2.4±1.5 pregnancies and 59.5% (78) of the mothers were between gravida 2-4. The mean pregnancy interval between the current and the previous pregnancy was 28.8±5.4 months, with 67.8% (56) of the mothers having a pregnancy interval ≥ 24 months. Among the mothers, 2.3% (3) had a previous history of LBW and 0.8 (1) reported the reason for LBW was due to hypertension with similar portions due to the Preterm premature rupture of the membranes (Pprom) and at 15 years old. History of miscarriage was reported by 9.9% (13), while 0.8% (1) had preterm premature rupture of membranes and a similar portion had a history of vaginal bleeding during the current pregnancy. The mean gestation at the 1st ANC visit was 18.8±7.3 weeks, and 59.5% (78) of the mothers started ANC visits during their 2nd trimester. The mean ANC visits during pregnancy were 4.2±1.7 visits, and 66.4% (87) of the mothers attended ANC ≥ 4 times. The mean gestation at birth was 38.9±1.9 weeks with 90.8% (119) of the mothers delivering at ≥ 37 weeks of gestation. Among the mothers, 4.6% (6) had hypertension during pregnancy. Birth weight status according to obstetric characteristics of the mother is represented in *Table 1*.

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Table 1: Distribution of Birth Weight Status by Maternal Obstetric Characteristics

Characteristic		Birth weight				Total	
		LBW (≥ 2500 g)		Normal Birth Weight (< 2500 g)			
		n	%	n	%	n	%
Number of pregnancies (gravidity)	1	9	(6.9)	35	(26.7)	44	(33.6)
	2-4	8	(6.1)	70	(53.4)	78	(59.5)
	≥5	1	(0.8)	8	(6.1)	9	(6.9)
Pregnancy interval of previous birth	<24 months	8	(9.2)	20	(23)	28	(32.2)
	≥24 months	1	(1.1)	58	(66.7)	59	(67.8)
Previous history of LBW	Yes	2	(1.5)	1	(0.8)	3	(2.3)
	No	16	(12.5)	112	(85.5)	128	(97.7)
Previous history of miscarriage	Yes	2	(1.5)	11	(8.4)	13	(9.9)
	No	16	(12.2)	102	(77.9	118	(90.1)
Pprom	Yes	1	(0.8)	0	(0)	1	(0.8)
	No	17	(13.0)	113	(86.3)	130	(99.2)
Vaginal bleeding in pregnancy	Yes	0	(0)	1	(0.8)	1	(0.8)
	No	18	(13.7)	112	(85.5)	130	(99.2)
Gestation at 1st ANC visit	< 12 weeks	3	(2.3)	22	(16.8)	25	(19.1)
	12-24 weeks	10	(7.6)	68	(51.9)	78	(59.5)
	> 24 weeks	5	(3.8)	23	(17.6)	28	(21.4)
Number of ANC visits	< 4 visits	10	(7.6)	34	(26.0)	44	(33.6)
	≥ 4 visits	8	(6.1)	79	(60.3)	87	(66.4)
Gestation at birth	< 37 weeks	4	(3.1)	8	(6.1)	12	(9.2)
	≥37 weeks	14	(10.7)	105	(80.2)	119	(90.8)
Hypertension in current pregnancy	Yes	3	(2.3)	3	(2.3)	6	(4.6)
	No	15	(11.5)	110	(84.0)	125	(95.4)

Key: *LBW- low birth weight, ANC- Antenatal clinic, Pprom-Preterm premature rapture of membranes*

Maternal Obstetric Characteristics Associated with Low Birth Weight

Pregnancy interval of < 24 months (AOR 13.722, C. I 1.832-103.52, p <0.05) was significantly associated with LBW both in crude odds ratio and adjusted odds ratio. This indicates that mothers who had a pregnancy interval of < 24 months from the previous birth to the current pregnancy were 13.722 times more likely to deliver LBW compared to mothers who had a birth interval of ≥ 24 months. Hypertension (AOR 11.753, C. I 1.137-121.51, p<0.05) was also significantly associated with LBW. This implies that mothers who had hypertension during pregnancy were 11.753 times more likely to get LBW as compared to mothers who did not suffer from hypertension during pregnancy. Previous history of LBW (COR 14.000, C.I 1.2-163.367, p<0.005) was significantly associated with LBW, but this was ruled out by the adjusted odds ratio.

Mothers having a previous history of LBW were 14 times more likely to deliver LBW compared to mothers who did not have a previous history of LBW. Gestation at birth (COR 3.750, C.I 0.988-14.086, p<0.05) was also significantly associated with LBW, but this did not hold after adjustment.

