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Low birth weight in Ethiopia: a multilevel analysis of 2016 Ethiopian demographic and health survey

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Abstract

Introduction: *the birth weight should be taken within an hour of delivery before major weight loss occurs. Low birth weight (LBW) a global serious public health problem that is associated with high stunting observed in less developed countries. Surprisingly there is an incidence of 15-20% newborns death is attributed by LBW globally every year. This study was aimed to identify the prevalence of LBW and its associated factors among women who gave birth five years before the survey and whose most recent newborn birth weight was known in Ethiopia.* ***Methods:*** *2016 Ethiopian Demographic and Health Survey (EDHS) data were utilized among 1,259 reproductive-age women who gave birth five years prior to the* *survey and who´s most recent newborn birth weight was known. The outcome variable was the low birth weight (LBW) and predictor variables were categorized into individual and community level. Multi-level logistic regression analysis was used to identify factors associated with LBW; STATA-14 software was used for data analysis. Weighted samples were used for data analysis to ensure the survey results were representative of the national and regional levels. Variables that were statistically significant on bivariate multilevel regression were considered for individual and community level. Multicollinearity was also checked among independent variables.* ***Results:*** *the prevalence of LBW in Ethiopia was 12.3% (95% CI: 10.1%, 15. 0%). The age of participants was ranged between 15-47 years with a mean ± SD of 28.28 ± 6.05 years. More than half (58.8%) of mothers who gave birth to a newborn with LBW were rural residents. Multiple pregnancy (AOR=4.67; 2.13, 10.50), maternal higher education (AOR=0.67; 95%CI: 0.45, 0.98), maternal primary education (AOR=0.50; 95% CI: 0.33, 0.77), resident in Afar (AOR=2.89; 95% CI: 1.05, 7.96) and Amhara (AOR=2.52; 95% CI: 1.15, 5.50) were factors associated low birth weight.* ***Conclusion:*** *more than one in ten mothers gave birth to a newborn with LBW in Ethiopia. The significant variations of the prevalence LBW among regions of Ethiopia need attention and women's education is important to reduce LBW.*

Introduction

Low birth weight (LBW) is defined as weight less than 2.5 kg at birth, regardless of gestational age [1]. The actual newborn birth weight is obtained in the first hour of delivery before major weight loss is occurred [2]. Low birth weight (LBW) is a global main public health problem [3] which expose newborns to plenty of immediate complications, like Sepsis [4], low blood glucose level, hypothermia [5-8]. LBW can also have a long-term impact on the life of children like cognitive disabilities and develop chronic diseases such as diabetes and coronary heart disease in adulthood period [4,7,9-11]. One in every six infants worldwide was reported to be small at birth [12] which is equivalent to 20 million newborns born with low birth weight occurs every with an incidence rate of 15 to 20%. The majority (96.5%) of global LBW occurs in developing countries; mainly in sub-Saharan Africa (SSA) and South Asia [13-15]. Even though there was good progress in minimizing neonatal mortality globally for the last 20 years, 2.5 million neonates died, due to low birth weight-related complications [16].

In Ethiopia, recent studies showed that the prevalence of LBW is between 11% and 23% [17]. In 2014, the World Health Organization (WHO) estimated LBW as a cause of 4.53% of total under-five child mortality in Ethiopia [18]. As a result, LBW creates a great burden on the political, social, economic, and healthcare systems in developing countries [2,13]. Different policies and strategies were used to minimize newborn with LBW with providing adequate care during pregnancy, labor/delivery and the postpartum period [13]. Previous studies also revealed that maternal, prenatal, delivery and neonatal [19-21] factors were reasons for high rate of LBW, and there was no significant reduction in the prevalence of LBW [22]. In developing countries, including Ethiopia, LBW is frequently related to child morbidity and mortality [11]. Varieties of studies were conducted in Ethiopia [23,24] to estimate the prevalence of LBW in Ethiopia. However, most of these studies were not nationwide, in which different geographical areas were not considered. Therefore, this study utilized EDHS 2016 dataset which had relatively complete and comprehensive data, aimed to estimate the average prevalence of low birth weight and its associated factors in Ethiopia.

