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Research Article

Level of Low Birth Weight and its Contributory Factors among Newborns Delivered in Addis Ababa; the Case of All African Leprosy and Tuberculosis Training and Rehabilitation Center

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Abstract

Background: Low birth weight is a substantial public health problem worldwide and considered as the single most important predictor of infant mortality and a valuable public health indicator of maternal health, nutrition, and poverty. Nonetheless, the problem has not been studied despite the substantial maternal deliveries attended in the studied site and therefore we examined the level of low birth weight and its contributory factors among newborns delivered at the center for some programmatic initiatives.

Objective: To assess level of low birth weight and its contributory factors among newborns delivered in All African leprosy and tuberculosis training and rehabilitation center (ALERT) center during the study period.

Method: A facility based cross-sectional study was conducted among 242 pregnant mothers who delivered at All African leprosy and tuberculosis training and rehabilitation center, Addis Ababa from July to September 2019. Interviewer administered questionnaire was used to collect data on socio demographic characteristics, reproductive health services, dietary history, maternal MUAC and birthweight. To estimate the association of with low birth weight, multiple binary logistic regression analyses was used. Odds ratio with its corresponding 95% CI was used as a measure of effect. A P value < 0.05 was used as a cutoff point to declare significance.

Result: The proportion of newborns with low birth weight was 19.4%. The major determinants for LBW were having low Dietary diversity score (AOR = 3.48; 95%CI = 1.49 - 8.130), fasting during pregnancy (AOR = 3.13; 95% CI = 1.20 - 8.18), received no prenatal supplement (AOR = 2.64; 95%CI = 1.03 - 6.75) and had ANC visit of less than 6 times (AOR = 2.33; 95%CI = 1.04 - 5.23).

Conclusion: Nearly one in five newborn delivered in the center had low birth weight. Having low Dietary diversity score, fasting during pregnancy, had no prenatal supplement and ANC visit of less than 6 times were the major predictors. Actions targeting the above predictors through appropriate health and nutrition counseling are recommended.

Keywords: *Low Birth Weight; Women Dietary Diversity; Prenatal Supplement; Fasting*

Abbreviations

ALERT: All African Leprosy and Tuberculosis Training and Rehabilitation Center; ANC: Ante-Natal Care; BMI: Body Mass Index; DHS: Demographic Health Survey; DDS: Dietary Diversity Score; DDI: Dietary Diversity Index; FAO: Food and Agriculture Organization; IUGR:

Intra Uterine Growth Restriction; IDDS: Individual Dietary Diversity Score; LBW: Low Birth Weight; LMP: Last Menstrual Period; MUAC: Mid Upper Arm Circumference; WHO: World Health Organization; WDDS: Women Dietary Diversity Score

Background

Low birth weight (LBW) refers to birth weight of less than 2,500 grams irrespective of their gestational age [1]. It is a substantial public health problem in most countries particularly among countries with resource constrained and associated with a range of both short-term and long-term consequences affecting human capital and the single most important predictor of infant mortality [2]. More than 80% of neonatal deaths are among newborns with low birth weight, of which two thirds are preterm and one third are term small-for-gestational-age [3]. It is a valuable public health indicator of maternal health, nutrition, healthcare delivery, and poverty [4]. Newborns with LBW have greater risk of dying and often suffer with long-term neurologic disability, impaired academic achievement, and increased risk of chronic diseases such as cardiovascular disease and diabetes [5] due to fetal programming which is the most sensitive period in developmental stage according to the fetal origin's hypothesis [6].

When newborns are prematurely delivered, they are deprived from staying in their mother's womb to grow and gain the desirable weight that should occurs during the last weeks of pregnancy and ultimately causing LBW [7]. Other than these cause, there are several factors documented to cause LBW ranging from socio-demographic (maternal education level, occupation, income and place of residence), maternal/obstetric (maternal age, antenatal care visit, maternal weight and stature, preterm birth and parity), obstetric and medical disorders during pregnancy (hypertensive disorders of pregnancy, anemia and malaria) and fetal factors such as infant sex and congenital malformations [7-12].

In Ethiopia the proportion of LBW in the past three DHS surveys was 14% in 2005, 11% in 2011, and 13% in 2016 [13-15]. According to the 2014 WHO policy briefs report, children with low birthweight are documented more likely to die than average or larger children. For example, infant mortality for small children at birth is 56 deaths per 1,000 live births compared with 43 deaths per 1,000 live births for average or larger children [16]. Several studies [7,22] attempted to investigate the determinants of low birth weight at different regional referral hospitals in our country and elsewhere though still remained a gray area particularly in the studied site where anecdotal evidences show an unacceptably high proportion of LBWs. The strong political commitment from national and local authorities for maternal and child health in general and skilled ANC service attendance in particular which has been the flagship of the ministry of health requires further evidences through identification of factors that triggered the persistently high percentage of LBW to track the achievement of maternal health continuum [23]. In view of the scarcity of recent studies regarding the issue we examined the magnitude and contributory factors to low birth weight anticipating that our findings will provide plausible information for some program improvements.

Objective of the Study

This study has attempted to examine the magnitude and contributors of low birth weight among newborns delivered in All African leprosy and tuberculosis training and rehabilitation center (ALERT) center during the study period and provide evidenced based information for some programmatic initiatives.

Methods

Study design, period and participants

A facility based cross-sectional study was conducted among 242 pregnant mothers who delivered between July and September 2019 at All African leprosy and tuberculosis training and rehabilitation center (ALERT) which serves as a referral and teaching hospital in the capital city of Ethiopia. The hospital handles over 400 deliveries monthly in addition to its specialized services that include dermatology, ophthalmology and other medical and surgical related services. The study populations were all third trimester pregnant mothers that

had their fourth visit with gestational age of 37 weeks and above with their newborn pair after delivery because third trimester is the period when the neonate can maximally increase in weight and allow us to catch the birth weight during the intended study period. Those pregnant mothers with twin and above deliveries and that had chronic illnesses were excluded.

