Determinants of low birth weight among neonates born in Amhara Regional State Referral Hospitals of Ethiopia: unmatched case control study

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Abstract

Objective: This study was conducted to identify the determinants of low birth weight among infants born in Amhara Regional State Referral Hospitals of Ethiopia.

Results: This study found that mothers who delivered female infants (AOR: 1.7, 95% CI 1.1, 2.6), occurrence of health problems during current pregnancy (AOR: 2.8, 95% CI 1.7, 4.5), absence of antenatal care (AOR: 2.3, 95% CI 1.3, 4.0), lack of iron supplementation (AOR: 2.8, 95% CI 1.6, 4.9), maternal MUAC below 23 cm (AOR: 1.7, 95% CI 1.0, 2.7), and gestational age below 37 completed weeks (AOR: 3.3; 95% CI 1.9, 5.7) were found to be determinants of low birth weight.

Keywords: Low birth weight, Maternal factors, Northwest Ethiopia

Introduction

Low birth weight (LBW) is defined as weight of the newborn at birth less than 2500 g [1]. Globally, more than 20 million infants are born being low birth weight each year. Of whom, majority of them were from developing countries, particularly Sub-Saharan countries including Ethiopia [2]. Africa is a home for 22% of low birth weight and in sub Saharan Africa low birth weight level is around 13–15% with a little variation across the regions [1]. According to the Ethiopian Demographic and Health Survey (EDHS 2011), the prevalence of low birth weight in Ethiopia is 11% [3]. Previous studies done in Ethiopia have shown that low birth weight prevalence was ranged from 22.5%, in Southwest and 17.5%, in Northwest [4, 5].

Low birth weight has both long and short-term complications unless early screening and interventions have been made [6]. Some of the long term complications of low birth weight include hypertension, diabetic nephropathy, proteinuria, progressive renal disease at late age, eye problems like strabismus and myopia, deafness, neurologic complications like cerebral palsy, developmental delay with IQ less than 70, epilepsy and behavioral disturbance [7]. The previous Ethiopian studies reported that different factors were significantly associated with low birth weight. Among these factors, being a female, first birth order and being a twin were significantly associated with low birth weight [5, 8]. Regarding maternal factors, maternal age at pregnancy, diet during pregnancy, her body composition at conception, lifestyle (alcohol, tobacco or drug abuse) exposure to malaria, HIV or syphilis or complications such as hypertension were also other factors significantly associated with low birth weight [9, 10]. Moreover, low socioeconomic status resulting in higher rates of maternal undernutrition, anemia, illness, inadequate prenatal care and obstetric complication has a strong positive correlation with low birth weight [11].

The Ethiopian government has acknowledged the severity of the problem, and currently some measures are taken by the government, Nongovernmental organizations (CU-ICAP, WHO), and professional associations like Ethiopian Pediatric Society [12, 13]. However, in Ethiopia only few researches have been conducted...
regarding the determinants of low birth weight, particularly in Amhara region. Therefore, this study aimed to identify the determinants of low birth weight focusing more of modifiable risk factors. The results of this study will be served as a baseline data for further studies. In addition it will be an input for planning health interventions to improve the wellbeing of children and women in Ethiopia, particularly in Amhara region.

Main text

Study area, design and period
An institution based unmatched case–control study was conducted among women who gave birth in Amhara region Referral Hospitals from March 20 to April 30, 2017. The region has a total of five referral hospitals. Of which, three of them were purposely selected because they have a large number of population in their catchment area (Debre Markos, Felege Hiwot, and University of Gondar referral hospitals). These three hospitals serve for more than 15 million populations in their catchment area.

Population
All mothers who gave birth in Amhara Regional State Referral Hospitals were our source population. Mothers who gave live births weighed less than 2500 g were considered as cases and those mothers with live births weighed 2500 g and above were considered as controls. Mothers who had single birth infants were included. However, mothers who had infants with congenital anomaly and with chronic diseases (diabetes mellitus and hypertension) were excluded from the study. In addition, those mothers who were seriously ill during the data collection period, and those who were unable to communicate were excluded from the study.

Sample size determination
The sample size was determined by using a double population proportion formula by considering the following statistical assumptions: 95% confidence interval \(Z_{a/2} = 1.96\), 80% power \(Z_{\beta} = 0.84\), case to control ratio \(r = 2\), the odds ratio to be detected \(\geq 2\) and the 20% control group were exposed. The final sample size of the study was 453 (151 cases and 302 controls).