Methods

Data source and sample size: data for this study were extracted from the 2016 Ethiopia Demographic and Health Surveys (EDHS), which is the most recent, and the fourth Demographic and

Health Survey series in Ethiopia. The survey was conducted in nine regional states and two city administrations of the country. In the 2016 EDHS, 15,683 women aged 15-49 years were interviewed. From this, 7,590 women had at least one birth in the last five years before the survey 5568 of participates newborn had not been weighted were excluded from the analysis of this study. Of the remaining, 2,022 women were checked for their neonates´ birth weight of the most recent birth, and those who did not know their birth weight were excluded (n=763). The final sample for this study was 1,259 participants [25], weighting and adjustment of data for survey design and sampling errors were made.

Sampling and data collection methods: the study participants were selected using stratified and two-stage sampling methods. At the first stage, enumeration areas (EAs), and in the second stage, households were selected. After the regions were stratified into urban and rural areas, probability proportional allocation to sample size was made. Based on this, 645 enumeration areas (EAs) were selected. Of this, 202 EAs were from urban and 443 were from rural areas [25].

Data collection instrument and period: Ethiopia Demographic and Health Surveys (EDHS) use household, women's and men's questionnaires adapted from the MEASURE DHS project. Additionally, EDHS use biomarker and health facility questionnaire. Since the study population for this study are reproductive age women who gave birth in the last five years before the survey, data from the women's questionnaire of the surveys were used for this study. The 2016 EDHS data collection tool was first prepared in English and then translated into the three main languages in the country-Amharic, Oromiffa, and Tigrigna languages [25].

Variables of the study

Outcome variables: the outcome variable of this study was the low birth weight, which is defined as the weight of newborn less than 2.5 kg at birth regardless of gestational age [25]. All interviewed women aged between 15 and 49 years old gave birth and whose newborn was weighted and remembered were included [25]. Newborns were classified into 2 groups: non-LBW (birth weight ≥ 2,500 grams, coded 0) or LBW (birth weight < 2,500 grams, coded 1).

Independent variables: the independent variables were categorized into two-level factors. The first category of variables is individual-level factors, which include the age of respondents, parity, educational status, wealth status, ANC visit, occupational status, marital status, iron supplementation, type of fuel used, source of drinking water, smoking, anemia status, type of last pregnancy (single vs multiple), history of pregnancy termination, the status of last pregnancy (intended vs unintended) and distance from health facility. Community-level factors include place of residence (urban vs rural), community media exposure (low vs high), community poverty level (low vs high), community women's educational level and geographic region.

Data processing and analysis: completed DHS questionnaires were carefully coded, entered, and edited [26]. Data analysis used the weighted samples to ensure the survey results were representative of the national and regional level findings. Data analysis was conducted using STATA-14 software (STATA Corporation, College Station, TX, USA). Descriptive statistics like frequency and percentage were used. Multi-level logistic regression analysis technique was used to identify the factors associated with low birth weight. The association of each predictor variable (Individual- and community-level) with the outcome variable was checked at a 5% significance level and 95% confidence interval. Variables that were statistically significant on bivariate multilevel regression analysis were considered for individual and community level model adjustments. The presence of multicollinearity was checked among independent variables using the Variance Inflation Factor (VIF) at a cutoff point of 10. Predictors having a VIF value of less than 10 indicate the absence of multicollinearity. Similarly, interactions between individual and community-level characteristics were added to the models to test whether the community level characteristic effects low birth weight were modified by individual-level characteristics [27].