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This indicates that mothers who gave birth at a gestation of < 37 weeks were 3.75 times more likely to deliver LBW compared to mothers who gave birth at a gestation of ≥ 37 weeks. The number of ANC visits (COR 2.904, C.I 1.055-7.997, p<0.05) had a significant association with LBW only in the crude odds ratio. This implies that mothers who had < 4 ANC visits had a 2.904 times likelihood of delivering LBW as compared to mothers who had ≥ 4 ANC visits. Gravidity, previous history of miscarriage and gestation at which ANC visits started had no significant association with LBW p>0.05, as shown in *Table 2*.

Table 2: Maternal Obstetric Characteristics associated with Low Birth Weight

Variable		Crude OR	(95% C.I)	Adjusted OR	(95% C.I)
No. of pregnancies (gravidity)	1 2-4 ≥ 5 (ref)	2.00 0.928	(0.221-11.112) (0.102-8.404)	42.676 4.242	**(0.752-2420.7)** **(0.144-124.78)**
Pregnancy interval	<24 months ≥24 months (ref)	3.720*	(1.305-10.606)	13.722*	**1.832-103.52)**
Previous history of LBW	Yes No (ref)	14.00*	(1.2-163.367)	16.247	**(0.406-649.85)**
Previous history of miscarriage	Yes No (ref)	1.159	(0.235-5.719)	0.625	**(0.06-6.539)**
Gestation at birth	< 37 weeks ≥ 37 weeks (ref)	3.750*	(0.988-14.086)	1.662	**(0.29-9.508)**
No. of ANC visits	< 4 visits ≥ 4 visits (ref)	2.904*	(1.055-7.997)	1.459	**(0.238-8.936)**
Gestation at 1st ANC visit	< 12 weeks (ref) 12-24 weeks > 24 weeks	1.078 1.594	(0.272-4.273) (0.34-7.482)	0.984 1.724	**(0.187-5.174)** **(0.163-18.207)**
Hypertension in pregnancy	Yes No (ref)	7.333*	(1.355-39.695)	11.753*	**(1.137-121.51)**

Key: OR – Odds Ratio, C.I – Confidence Interval, LBW- low birth weight, ANC- Antenatal clinic, ref-reference category, *- P value ≤0.05

DISCUSSION

The results of this study showed that 86.3% of the babies were born with normal birth weights. The prevalence of low birth weight (LBW) was 13.7%. This finding of LBW prevalence of 13.7% was higher than the national prevalence of 8% and thrice regional 4%, according to the Kenya Demographic Health Survey (KDHS) report of 2014 (KNBS and ICF International, 2015). Further analysis using the Z-score test indicated that the prevalence of 13.7% differed significantly from the expected prevalence of 8% national rate by KDHS (2014), with a p=0.016 (P≤0.05). The variation may be due to the difference in sample sizes, and also, the national and regional prevalence estimates are pooled while the study findings of 13.7% were from a sample selected from a population of mothers delivering at JOOTRH. The finding almost agrees with the LBW prevalence of 12.3% found in the study conducted at the Olkalou Hospital in Kenya (Muchemi *et al.,* 2015) and another study carried out in Khartoum

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State, Sudan (Saeed *et al.,* 2011)**.** The findings were slightly higher than the current data from the District Health Information System (DHIS) at JOOTRH, 11.1% (DHIS, 2016). The reason for this variation may be due to the study findings being from a selected sample of mothers, while data from DHIS was from monthly statistics of the whole population of mothers delivering at JOOTRH.

The birth interval was significantly associated with LBW both in crude odds ratio and adjusted odds ratio. A similar finding was observed in Ethiopia (Demelash *et al.,* 2015) and in Shimoga, Karnataka (Rajashree *et al.,* 2015). Study results showed that mothers who had a pregnancy interval of < 24 months from the previous birth and current pregnancy were 13.722 times more likely to deliver LBW compared to mothers who had a birth interval of ≥ 24 months. This could be explained by the reason that short pregnancy interval of below 2 years results in inadequate replenishment of the maternal nutrient stores that were depleted during the previous pregnancy, thus resulting in restricted foetal growth in the current pregnancy (Demelash *et al.,* 2015).

Hypertension in pregnancy significantly predicted LBW both in crude odds ratio and adjusted odds ratio. This finding was consistent with other studies conducted in Khartoum State, Sudan (Saeed *et al.,* 2011) and in North-Eastern Nigeria (Takai *et al.,* 2014). In this study, mothers who had hypertension during pregnancy were 11.753 times more likely to get LBW as compared to mothers who did not suffer from hypertension during pregnancy. Hypertension is a risk factor of LBW due to the premature termination of pregnancy to save the mother and the foetus from obstetric complications (Ojha, 2015).

