FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT OF RECENTLY DELIVERED BABIES IN PUBLIC HOSPITALS, ADDIS ABABA, ETHIOPIA, 2021: FACILITY-BASED CROSS-SECTIONAL STUDY

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Abstract

Background: The incidence of low birth weight is estimated to be 16% worldwide, 19% in developing countries, and 7% in developed countries. Currently, 13% of Ethiopian babies are born with a low weight; different studies have reported that the prevalence of low birth weight accounts for about 8.8% in Addis Ababa and 10.5% in the Tigray region. This study is primarily aimed at assessing the factors associated with the low birth weight of newborns in selected Addis Ababa public hospitals.

Methods: Data collection was conducted in Addis Ababa from March 2021 to April 2021. A facility-based cross-sectional study was used among 466 mothers who gave birth in public hospitals during a reference period. Primary data were collected using a structured questionnaire adopted from previous studies. The sample size was calculated by Epi Info calc using an assumption of 95% CI, 80% power, 20.6 percent exposed, 10.4 percent unexposed, and 2.2 Adjusted Odds Ratio (AOR). Univariate, bivariate, and multiple logistic regression analyses were used. Adjusted odds ratios were used to identify the association between the key predictors and the dependent variable (birth weight).

Results: Of the total respondents, 12.4% gave birth to infants with a low birth weight. The median age of the participants was 28 yrs (IQR = 7). The results of multivariable logistic regression showed that the key determinants of low birth weight among the study population were: number of ANC (Antenatal Care) visits (AOR = 0.4, 95% CI: 0.17–0.99), presence of Abnormal Uterine Bleeding (AUB) during recent pregnancy (AOR = 10.9, 95% CI: 2.5–15.8), having pre-eclampsia or eclampsia during recent pregnancy (AOR 9.5, 95% CI: 4.8–10.8), Anemia during pregnancy (AOR = 3.3, 95% CI 3.1–3.6), Chewing Kchat (AOR = 7.9, 95% CI: 3.9–16.1), and pre-pregnancy maternal nutritional (AOR = 0.2, 95% CI: 0.1–0.5).

Conclusions: Encouraging pregnant mothers to make frequent ANC visits, behavioral change communications that target pregnant women for improving women's nutritional status, and reducing maternal toxic exposures should be priority areas of interventions to curb the problem.

Keywords: *Ethiopia; Determinants; Health facility; Low Birth Weight (LBW); Recent delivery*

Abbreviations:

ANC: Antenatal Care; AOR: Adjusted Odds Ratio; AUB: Abnormal Uterine Bleeding; BMI: Body Mass Index; CI: Confidence Interval; CO_2: Carbon Dioxide; CSA: Central Statistical Agency; $DHIS_2$: District Health Information System Version 2; FMoH: Federal Ministry of Health; ICF: International Coaching Federation; IQR: Inter Quartile Range; LBW: Low Birth Weight; SPSS: Statistical Package for the Social sciences; WHO: World Health Organization.

ORIGINAL ARTICLE

INTRODUCTION

Birth weight is the weight of a newborn immediately after birth. Low Birth Weight (LBW) is defined by the World Health Organization (WHO) as a weight at birth of less than 2,500 g (5.5 lb) (WHO, 1992). Newborns with low birth weight are at higher risk of stillbirth, low Apgar score, admission to neonatal intensive care unit, and early neonatal death (Chibwesha et al., 2016). Additionally, low birth weight is associated with a risk of hypertension later in life (Lule et al., 2018).

The incidence of LBW is estimated to be 16% worldwide, 19% in developing countries, and 7% in developed countries (Bhaskar et al., 2015). Globally, neonatal mortality is 20 times more likely for LBW babies compared to Normal Birth Weight (NBW) babies (>2.5 kg) (Bhaskar et al., 2015). In 2014, there were 27,243 deaths due to low birth weight, accounting for 4.53% of the total early deaths in Ethiopia (Chibwesha et al., 2016). According to a recent WHO report (2017), deaths due to low birth weight in Ethiopia reached 23,091 or 3.63% of total deaths, which ranks Ethiopia 48th in the world (WHO, 2018). The prevalence of LBW was reported as 8.8% in Addis Ababa (Mulatu et al., 2017). The Addis Ababa health bureau report, generated from District Health Information Software 2 ($DHIS_2$) reporting tool, indicated that about 6.9% of live births were under 2500 gm. Low Birth Weight is the fourth leading cause of death in children who are under one year old in Addis Ababa (FMoH $DHIS_2$, 2019–2020).