A total of four models were conducted. The first model was an empty model, which was conducted to estimate the random variability in the intercept. The second model was conducted to estimate the effect of individual-level factors on low birth weight. The third model assessed the effect of community-level factors on low birth weight. Finally, model four estimated the effect of both individual- and community-level factors low birth weight. The Intra-Cluster Correlation (ICC) was calculated to show between cluster correlations within a model. The Proportional Change in Variance (PCV) was also calculated to determine the power of variables included in each model in predicting low birth weight. The model with the highest PCV value was considered to identify the factors associated with low birth weight. Variables with a p-value of less than 0.05 were taken as significant factors. Regarding on Model fit statistics Akakie Information Criterion (AIC) was used to estimate the goodness of fit of the adjusted final model in comparison to the preceding models (Individual and community-level model adjustments), the AIC value for each subsequent model was compared and the model with the lowest value was considered to be the best fit model [28-30].

Results

Sociodemographic and obstetrics characteristics of participants: of the total of the study participants (1,259) from 645 clusters, the prevalence of low birth weight was 12.34%. The age of participants was ranged between 15-47 years, with a mean ± SD of 28.28±6.05 years. More than half (58.8%) of mothers who gave birth to a newborn with LBW were rural residents. And the majority (95%) of mothers who gave birth to a newborn with LBW were married or living with their partners. Less than half of them (41%) and only 30 % have no formal education and attended a primary education, respectively. Around three in tens (27.6%) of mothers who gave birth to a newborn with LBW have a problem with a distance to a health care facility. More than half (59%) of the participants' born LBW were anemic, and 54.9% of them have no work, the majority (86.3%) of the participants' born LBW newborn used polluting fuels (Table 1).

Factors associated with low birth weight: Table 2, presents the results of multilevel analyses examining the effect of individual characteristics and community-level factors affecting low birth weight. Model 1, the empty model, includes only a random intercept to capture between-cluster variability. In this model, 88.7% of the total variance in the odds of having low birth weight was accounted for by between-cluster variation was (ICC=0. 88, P<0.000). The ICC was calculated in each successive model to understand the relative effects of individual and community-level factors on women having a newborn with low birth weight. Cluster variability decreased over successive models, from 88.7% in the empty model to 81.6% in the individual level only model, 52.7% in the community level only model and 37.4% in the combined model. Proportional change in variance showed that the addition of predictors to the empty model better explained women's getting newborns with low birth weight. The combined model found higher PCV; that is, 29.9% of the variance in women´s getting newborns with low birth weight could be explained by the combined factors at the individual and community levels. Accordingly, the combined model of individual- and community-level factors was selected for predicting women´s getting neonate with low birth weight. Finally, factors associated with LBW were educational level and type of pregnancy from individual-level factors and region from community-level factors.

The educational level of mothers was independently and negatively associated with low birth weight. Women with secondary (or higher) educational levels were 44% (OR=0.56; 95% CI: (0.37, 0.84) less likely to experience low birth weight compared with women who haven´t attended formal education. Similarly, after adjusting for individual and community-level factors women carried more than one fetus had almost 5 (OR=4.67; 95% CI: 2.10,10.39) times more likely in getting a newborn with low birth weight than women carrying a single fetus. After adjusting for individual and community level factors geographical region was a significant predictor of low birth weight, women who were in Afar and Amhara region had almost 3 times (OR=2.89, 95% CI: 1.05, 7.96) and (OR=2.52, 95% CI: 1.15, 5.50) more likely for getting newborn with low birth weight compared with women living in Tigray region respectively (Table 2).

Ethical considerations and data set access: these EDHS 2016 were conducted after obtaining ethical clearance from Ethiopia Health and Nutrition Research Institute Review Board, the Ministry of Science and Technology, Institutional Review Board of ICF International, and the CDC. The overall process of the survey and all people involved in the process and report writing were strictly followed. Data were collected after taking informed consent, and all information were kept confidential [25]. The current study was conducted after obtaining permission from Demographic and Health Surveys Program; the datasets were treated with the utmost confidentiality.