Data collection procedures
Data were collected by using a structured interviewer administered questionnaire. The questionnaire was adapted from the Ethiopian Demographic and Health Survey. Trained midwives and nurses working outside the respective hospitals conducted the interviews and anthropometric measurements. The weight of the newborns was measured within 15 min after birth using a balanced scale. The scale was always checked and zeroed before weighing each newborn. Maternal height was measured against a wall height scale to the nearest centimeter. Patient records (charts) were also used to take some important variables like maternal hemoglobin level and co-morbid conditions.

Data processing and analysis
Data were entered into Epi-data Version 3.1 and exported to SPSS version 22 for further analysis. Summary statistics (mean or median) for continues variables and percentage and frequency for categorical variables were computed for case and control groups separately. Both bivariable and Multivariable binary logistic regression were fitted for each explanatory variable. Finally, in the multivariable binary logistic regression analysis, adjusted odds ratio (AOR) with 95% CI and p-values were used to identify significant variables. Variables having p-value less than 0.05 were considered as significant determinants of low birth weight.

Results
Socio-demographic characteristics of the study participants
From a total of 453 sample size, 429 mothers-baby pairs (143 cases and 286 controls) were included in the final analysis making a response rate of (94.7%). More than half (55.2%) of mothers in cases and 40% in controls had female infants. The majority of mothers in cases and control group (72 and 84.3% respectively) were married. Regarding educational status, 35% of mothers among cases were unable to read and write, and 33.2% of mothers in the control group were diploma and above (Table 1).

Maternal obstetrics and behavioral related factors
More than half (61.5%) of mothers in the case group and three quarters of mothers in the control group had a mid-upper arm circumference of below 23 cm. The majority of the mothers (83.2% in cases and 87.8% in controls) had no history of abortion (Table 2).

Determinants of low birth weight
In multivariable binary logistic regression analyses, mothers who encountered any pregnancy related problems during their current pregnancy were more prone to have a low birth weight baby as compared to mothers who didn't encounter any health problems (AOR: 2.8, 95% CI 1.1, 4.5). The odds of low birth weight was higher among female neonates as compared to their male counterparts (AOR: 1.7, 95% CI 1.1, 2.6). The odds of low birth weight was also higher among mothers who didn't attend ANC as compared
to mothers who attended ANC follow up in the current pregnancy (AOR: 2.3, 95% CI 1.3, 4.0). The odds of low birth weight was also higher among mothers who did not take iron supplementation as compared to mothers who took iron supplementation during the current pregnancy (AOR: 2.8, 95% CI 1.6, 4.9). Mothers who had MUAC below 23 cm (AOR: 1.7, 95% CI 1.0, 2.7) and gestational age below 37 completed weeks (AOR: 3.3, 95% CI 1.95, 5.7) were found to be risk factors for low birth weight (Table 3).

### Discussion

In this study, we aimed to identify the determinants of low birth weight among mothers who gave birth in Amhara region referral hospitals, Northwest Ethiopia. The findings of this study revealed that newborn characteristic such as sex was found to be significantly associated with low birth weight. Accordingly, the risk of low birth weight was higher among female neonates as compared to their male counterparts. This finding is consistent with the findings of earlier studies conducted in
Table 2 Obstetrics and behavioral related history of mothers in Amhara Regional State Referral Hospitals, Ethiopia, 2017 (n = 429)