Of the different factors associated with newborn weight, most of them are easily manageable through continuous follow-up and counseling during ANC. A study reported that newborn weight may be significantly influenced by maternal age (especially younger than 16 years of age or older than 40 years) (Lean et al., 2017). A case-control study conducted in Nepal in 2011 (Sharma et al., 2015) and Bale zone hospitals, South-East Ethiopia (Demelash et al., 2015) showed that the odds of having a low birth weight baby were found to be higher among younger mothers. In addition, the same study reported that children of mothers with a height of <150 cm are more likely to have low birth weight (Demelash et al., 2015).

A study conducted in Wolaita Sodo showed that mothers with a primary education or less were 5.8 times more likely to have low birth weight newborns than those with secondary and higher educational levels (Kastro et al., 2018). Maternal obstetric history and pregnancy complications were the other factors mostly affecting birth weight. A case-control study conducted in Amhara regional state referral hospital (Asmare et al., 2018) and a study conducted in the Amhara region Debrebirhan Hospital, Ethiopia (Hailu and Kebede, 2018) showed that mothers who had pregnancy-related problems during their pregnancy were more likely to have a low birth weight baby compared to mothers without any health problems.

Maternal morbidity such as chronic maternal conditions (e.g. hypertensive disorders of pregnancy and diabetic mellitus), infections (e.g, malaria, urinary tract infections, genital tract infections), and other infectious and noninfectious illness during pregnancy period are the other factors affecting newborn birth weight – either directly from the disease or indirectly due to a drug taken during illness (Accrombessi et al., 2018).

A systematic review and meta-analysis study conducted in America showed that active maternal smoking showed a significant correlation with low birth weight, with smokers two times more likely to have low birth weight babies than non-smokers (Pereira et al., 2017). On the other hand, a study conducted in Bale, Oromia region of Ethiopia, showed that the odds of low birth weight were higher among mothers who chew 'kchats' during pregnancy (Demelash et al., 2015).

An iron foliate supplement is advisable for all pregnant mothers during pregnancy to prevent the possible occurrence of iron deficiency anemia. A study reported that the odds of low birth weight were found to be higher among mothers who did not take iron foliate supplements compared to mothers who took iron supplements during pregnancy. The study reported that mothers who had a Mid Upper Arm Circumference (MUAC) of below 23 cm were at higher risk for newborn low birth weight (Asmare et al., 2018). A similar study conducted in Bale zone hospitals, South-East Ethiopia, also showed that mothers with a Body Mass Index (BMI) of <18.5 were more

prone to have low birth weight babies than those with a BMI of >18.5 (Demelash et al., 2015).

In the past few years, researchers have conducted different studies on associated risk factors of LBW in different parts of the country, as well as in parts of Addis Ababa, using secondary data. However, most were limited in both scope and the number of predictors included, and mostly depended on all births (both recent and remote birth reporting). In this study, the researchers used primary data to assess factors affecting LBW among recent deliveries in Addis Ababa. Socio-demographic factors, maternal morbidity, nutritional factors, maternal toxic exposure history, and obstetric factors were assessed.

MATERIALS AND METHODS

Study setting

This study was conducted in Addis Ababa City Administration, the capital of Ethiopia and commercial center for Africa. Addis Ababa is located in the center of the country and hosts different international events. Data were collected from selected public hospitals in the city. According to the last available census of 2007, the total population of Addis Ababa is 3,770,554 (CSA FCI, 2017), of which females account for 51.5%. Of the total female population, those in the reproductive age group account for about 33%. The city administration has three-tier health system structures which follow the strategy of health promotion and disease prevention. As the Addis Ababa Health City Administration health bureau profile shows, there are more than 1,000 health facilities in Addis Ababa; including 12 public hospitals, 33 private hospitals, 102 health centers, and several higher or medium clinics.

Study design

A facility-based analytical cross-sectional study was employed to assess factors affecting birth weight among recent deliveries in selected public hospitals of Addis Ababa.

Sample size determination and sampling techniques

Epi Info version 7.1.1 was used to determine sample size using the double population proportion exposure difference formula. The sample size was calculated at 95% CI, 80% power, 20.6% exposed, 10.4% unexposed, and 2.2 Adjusted Odds Ratio (AOR). The final calculated sample size was 475, including 10% expected non-response rate.