Discussion

The current study was conducted to assess magnitude and determinants of LBW in Ethiopia using the 2016 EDHS. Previous reports showed that newborns born with LBW were more likely to have developmental delayed [31], had a six-fold risk of very early neonatal death, and are more likely to experience lifelong repercussion [32,33]. This study investigated significant individual and community level determinants of low birth weight in Ethiopia using nationally representative survey data (EDHS 2016). The prevalence of low birth weight among women who gave birth five years preceding the survey was 12.3% with 95% CI [10.1,15.0]. Although several strategies had been implemented in the health sectors, the finding was greater than the EDHS 2011 report (11%) [12]. It was in line with the study done in different parts of the country Debre Tabor (12%) [34], Southern Ethiopia (12.7%) [35] and Gondar (12.9%) [36]. The result of this study showed that maternal educational status is a strong determinant of low birth weight, in which mothers who attended or completed primary education and secondary or higher education were less likely to give birth to a low weight baby than those with no education the more educated mothers were less likely to give birth to underweight neonates. This finding is consistent with studies done in Ghana [37,38], India [39], Afghanistan [40], developing countries [11] and Cambodia [41]. This might be due to education decreases teenage pregnancy which can be ended up with LBW [38], teenage mothers have two folds risk of LBW [38] because of their demand for a double set of nutrition needed in completing her growth [42]. Moreover, increased maternal education level improves ANC attendance [43,44], which combats the incidence of LBW [45].

This study also identified that multiple pregnancies were significantly associated with low birth weight which is supported by different population-based studies in different countries including Ethiopia [32,46,47]. This might be due to multiple pregnancies to produce IUGR [48], 25% IUGR is due to twin pregnancy [49]. The lower weight of fetuses from multiple pregnancies might be due to an inability of the uterine environment to meet its nutritional needs, as well as different pregnancy-related complications i.e. maternal under nutrition, preeclampsia [50], twin-twin transfusion [51] and congenital anomalies [52] are more common in multiple gestations. This study revealed that low birth weight was significantly associated with the region, in which women who reside in Afar and Amhara regions were more likely to have newborns with low birth weight. This was consistent with a nationwide study utilized EDHS 2011 Dataset [1] regarding on the strength of the study, we tried to use the most recent births to minimize the recall bias expected from the participants. However, we believe our study has some limitations since it is cross-sectional it doesn't show cause and effect.

Conclusion

The current study revealed that nearly one in ten neonates born with LBW in Ethiopia. At the individual level, women's levels of education and type of pregnancy were factors significantly associated with LBW, whereas geographical region was a significantly associated factor at the community level. The government of Ethiopia and other stakeholders should design strategies that minimize low birth weight focusing on women's education; moreover, the root cause of regional variations should be identified.

What is known about this topic

- *Maternal, prenatal, delivery and neonatal factors were reasons for high rate of LBW, and there was no significant reduction in the prevalence of LBW;*
- *In developing countries, including Ethiopia, LBW is frequently related to child morbidity and mortality.*

What this study adds

- *Beyond 10% of the mother have a newborn with LBW in Ethiopia;*
- *The significant variations of the prevalence LBW among regions of Ethiopia need attention and women's education is important to reduce LBW.*

Competing interests

The authors declare no competing interests.

Authors' contributions

AAA was involved in the conceptualization, design, data extraction, statistical analysis, and drafting of the manuscript BYA was variously involved in the statistical analysis and editing of the manuscript. All authors approved the final version of the manuscript.

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Tables

Table 1: shows low birth weight at birth within different categories of explanatory variables, EDHS 2016 (N=1,259)

Table 2: factors associated with low birth weight identified through multilevel logistic regression

References

1. Betew W, Muluneh E. Determinants of low birth weight among children aged 0 to 59 months in Ethiopia. Int J Pure Appl Sci Technol. 2014;25(251): 14-25. **Google Scholar**
2. World Health Organization. The World health report: changing history. 2004.
3. Rezende J, Mattos IE, Koifman RJ, Koifman S, Moraes P, Meyer A. Prevalence of very low birthweight, malformation, and low Apgar score among newborns in Brazil according to maternal urban or rural residence at birth. J Obstet Gynaecol Res. 2016;42(5): 496-504. **Google Scholar**
4. Andegiorgish AK, Andemariam M, Temesghen S, Ogbai L, Ogbe Z, Zeng L. Neonatal mortality and associated factors in the specialized neonatal care unit Asmara, Eritrea. BMC Public Health. 2020;20(1): 10. **PubMed** | **Google Scholar**