| Variables                          | LBW Count (n) | LBW % | NBW Count (n) | NBW % | Total Count (n) | Total % |
|-----------------------------------|---------------|-------|---------------|-------|----------------|---------|
| MUAC                              |               |       |               |       |                |         |
| < 23 cm                           | 88            | 61.5  | 217           | 75.9  | 305            | 71.1    |
| ≥ 23 cm                           | 55            | 38.5  | 69            | 24.1  | 124            | 28.9    |
| History of abortions              |               |       |               |       |                |         |
| Yes                               | 24            | 16.8  | 35            | 12.2  | 59             | 13.8    |
| No                                | 119           | 83.2  | 251           | 87.8  | 370            | 86.2    |
| Mode of delivery                  |               |       |               |       |                |         |
| Spontaneous vaginal               | 113           | 79.0  | 188           | 65.7  | 301            | 70.2    |
| Assisted vaginal                  | 3             | 2.1   | 22            | 7.7   | 25             | 5.8     |
| Caesarean section                 | 27            | 18.9  | 76            | 26.6  | 103            | 24.0    |
| ANC visit                         |               |       |               |       |                |         |
| Yes                               | 101           | 70.6  | 245           | 85.6  | 346            | 80.7    |
| No                                | 42            | 29.4  | 41            | 14.4  | 83             | 19.3    |
| Health problems                   |               |       |               |       |                |         |
| Yes                               | 77            | 53.8  | 111           | 38.8  | 188            | 43.8    |
| No                                | 66            | 46.2  | 175           | 61.2  | 241            | 56.2    |
| Iron supplementation              |               |       |               |       |                |         |
| Yes                               | 95            | 66.4  | 244           | 85.3  | 339            | 79.0    |
| No                                | 48            | 33.6  | 42            | 14.7  | 90             | 20.1    |
| Gravidity                         |               |       |               |       |                |         |
| Primigravid                       | 70            | 49.0  | 123           | 43.0  | 193            | 45.0    |
| Multigravida                      | 73            | 51.0  | 163           | 57.0  | 236            | 55.0    |
| Parity                            |               |       |               |       |                |         |
| Primipara                         | 79            | 55.2  | 129           | 45.1  | 208            | 48.5    |
| Multipara                         | 64            | 44.8  | 157           | 54.9  | 221            | 51.5    |
| Gestational age                   |               |       |               |       |                |         |
| Preterm                           | 48            | 33.6  | 37            | 12.9  | 85             | 19.8    |
| Term and above                    | 95            | 66.4  | 249           | 87.1  | 344            | 80.2    |
| History of low birth weight       |               |       |               |       |                |         |
| Yes                               | 26            | 18.2  | 29            | 10.1  | 55             | 12.8    |
| No                                | 117           | 81.8  | 257           | 89.9  | 374            | 87.2    |
| History of trauma                 |               |       |               |       |                |         |
| Yes                               | 17            | 4.9   | 14            | 11.9  | 31             | 7.2     |
| No                                | 125           | 95.1  | 269           | 88.1  | 398            | 92.8    |
| Ever drink alcohol                |               |       |               |       |                |         |
| Yes                               | 19            | 13.3  | 23            | 8     | 42             | 9.8     |
| No                                | 117           | 86.7  | 263           | 92    | 387            | 90.2    |
| Ever chew chat                    |               |       |               |       |                |         |
| Yes                               | 3             | 2.1   | 1             | 0.3   | 4              | 0.9     |
| No                                | 140           | 97.9  | 285           | 99.7  | 425            | 99.1    |
| Ever smoke cigarette              |               |       |               |       |                |         |
| Yes                               | 0             | 0.0   | 0             | 0.0   | 0              | 0.0     |
| No                                | 143           | 100.0 | 286           | 100.0 | 429            | 100.0   |
Ethiopia and Nigeria [11, 14]. In the present study, Nutritional status of women as proxy by MUAC was also found to be a significant determinate of LBW. This finding is consistent with a study conducted at Kersa, Ethiopia [15]. The nutritional status of the newborns ultimately depends on the nutritional status of the mothers during the time of pregnancy because the baby solely depends on placental feeding throughout the entire pregnancy.

Moreover, the study found that mothers who encountered pregnancy related problems during their current pregnancy were at higher risk to deliver low birth weight baby than mothers who didn’t have complications. This finding is similar to studies conducted in Tigray, Northern Ethiopia and Bale zone, Southeast Ethiopia [4, 16]. Mothers who had pregnancy related complications like preeclampsia are at higher risk of low birth weight than mothers who didn’t have complications. This is because of most commonly women with preeclampsia or pregnancy related hypertensive disorders end up with abruptio placenta this results decreasing nutrition and