A total of four public hospitals were randomly selected of the 12 public hospitals currently functioning in Addis Ababa. The estimated sample size was distributed proportionally for the four selected hospitals, according to the skilled delivery performance of the hospitals in the previous year (2019/2020). Finally, the participants were selected from each hospital according to their shares using a systematic sampling technique.

Data collection: tools and procedures

A structured questionnaire, adopted from different reports, was used to collect data from selected mothers. The questionnaire was categorized into five groups (socio-demographic factors, maternal morbidity during pregnancy period, maternal nutrition during pregnancy period, obstetric factors during pregnancy, and maternal toxic exposure). To create a common understanding among the data collectors, a half-day orientation was provided for data collectors before the beginning of data collection.

Interviewer-administered data collection methods were employed. Two midwives or other health personnel working in the delivery room were selected for data collection at each sample hospital. Selected mothers were interviewed immediately after they gave birth and admitted to the post-natal ward based on inclusion and exclusion criteria.

Statistical analysis

Data were checked for completeness and consistency, coded, and entered into SPSS version 26. Data cleaning was done before subsequent analysis. Birth weight was used as an outcome variable. Univariate (frequency) analysis was used to describe the characteristics of the study participants. Bivariate and multiple logistic regression analyses were completed to examine the association between the independent variables and the dependent variable (birth weight). The bivariate association between the dependent and independent variables was checked using the Chi-Square test. The sets of independent variables that had a *p*-value of less than 0.2 in the

bivariate analysis were re-entered into multiple logistic regressions analysis. Adjusted Odds Ratio (AOR) was used to depict the net effects of the explanatory variables on the outcome variable. All statistical tests were two-sided and a significant association was declared at a *p*-value less than 0.05.

RESULTS

Characteristics of study participants

The overall response rate was 98%. Of the total mothers who participated in the study, 401 (86.1%) were in the age group of 18–34, while the rest were above 34 years old. The median age of the participants was 28 (IQR = 7). A total of 58 (12.4%) mothers gave birth to low birth weight children during the study period. Of the total respondents, 340 (73%) reported receiving counseling services during pregnancy about the importance of a balanced diet. While only half of them – 231 (50.4%) – received extra meals (more than three times per day) – Table 1.

Table 1 – Distribution of respondents (with recent deliveries) by socio-demographic characterstics, Public Hospitals of Addis Ababa, Ethiopia, 2021

Variables	Frequency	Percent (%)
Age of mother		
<18 yrs	0	0.0
18–34 yrs	401	86.1
>34 yrs	65	13.9
Low Birth Weight (LBW)		
Yes	58	12.4
No	408	87.6
Marital status		
Currently married	430	92.3
Divorced/widowed	17	3.6
Single	19	4.1
Mother's education		
Illiterate	71	15.2
Primary (1–8)	166	35.6
Secondary(9–12)	136	29.2
Higher education	93	20.0
Mother's occupation		
Housewife/unemployed	292	62.7
Employed	76	16.3
Self-employed	98	21.0
Household size		
<5 member	422	90.6
>5 members	44	9.4
Iron supplement during pregnancy		
Yes	384	82.4
No	82	17.6
Get extra meal		
Yes	231	49.6
No	235	50.4
Get nutritional counselling		
Yes	340	73.0
No	126	27.0
Frequency of meat and meat product intake		
Daily	17	3.6
At least once/week	229	49.1
At least once/month	162	34.8
Not at all	58	12.4

Table 1 – *continued*

Variables	Frequency	Percent (%)
Frequency of milk and milk product intake		
Daily	73	15.7
At least once/week	218	46.8
At least once/month	113	24.2
Not at all	62	13.3
Frequency of vegetable intake		
Daily	116	24.9
At least once/week	249	53.4
At least once/month	85	18.2
Not at all	16	3.4
Frequency of fruit intake		
Daily	283	60.7
At least once/week	97	20.8
At least once/month	24	5.2
Not at all	0	0
Maternal prepregnancy nutritional status		
Underweight (BMI <18.5 kg/m^2)	47	10.1
Normal (BMI 18.5–24.9 kg/m^2)	330	70.8
Overweight (BMI >24.9 kg/m^2)	89	19.1
Maternal post-delivery nutritional status		
Underweight (MUAC <23 cm)	116	24.8
Normal (MUAC 23–24.9 cm)	160	34.3
Overweight (MUAC >25 cm)	190	40.8

Obstetric and maternal toxic exposure during pregnancy

Obstetric history is one of the predictors of healthy birth outcomes. Of the total mothers interviewed, 76 (16.3%) of them reported that their pregnancy was unplanned and about 201 (43.1%) of the mothers were primigravida. Further, 155 (33.3%) of them did not receive counseling on the danger signs during the pregnancy period. On the other hand, 103 (25.5%) of them experienced at least one pregnancy-related danger sign that ranged from mild to severe (Table 2). Of the danger signs that those mothers experienced, Eclampsia or/and preeclampsia (7.9%), abnormal uterine bleeding (4.3%), and pregnancy-induced hypertension (2.8%) were the major problems reported during pregnancy (Table 2).