5. David RJ, Collins Jr JW. Differing birth weight among infants of US-born blacks, African-born blacks, and US-born whites. N Engl J Med. 1997;337(17): 1209-14. **Google Scholar**
6. Kramer MS. Intrauterine growth and gestational duration determinants. Pediatrics. 1987;80(4): 502-11. **PubMed**| **Google Scholar**
7. Aminu M, Unkels R, Mdegela M, Utz B, Adaji S, Van Den Broek N. Causes of and factors associated with stillbirth in low-and middle-income countries: a systematic literature review. BJOG An Int J Obstet Gynaecol. 2014;121: 141-53. **PubMed**| **Google Scholar**
8. Seyum T, Ebrahim E. Proportion of neonatal hypothermia and associated factors among new-borns at Gondar University teaching and Refferal hospital, Northwest Ethiopia: a hospital based cross sectional study. Gen Med Open Access. 2015;2015. **Google Scholar**
9. UNICEF. The state of the world´s children 2009: maternal and newborn health. UNICEF. 2008;9. **Google Scholar**
10. Rogers LK, Velten M. Maternal inflammation, growth retardation, and preterm birth: insights into adult cardiovascular disease. Life Sci. 2011;89(13-14): 417-21. **PubMed**| **Google Scholar**
11. Mahumud RA, Sultana M, Sarker AR. Distribution and determinants of low birth weight in developing countries. J Prev Med Public Heal. 2017;50(1): 18-28. **PubMed**| **Google Scholar**
12. Khanal V, Sauer K, Karkee R, Zhao Y. Factors associated with small size at birth in Nepal: further analysis of Nepal Demographic and Health Survey 2011. BMC Pregnancy Childbirth. 2014 Jan 18;14: 32. **PubMed**| **Google Scholar**
13. Targets WHOWHAGN. Low birth weight policy brief. Geneva WHO. 2014.
14. Mahumud RA, Sultana M, Sarker AR. Distribution and determinants of low birth weight in developing countries. J Prev Med public Heal. 2017;50(1): 18. **PubMed**| **Google Scholar**
15. Wardlaw TM. Low birthweight: country, regional and global estimates. Unicef. 2004. **Google Scholar**
16. You D, New JR, Wardlaw T. Levels and trends in child mortality, report 2015: estimates developed by the UN inter-agency Group for Child Mortality Estimation. New York: United Nations Children´s Fund 2015. 2017. **Google Scholar**
17. Alemu T, Umeta M. Prevalence and determinants of small size babies in Ethiopia: results from in-depth analyses of the Ethiopian demographic and health survey-2011. Ethiop J Health Sci. 2016 May;26(3): 243-50. **PubMed**| **Google Scholar**
18. World Health Organization. **World health rankings; Nigeria**. 2018. Accessed on March 22, 2017.
19. Oraneli BU, Okeke OC, Ubachukwu PO. Effect of placental malaria on birth weight of babies in Nnewi, Anambra state, Nigeria. J Vector Borne Dis. 2013;50(1): 13. **PubMed**| **Google Scholar**
20. Njim T, Atashili J, Mbu R, Choukem SP. Low birth weight in a sub-urban area of Cameroon: an analysis of the clinical cut-off, incidence, predictors and complications. BMC Pregnancy Childbirth. 2015;15: 288. **PubMed**| **Google Scholar**
21. Muchemi OM, Echoka E, Makokha A. Factors associated with low birth weight among neonates born at Olkalou District Hospital, Central Region, Kenya. Pan Afr Med J. 2015 Feb 5;20: 108. **PubMed**| **Google Scholar**