| Variables                        | LBW (n) | LBW (%) | COR       | AOR       |
|----------------------------------|---------|---------|-----------|-----------|
| Sex                              |         |         |           |           |
| Male                             | 64      | 44.8    | 170       | 59.4      | 1         | 1         |
| Female                           | 79      | 55.2    | 116       | 40.6      | 1.81 (1.2, 2.7) | 1.7 (1.1, 2.6) |
| Residence place                  |         |         |           |           |
| Rural                            | 72      | 50.3    | 103       | 36.0      | 1.8 (1.20–2.27) | 1.0 (0.6, 1.8) |
| Urban                            | 71      | 49.7    | 183       | 64.0      | 1         | 1         |
| Educational status               |         |         |           |           |
| Unable to read and write         | 50      | 35.0    | 59        | 20.6      | 2.44 (1.41–4.21) | 1.32 (0.69–2.52) |
| Grade 1–8                        | 33      | 23.1    | 63        | 22.0      | 1.51 (0.85–2.69) | 0.93 (0.48–1.79) |
| Grade 9–12                       | 27      | 18.9    | 69        | 24.1      | 1.13 (0.62–2.04) | 0.92 (0.48–1.76) |
| Diploma and above                | 33      | 23.1    | 95        | 33.2      | 1         | 1         |
| MUAC category                    |         |         |           |           |
| ≥ 23 cm                          | 88      | 61.5    | 217       | 75.9      | 1         | 1         |
| < 23 cm                          | 55      | 38.5    | 69        | 24.1      | 1.97 (1.28–3.03) | 1.66 (1.02–2.70) |
| History of abortions             |         |         |           |           |
| Yes                              | 24      | 16.8    | 35        | 12.2      | 1.45 (0.82–2.54) | 1.38 (0.71–2.67) |
| No                               | 119     | 83.2    | 251       | 87.8      | 1         | 1         |
| ANC visit                        |         |         |           |           |
| Yes                              | 101     | 29.2    | 245       | 70.8      | 1         | 1         |
| No                               | 42      | 50.6    | 41        | 49.4      | 2.49 (1.52–4.05) | 2.31 (1.32–4.04) |
| Complications during pregnancy   |         |         |           |           |
| Yes                              | 77      | 41.0    | 111       | 59.0      | 1.84 (1.23–2.76) | 2.79 (1.74–4.45) |
| No                               | 66      | 27.4    | 175       | 72.6      | 1         | 1         |
| Iron tabs given                  |         |         |           |           |
| Yes                              | 95      | 66.4    | 244       | 85.3      | 1         | 1         |
| No                               | 48      | 33.6    | 42        | 14.7      | 2.94 (1.82–4.73) | 2.82 (1.62–4.91) |
| Parity                           |         |         |           |           |
| Primi-para                       | 79      | 55.2    | 129       | 45.1      | 1.5 (1.03–2.25) | 1.45 (0.92–2.31) |
| Multipara                        | 64      | 44.8    | 157       | 54.9      | 1         | 1         |
| Gestational age                  |         |         |           |           |
| Preterm                          | 48      | 56.5    | 37        | 43.5      | 3.4 (2.08–5.55) | 3.33 (1.95–5.67) |
| Term and above                   | 95      | 27.6    | 249       | 72.4      | 1         | 1         |
| History of LBW                   |         |         |           |           |
| Yes                              | 26      | 18.2    | 29        | 10.1      | 1.97 (1.11–3.49) | 1.85 (0.97–3.35) |
| No                               | 117     | 81.8    | 257       | 89.9      | 1         | 1         |

Italic values indicates significantly associated in the multivariable analysis
perfusion to the fetus finally end up with low birth weight or fetal death.

The risk of having low birth weight baby was higher among mothers who didn’t attend antenatal care in their current pregnancy as compared to mothers who attended ANC. Different studies done in different counters also supported this finding as birth weight was significantly associated with ANC service utilization [2, 4, 5, 8, 15]. Antenatal care visits are very important for both newborns and mothers as they provide chances for timely detection and intervention of feto-maternal problems and enable the mother to promote her health through counseling that she might receive. Another possible explanation might be mothers who had ANC follow up could get nutritional counseling to improve their dietary diversity that enables her and her fetus for better pregnancy outcome.

Likewise, mothers who didn’t get iron supplementation were also more risk to deliver low birth weight infant than mothers who took iron supplementation during the current pregnancy. This supported with a study done in Kerala state, India [17]. Iron and folic acid supplementation for pregnant mothers has a great importance to prevent anemia during pregnancy, thereby enhancing better health outcome for both the mother and the fetus [18].

Furthermore, in this study, we also found that preterm (gestational age below 37 completed weeks) was found to be a risk factor for LBW. Supportive finding were obtained from studies done in Bale zone, Southeast Ethiopia [4] and Tigray region, Northern Ethiopia [19]. It is well known that as the gestational age of the fetus falls below the term level the body weight of the fetus falls dramatically due to prematurity.

This study found that infant sex being female, preterm, absence of ANC visits, MUAC less than 23 cm, lack of iron or folic acid supplementation and complication during pregnancy the current pregnancy were found to be significant determinants of low birth weight.

Limitations
Since the majority of cases were referred from other health institutions, variables like pre-pregnancy weight and gestational age of the first ANC visit were difficult to access. Therefore, these variables were not addressed in this study. In addition, important variables like physical activity and exposure of ambient air pollution were not assessed because we adapted the EDHS tool, which had no such components.

Abbreviations
ANC: antenatal care; EDHS: Ethiopia Demographic and Health Survey; LBW: low birth weight; MUAC: mid upper arm circumference; NBW: normal birth weight; WHO: World Health Organization.
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