Maternal morbidity

Of the total participants, 374 (80%) did not experience any medical illness during the pregnancy, while 64 (14%) had no history of chronic illness during pregnancy (Fig. 1).

Determinants of LBW

To assess the association between selected independent variables and the outcome variable, a total of 41 predicators were cross-tabulated (table not shown) with the dependent variable (low birth weight). Of the socio-demographic factors hypothesized to have an association with LBW, none of them were found to have a significant association with LBW.

Obstetric-related variables were also cross-tabulated with low birth weight among recent deliveries. ANC follow up, number of ANC visits, and experiencing danger signs during pregnancy were found to have a significant bivariate association with LBW. History of having any medical illness during pregnancy, developing any chronic illness, and having a history of anemia during pregnancy were found to have significant association with low birth weight in the bivariate analysis.

The effect of certain maternal toxic exposures was also assessed. Of the total factors entered into bivariate analysis, only a history of medication intake during pregnancy was found to have a significant association with low birth weight. Maternal nutritional status was the other focus of this study, and different nutrition-related factors were cross-tabulated with low birth weight to assess their association with the outcome variable. Nutritional counseling during pregnancy, iron supple-

Table 2 – Obstetric and maternal toxic exposure history among recently delivered babies in public hospitals of Addis Ababa, Ethiopia, 2021

Category	Frequency	Percent (%)
Pregnancy type		
Planned	390	83.7
Unplanned	76	16.3
ANC follow up during recent pregnancy		
No	41	8.8
Yes	425	91.2
Number of ANC visits during recent pregnancy		
<4 times	160	34.3
≥4 times	306	65.7
Gravidity		
Primigravidity	196	42.1
Multigravida	270	57.9
Counseled on danger signs		
No	155	33.3
Yes	311	66.7
Experienced a danger sign/s during pregnancy		
No	347	74.5
Yes	119	25.5
AUB during recent pregnancy		
Yes	20	4.3
No	446	95.7
Pre-eclampsia/eclampsia		
Yes	37	7.9
No	429	92.1
Pregnancy induced hypertension		
Yes	13	2.8
No	453	97.2
Other danger sign		
Yes	53	11.4
No	413	88.6
Medication taken during pregnancy		
No	430	92.3
Yes	36	7.7
Smoking during pregnancy		
No	466	100.0
Yes	0	0
Chewing Khat		
No	460	98.7
Yes	6	1.3
Alcohol consumption		
No	392	84.1
Yes	74	15.9
Main source of energy for food preparation		
Kerosene	29	6.2
Charcoal (wood)	130	27.9
Electricity/other	307	65.9
Work in CO_2 producing factory		
No	431	92.5
Yes	35	7.5

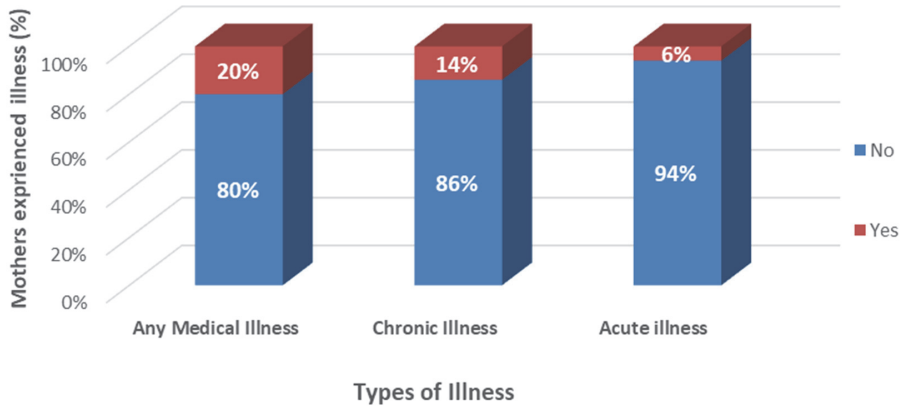

Fig. 1 – Number of mothers who experienced medical illness during their recent pregnancy, Addis Ababa, Ethiopia, 2021

mentation, fruit consumption during pregnancy, and pre-pregnancy maternal weight were found to have significant associations with LBW.