22. Khanal V, Zhao Y, Sauer K. Role of antenatal care and iron supplementation during pregnancy in preventing low birth weight in Nepal?: comparison of national surveys 2006 and 2011. Arch Public Health. 2014 Feb 5;72(1): 4. **PubMed** | **Google Scholar**
23. Madebo T. A two year retrospective study of birth weight in Sidamo Regional Hospital. Ethiop Med J. 1994;32(4): 255-60. **PubMed** | **Google Scholar**
24. Korsak VS. Incidence and some perinatal problems of multiple pregnancies in a central referral hospital, Addis Ababa. Ethiop Med J. 1989;27(4): 217-21. **PubMed** | **Google Scholar**
25. Kaewkiattikun K. Effects of immediate postpartum contraceptive counseling on long-acting reversible contraceptive use in adolescents. Adolescent Health, Medicine and Therapeutics. 2017;8: 115-123. **PubMed** | **Google Scholar**
26. Manual SR. Demographic and health surveys methodology. 2011.
27. Darmawan I, Keeves JP. Suppressor variables and multilevel mixture modelling. International Education Journal. 2006. **Google Scholar**
28. Goldstein H. Multilevel statistical models. John Wiley & Sons. 2011;922. **Google Scholar**
29. Schwarz G. Estimating the dimension of a model. Ann Stat. 1978;6(2): 461-4.
30. Akaike H. A new look at the statistical model identification. IEEE Trans Automat Contr. 1974;19(6): 716-23. **Google Scholar**
31. Ahishakiye A, Abimana MC, Beck K, Miller AC, Betancourt TS, Magge H *et al*. Developmental outcomes of preterm and low birth weight toddlers and term peers in Rwanda. Ann Glob Heal. 2019;85(1): 1-11. **PubMed** | **Google Scholar**
32. Chibwesha CJ, Zanolini A, Smid M, Vwalika B, Kasaro MP, Mwanahamuntu M *et al*. Predictors and outcomes of low birth weight in Lusaka, Zambia. Int J Gynecol Obstet. 2016;134(3): 309-14. **PubMed** | **Google Scholar**
33. Martinson ML, Choi KH. Low birth weight and childhood health: the role of maternal education. Ann Epidemiol. 2019;39: 39-45. **PubMed** | **Google Scholar**
34. Mekie M, Taklual W. Magnitude of low birth weight and maternal risk factors among women who delivered in Debre Tabor Hospital, Amhara Region, Ethiopia: a facility based cross-sectional study. Ital J Pediatr. 2019 Jul 19;45(1): 86. **PubMed** | **Google Scholar**
35. Halil HM, Abdo RA, Anshebo AA, Hailu AG. Low birth weight and risk factors among newborns at Nigist Eleni Mohammed Memorial Referral Hospital, Southern Ethiopia: a cross-sectional study. Pediatr Ther. 2019;9(07): 665-2161. **Google Scholar**
36. Ekubagewargies DT, Kassie DG, Takele WW. Maternal HIV infection and preeclampsia increased risk of low birth weight among newborns delivered at University of Gondar specialized referral hospital, Northwest Ethiopia, 2017. Ital J Pediatr. 2019;45(1): 7. **PubMed** | **Google Scholar**
37. Adam Z, Ameme DK, Nortey P, Afari EA, Kenu E. Determinants of low birth weight in neonates born in three hospitals in Brong Ahafo region, Ghana, 2016- an unmatched case-control study. BMC Pregnancy Childbirth. 2019 May 16;19(1): 174. **PubMed** | **Google Scholar**
38. Mohammed S, Bonsing I, Yakubu I, Wondong WP. Maternal obstetric and socio-demographic determinants of low birth weight: a retrospective cross-sectional study in Ghana. Reprod Health. 29;16(1): 70. **PubMed** | **Google Scholar**