The previous history of LBW was significantly associated with LBW in crude odds ratio, but the significance did not hold after adjustment. This was similar to the findings of studies conducted in Selected Hospitals in Nepal (Shakya *et al.,* 2015) and in Nanded, Maharashtra (Domple *et al.,* 2016). Mothers having a previous history of LBW were 14 times more likely to deliver LBW compared to mothers who did not have a previous history of LBW.

Gestation at birth also had a significant association with crude odds ratio, though the significance was ruled out after adjustment. The results were in agreement with studies conducted in Olkalou District Hospital, Kenya (Muchemi *et al.,* 2015) and in Egypt (El-Moselhy *et al.,* 2012). In this study, mothers who gave birth at a gestation of < 37 weeks were 3.75 times more likely of delivering LBW compared to mothers who gave birth at a gestation of ≥ 37 weeks. Preterm babies are usually small due to prematurity because as gestational age increases, the growth and weight also increase (Abdeen *et al.,* 2016).

The number of ANC visits attended during pregnancy had significantly associated with LBW in the crude odds ratio, but the significance did not hold after adjustment. This can be compared with a study done in North-Eastern Nigeria (Takai *et al.,* 2014) and in India (Bendhari and Haralkar, 2015). The study results showed that mothers who had < 4 ANC visits during pregnancy were 2.904 times more likely to deliver LBW compared to mothers who had ≥ 4 ANC visits. Regular ANC visits have a beneficial impact on the birth outcome, either by improving the intrauterine growth or gestational duration through nutritional counselling and early diagnosis and timely treatment of pregnancy complications (Singh *et al.,* 2009).

Some studies found a significant association between primigravida with LBW such as studies conducted in Nagpur City of Maharashtra (Nagargoje *et al.,* 2011) and in Ethiopia (Demelash *et al.,* 2015), but this study did not find a significant association between primigravida and LBW, similar to a study conducted in Egypt (El-MoselhY *et al.,* 2012). However, the study results showed that primigravidas were 2 times more (COR) and 42.676 times higher (AOR) to deliver LBW compared to

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mothers who had more than 4 pregnancies. This may be explained by the reason that primigravida mothers may be of young age; thus, there is competition for the nutrient to meet the needs of the growing fetus and individual growth, poor health education and psychological disturbance leading to deficient nutrients (WHO, 2006).

In this study, the previous history of miscarriage did not have significance with LBW similar to other studies conducted in Tigray, Northern Ethiopia (Gebremedhin *et al.,* 2015) and in an urban slum of Western India (Patel *et al.,* 2015). This study's finding was contrary to a study done at Tertiary Care Hospital, Nepal (Ojha, 2015), which found the previous history of miscarriage to be significantly associated with LBW. However, mothers who had a miscarriage previously were 1.159 times more likely to have LBW compared to those who did not have a history of miscarriage. Miscarriage affects maternal health through haemorrhage resulting in anaemia and poor pregnancy outcomes, especially due to short gestation leading to LBW (El-Moselhy *et al.*, 2012).

Gestation at which antenatal clinic (ANC) visits started had no significant association with LBW. The finding was in agreement with other studies conducted in Khartoum State, Sudan (Saeed *et al.*, 2011) and in a tertiary care government hospital in Solapu (Bendhari & Haralkar, 2015). However, the study findings showed that the risk of LBW increased with the late start of ANC visits. Mothers who started the clinic between 12-24 weeks were 1.078 times more likely to deliver LBW, while those who started at > 24 weeks were 1.594 times more likely to have LBW compared to mothers who started the clinic <12 weeks. Early ANC booking is an important entry point for health education, prevention and identification of basic detectable maternal risk factors such as high blood pressure and anaemia that affect the birth outcome (Jammeh *et al.*, 2011).

This study did not find any risk associated with vaginal bleeding in the current pregnancy and Pprom; this agrees with studies conducted in Sudan (Saeed *et al.,* 2011) and in Gambia (Jammeh *et al.,* 2011).

CONCLUSION

Birth interval and hypertension were found to be independent predictors of LBW both in crude and adjusted odds ratios. The number of ANC visits, gestation at birth, and previous history of LBW was significantly associated with LBW only in crude odds ratio. However, gravidity, previous history of miscarriage, gestation at which ANC visits started, and vaginal bleeding in the current pregnancy had no significant association with LBW. The Ministry of Health, Kisumu County Government, should plan and implement interventions targeting mothers of reproductive age, educate them on how to carry a healthy pregnancy, improving the health of the mother before and during pregnancy.

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