In bivariate analyses performed to identify candidate variables for multivariable analysis (table not shown), variables with a *p*-value < 0.2 were considered candidates for the multivariable logistic regression model. Thus, the results shown in Table 3 included all potential predictors with a *p*-value < 0.2 in bivariate analyses. Of the total independent variables entered into multivariable logistic regression, the number of ANC visits, presence of Abnormal Uterine Bleeding (AUB) during pregnancy, presence of Pre-eclampsia or Eclampsia, presence of anemia during pregnancy, chewing kchat, and maternal pre-pregnancy nutritional status were found to be key determinants of low birth weight in this study.

In this study, mothers who made four or more ANC visits (WHO recommended ANC follow up) during their pregnancy were 60% less likely to give birth to LBW babies compared to those who made fewer than four visits (AOR = 0.4; 95% CI: 0.17–0.99). On the other hand, LBW was 3.3 times more likely among mothers who had anemia during the pregnancy period than those who did not (AOR = 3.3; 95% CI: 3.1–3.6). Pre-pregnancy maternal nutritional status was measured using maternal weight before pregnancy and height – which provided the Body Mass Index (BMI) measurements. Mothers who had normal weight (BMI 18.5 kg/m²–24.5 kg/m²) before pregnancy were found to be 80% less likely to have a baby with LBW than underweight mothers (<18.5 kg/m²) (AOR = 0.2; 95% CI: 0.1–0.5) – Table 3.

Table 3 – Multivariable logistic regression analysis for the determinants of LBW in mothers who recently delivered babies in public hospitals in Addis Ababa, Ethiopia, 2021

Variables	AOR (95% CI)	*p*-value
Number of ANC visits Less than 4 times [RC] 4 times or more	 1 0.4 (0.17–0.99)	 0.049*
Experienced at least one danger sign No [RC] Yes	 1 0.33 (0.08–1.29)	 0.113
Abnormal uterine bleeding during pregnancy No [RC] Yes	 1 10.9 (2.5–15.8)	 0.001*

Table 3 – *continued*

Variables	AOR (95% CI)	*p*-value
Preeclampsia during pregnancy		
No [RC]	1	
Yes	9.5 (4.8–10.8)	0.006*
Any medical illness during pregnancy		
No [RC]	1	
Yes	1.2 (0.08–17.57)	0.892
Chronic illness during pregnancy		
No [RC]	1	
Yes	0.57 (0.02–11.6)	0.718
Anemia during pregnancy		
No [RC]	1	
Yes	3.3 (3.1–3.6)	0.003*
Medication for treatment during pregnancy		
No [RC]	1	
Yes	1.1 (0.16–6.17)	0.992
Chewing Kchat		
No [RC]	1	
Yes	7.9 (3.9–16.1)	0.004*
Nutritional counseling during pregnancy		
No [RC]	1	
Yes	0.5 (0.2–1.5)	0.209
Received iron supplements		
No [RC]	1	
Yes	1.2 (0.5–3.2)	0.653
Frequency of getting fruit		
Daily [RC]	1	
At least once/week	1.1 (0.3–3.9)	0.891
At least once/month	0.7 (0.2–2.7)	0.626
Not at all	1.5 (0.2–9.9)	0.702
Pre-pregnancy nutritional Status		
Underweight [RC]	1	
Normal	0.2 (0.1–0.5)	0.001*
Overweight	0.1 (0.1–0.4)	0.003*

Note: * significant at <0.05.

DISCUSSION

The primary aim of this study was to assess the main predictors of LBW among recent births in selected health facilities in Addis Ababa. Low birth weight (LBW) is a major public health problem due to its association with high morbidity and mortality of children. Newborn mortality and disease are directly related to birth weight. Insufficient or excess weight at birth is always accompanied by an increase of these risk factors (CSA ICF, 2017). Birth weight can be affected by different conditions that happen during the pregnancy period. These conditions may be maternal factors, environmental, or natural/biological factors.