39. Khan N, Mozumdar A, Kaur S. Determinants of low birth weight in India: an investigation from the National Family Health Survey. Am J Hum Biol. 2020 May;32(3): e23355. **PubMed**| **Google Scholar**
40. Gupta R Das, Swasey K, Burrowes V, Hashan MR, Al Kibria GM. Factors associated with low birth weight in Afghanistan: a cross-sectional analysis of the demographic and health survey 2015. BMJ Open. 2019;9(5): 1-8. **PubMed**| **Google Scholar**
41. Chhea C, Ir P, Sopheab H. Low birth weight of institutional births in Cambodia: analysis of the demographic and health surveys 2010-2014. PLoS One. 2018 Nov 8;13(11): e0207021. **PubMed**| **Google Scholar**
42. Rahman MS, Howlader T, Masud MS. Association of low-birth weight with malnutrition in children under five years in Bangladesh?: Do Mother's Education. Socio- Economic Status, and Birth Interval Matter. 2016 Jun 29;11(6): e0157814. **PubMed**| **Google Scholar**
43. Abebe AM, Fitie GW, Jember DA, Reda MM, Wake GE. Teenage pregnancy and its adverse obstetric and perinatal outcomes at Lemlem Karl Hospital, Tigray, Ethiopia, 2018. Biomed Res Int. 2020 Jan 19;2020: 3124847. **PubMed**| **Google Scholar**
44. Mohammed S, Bonsing I, Yakubu I, Wondong WP. Maternal obstetric and socio-demographic determinants of low birth weight: a retrospective cross-sectional study in Ghana. Reprod Health. 2019;16(1): 70. **PubMed**| **Google Scholar**
45. Paul P, Zaveri A, Chouhan P. Assessing the impact of antenatal care utilization on low birthweight in India: analysis of the 2015-2016 National Family Health Survey. Child Youth Serv Rev. 2019;106: 104459. **Google Scholar**
46. Gogoi N. Maternal and neonatal risk factors of low birth weight in Guwahati Metro, Assam, Northeast India. Acad J Pediatr Neonatol. 2018;6(5): 1-6. **Google Scholar**
47. Gupta R Das, Swasey K, Burrowes V, Hashan MR, Muhammed G, Kibria A. Factors associated with low birth weight in Afghanistan?: a cross-sectional analysis of the demographic and health survey 2015. 2019 May 14;9(5): e025715. **PubMed**| **Google Scholar**
48. Valero De Bernabé J, Soriano T, Albaladejo R, Juarranz M, Calle ME, Martínez D *et al*. Risk factors for low birth weight: a review. Eur J Obstet Gynecol Reprod Biol. 2004;116(1): 3-15. **PubMed**| **Google Scholar**
49. Arbuckle TE, Wilkins R, Sherman GJ. Birth weight percentiles by gestational age in Canada. Obstet Gynecol. 1993;81(1): 39-48. **PubMed**| **Google Scholar**
50. Kothari S, Jora R, Chouhan H. Incidence & risk factors for low birth weight, very low birth weight & extremely low birth weight babies in Western Rajasthan. Journal of developmental origins. 2016;3(5): 102-5. **Google Scholar**
51. Groene, Tollenaar, van Klink, Haak, Klumper, Middeldorp *et al*. Twin-twin transfusion syndrome with and without selective fetal growth restriction prior to fetoscopic laser surgery: short and long-term outcome. J Clin Med. 2019;8(7): 969. **PubMed**| **Google Scholar**
52. Walden RV, Taylor SC, Hansen NI, Poole WK, Stoll BJ, Abuelo D *et al*. Major congenital anomalies place extremely low birth weight infants at higher risk for poor growth and developmental outcomes. Pediatrics. 2007 Dec;120(6): e1512-9. **PubMed**| **Google Scholar**

Table 1: shows low birth weight at birth within different categories of explanatory variables, EDHS 2016 (N=1,259)