Sometimes a pregnancy can end up with obstetric complications, or mothers may experience different types of pregnancy-related danger signs which could negatively affect the outcomes of a newborn. To reduce the potential risk of danger signs during pregnancy and increase the early healthcare-seeking behavior of mothers in relation to pregnancy-related danger signs, professional counseling is very important during pregnancy, especially during ANC follow-ups. The analysis indicated that the odds of low birth weight were lower in mothers who made four or more ANC visits during the pregnancy compared to those who visited less than four times. This finding is consistent with the study conducted

in Amhara Regional State Referral Hospitals (Asmare et al., 2018). The odds of a low birth weight baby were found to be higher among mothers who experienced either preeclampsia or eclampsia than those who did not. Abnormal uterine bleeding (AUB) is one of the pregnancy-related danger signs. Similar to other research findings, this study showed that mothers with a history of AUB during their recent pregnancy were more likely to give birth to a low birth weight baby compared to those without AUB. This finding is consistent with the study conducted in west Iran (Moradi et al., 2017). In addition to this, different studies conducted in different regions of Ethiopia showed that the odds of having a low birth weight baby were higher among those who experienced pregnancy-related complications compared to those who didn't (Hailu and Kebede, 2018).

Newborn weight is a parameter directly related to the health of the mother and development of the newborn (Yilgwan et al., 2012). The study showed that maternal medical illness during pregnancy was another factor that could affect the newborn birth outcome. The likelihood of having LBW was found to be higher among mothers who had anemia during the recent pregnancy than those who did not. This finding is consistent with the studies conducted in Iran (Moradi et al., 2017) and Ethiopia, Tigray, and Dessie (Aboye et al., 2018, Ahmed et al., 2018).

Smoking, alcohol intake, Kchat chewing, CO2, and using different medications during pregnancy are some of the toxic agents that were reported to have negative impacts on birth weight (Pereira et al., 2017). In this study, the odds of giving birth to a low birth weight baby were higher among mothers who chewed kchat during pregnancy compared to those who did not. This finding is also supported by the study conducted in Bale, Oromia region (Demelash et al., 2015).

Maternal weight before pregnancy is the other indicator of maternal nutritional status contributing to newborn health and childbirth weight. In this study, the likelihood of having a low birth weight baby is lower among mothers who have normal nutritional status (BMI of 18.5–24.9 kg/m^2) compared to those who were undernourished (BMI of <18.5 kg/m^2). This finding is supported by the study conducted in Bale zone, south Ethiopia (Demelash et al., 2015). Furthermore, some maternal nutrition-related factors that were key predictors of newborn birth weight were not found to be significant predictors in this study. This could be because of the study design difference. Also, most of the mothers who participated in this study (92.6%) had an ANC follow up which helped them to receive nutritional counseling and contributed to the adoption of a balanced diet during their pregnancy.

Despite the evidence reported by different studies, no significant association was observed among most maternal illnesses and low birth weight in this study. This may be due to homogeneity of responses of mothers on their health condition. In the study area, most of the mothers who attended hospitals had a referral from primary health care facilities with a possible underlying condition that required second-level health care setting management.

CONCLUSIONS AND RECOMMENDATIONS

The number of ANC visits, presence of abnormal uterine bleeding during pregnancy, history of pre-eclampsia or eclampsia, anemia, chewing Kchat, and pre-pregnancy nutritional status were found to be the key predictors of low birth weight among the study population. The findings indicate the importance of encouraging pregnant mothers to make frequent ANC visits and educating mothers to recognize preventable pregnancy-related danger signs such as AUB. Counseling on early health-seeking behavior when any pregnancy-related danger signs are experienced plays a great role in reducing LBW. Behavioral change communications that target pregnant mothers to improve their nutritional status, along with reducing maternal toxic exposures, should be key strategies used by health extension workers and health professionals working at ANC services to reduce the incidence of LBW babies in Addis Ababa and Ethiopia.

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Ethical clearance
Ethical clearance was obtained from Addis Ababa University and the Addis Ababa regional Health bureau research department ethical review committees. Informed consent was received from the study participants. Any information related to personal identification was not used in the report and the confidentiality of the participants was maintained throughout the study.

Author's contribution
MH and NR were involved in framing the study title, study area selection, and design. MH was responsible for data entry, cleaning, analysis, and writing the draft manuscript. Both authors contributed to the discussion, interpreted the findings, and reviewed and edited the manuscript for intellectual content.

Conflict of interests
The authors have no financial, commercial, or legal conflict of interests to declare.

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