Individual characteristics	**Category**	**Birth weight**				**X^2 test P=value**
		≥2500gm		**<2500gm**		
		N (%)	**Percent**	**Number**	**Percent**	
Individual level factors						
Maternal age at last birth	15-24	294	27	37	24	0.807
	25-34	623	56	93	60	
	35-47	187	17	25	16	
Marital status	Never married	11	1	2	1	0.554
	Married	1029	93.2	147	95	
	Formerly married	64	5.8	6	4	
Educational status	No education	293	26.5	64	41	0.013
	Primary	427	38.7	47	30	
	20 or higher	384	34.8	44	29	
Parity	One	407	37	44	28	0.2258
	2-4	496	45	83	54	
	≥5	201	18	28	18	
ANC visit	No	67	6	5	3	0.328
	Yes	1037	94	150	97	
Was she Anemic	Yes	582	53	91	59	0.400
	No	521	47	64	41	
Smoking	No	1099	99.5	154	99.5	0.794
	Yes	5	0.5	1	0.5	
Wealth index	Poor	282	25.5	34	22	0.245
	Average	255	23.1	48	32	
	Rich	567	51.4	72	46	
Abortion history	No	1028	93	150	93.6	0.062
	Yes	76	7	5	6.4	
Sex of neonate	Male	581	52.6	71	46	0.294
	Female	523	47.4	84	54	
Maternal current work	Not working	604	54.7	85	54.9	0.973
	Working	500	45.3	70	45.1	
Iron supplementation	No	359	33	47	30	0.664
	Yes	745	67	108	70	
Pregnancy status	Intended	876	79.3	130	84	0.289
	Unintended	228	20.7	25	16	
Fuel used	Non polluting	233	21	21	13.7	0.053
	Polluting	871	79	134	86.3	
Source of drinking water	Improved	929	84	133	84	0.674
	Less improved	175	16	24	14	
Facility distance	Big problem	393	35.6	43	27.6	0.136
	Not a big problem	711	64.4	112	72.4	
Pregnancy type	Single	1092	99	144	98	0.000
	Multiple	12	1	11	2	
Community level factors						
Residence	Urban	555	50.2	64	41.2	0.129
	Rural	549	49.8	91	58.8	
Region	Tigray	164	14.8	13	9.5	0.007
	Afar	4	0.4	1	0.8	
	Amhara	149	13.5	35	22.6	
	Oromia	320	28.9	38	25.7	
	Somali	29	2.6	4	3	
	Benshangul	19	1.7	2	1.4	
	SNNPR	236	21.3	32	21.6	
	Gambella	6	0.57	9	0.6	
	Harar	7	0.7	1	0.2	
	Addis Ababa	155	14	2	13	
	Dire Dawa	15	1.4	1	1	

Table 2: factors associated with low birth weight identified through multilevel logistic regression				
Variable	**Model I**	**Model II**	**Model III**	**Model IV**
Pregnancy type				
Single		1.00		1.00
Multiple		4.83(2.16 ,10.78)***		4.67(2.13,10.50)***
Educational status				
No education		1.00		1.00
Primary		0.69(0.47,1.01)		0.67(0.45,0.98)*
20 or higher		0.56(0.37, 0.84)**		0.50(0.33, 0.77)*
Region				
Tigray			1.00	1.00
Afar			3.04(1.10,8.39)*	2.89(1.05,7.96)*
Amhara			2.65(1.21,5.79)*	2.52(1.15, 5.50)*
Oromia			1.66(0.79,3.51)	1.61(0.77, 3.39)
Somali			1.93(0.89,4.17)	1.9(0.88, 4.09)
Benshangul			1.18(0.55,2.55)	1.07(.49 ,2.33)
SNNPR			1.75(0.88,3.47)	1.66(0.84 ,3.29)
Gambella			1.96(0.97,3.92)	1.87(0.94 ,3.74)
Harar			0.5(0.21,1.19)	0.47(0.19 ,1.13)
Addis Ababa			1.44(0.79 ,2.64)	1.38(0.75 ,2.50)
Dire Dawa			1.09(.54,2.20)	1.09(0.54, 2.18)
Random effect				
ICC	88.7%	81.6%	52.7%	37.4%
PCV1	N/A	8.8%	10.7%	29.9%
Model fitness				
Log-likelihood	-593.82335	-583.41201		-571.01722
AIC	1191.647	1176.824	1188.589	1172.034
Significat codes: *** < 0.001 **< 0.01 * < 0.05 1PCV was calculated for successive models with reference to null model to look at relative contribution of each model to explain predictors of low birth weight				