Sample size and sample technique

Assuming a pooled prevalence of LBW of 17.3% based on systematic review and meta-analysis done for 30 studies in 2018 [17] with a 95% level of confidence, 4% margin of error and 10% of non-response rate, a sample size of 242 was obtained. Using the antenatal registration book as the sampling frame comprising of 350 pregnant in their third trimester, the sampling interval of 1.4 was calculated and thus every other of the eligible mothers were systematically selected until the sample size was reached.

Data collection process and instrument

Three midwife nurses were recruited and trained for three days to standardize the technique of interviewing, data extraction and method of MUAC measurements. All participants during the study period were interviewed after their consent was obtained using a pre-tested tool containing socio-demographic data, MUAC measurements and information on individual routine complete blood count results.

Measurements

Nutrition status was assessed using non-stretchable measuring tape to the nearest 0.1 cm with no clothing on the arm and done in duplicate. Mothers were classified as underweight when their MUAC was below 23 cm while those above 23 cm as normal. Information on Anemia [25], gestational hypertension [25] and other important variables such as congenital malformation [18] and infant sex were also obtained from the respective antenatal charts recorded.

Babies delivered in the hospital were weighed naked within two hours of delivery by the trained midwives on a standard baby weighing scale, to the nearest 0.1 kg and were classified as LBW when their birthweight was less than 2500 grams while those equal to or above 2500 grams as normal [24].

The new dietary diversity indicator which is the Minimum Dietary Diversity-Women (MDD-W) was used by replacing the Women's Dietary Diversity Score (WDDS) to measure the dietary diversity of pregnant women which is a simple proxy indicator for global use that has been shown to reflect one key dimension of diet quality such as micronutrient adequacy in the diet of women of reproductive age. The dichotomous indicator, made up of ten defined food groups (Dark green leafy vegetables, Other Vitamin A fruits/vegetables, Other fruits/vegetables, Organ meat, Flesh meat, Eggs, Legumes, Milk and fat/oil) the previous day or night with a cutoff point at five, reflects that women consuming foods from five or more food groups have a greater likelihood of meeting their micronutrient requirements than women consuming foods from fewer food groups [19,21].

Data processing and analysis

The collected data were cleaned and entered into Epi- info version 7.1 and exported to SPSS version 20 software for analysis. Descriptive statistics were generated to describe the socio demographic, dietary practice and reproductive health and family planning use. Binary logistic regression analyses were used to estimate the crude association of LBW with various important variables. Variables with p value less than 0.2 in the binary regression model were selected as candidate variables for the multiple logistic regression analysis. The results are presented as odds ratios and 95 percent confidence intervals. A p value of less than 0.05 was used as cutoff points to declare significance. All the assumption like normality of continuous variable, multi co linearity of independent variables and model fit was checked using the appropriate method.

Result

Socio-demographic characteristics of respondents

A total of 242 pregnant women participated in this study making the response rate 100%. About two-thirds (66.9%) of them were b/n the age ranges of 25 and 34 years. One hundred thirty two (54.5%) had attained primary to secondary education. Over half (57.4%) had a family size 3-5 persons and half (50.8%) of them were Muslims. About a quarter (26.0%) of the respondents were engages in some kind of private work and more than half (66.9%) of them were house wives. Slightly above one-third (35%) were earning between 500 and 1500 ETB per month (Table 1).

Variable	Category	Frequency	Percentage
Age	19 - 24	53	23.60%
	25 - 34	162	66.90%
	> 35	23	9.50%
Educational status	Cannot read and write-read write	78	32.20%
	Primary-secondary	132	54.50%
	College and above	32	13.20%
Family size	< Three	50	20.70%
	Three-Five	139	57.40%
	> Five	53	21.90%
Religion	Orthodox	87	36.00%
	Muslim	123	50.80%
	Protestant	30	12.40%
	Catholic	2	80.00%
Occupation	House wife	162	66.90%
	Daily labor	17	7.00%
	Employed-private work	63	26.00%
Monthly income	500 - 1500ETB	84	34.70%
	1500 - 3500ETB	98	40.10%
	3500 - 4500	60	24.80%

Table 1: *Socio-demographic characteristics of mothers delivered at ALERT center.*

ETB = Ethiopian Birr (1USD = 55.5).

Reproductive health services and dietary practices of respondents during the current pregnancy

As shown in table 2, 183 (75.6%) of them attained ANC greater than 6 times. Concerning their gravidity status, 122 (50.4%) had pregnancy of 3 - 4 times. The percentage of participant that have less than two years intra pregnancy gap was 23.1% and over-three quarters (79.8%) used different contraceptive methods. The proportion of respondents with hemoglobin concentration of lower than 11 mg/dl (anemia) was 69.4%.

About a quarter (25.6%) of them had a weight of below 50 kg at first ANC visit. The proportion of respondents who had MUAC greater than 23 cm, between 21 cm - 23 cm and below 21 cm was 56.6%, 39% and 4%, respectively. The majority (85.5%) of them were given prenatal supplement.

Less than half (44.2%) had meal frequency of two–three times per day meaning that they have skipped one of their recommended meals. Slightly over one third (34.3%) had an additional one meal (4 times) and 19% of them have more than one (5 times) additional meal. Over-two thirds (66.0%) had been fasting during their pregnancy and the majority (87.5%) of them did not avoid any food during the current pregnancy. On the other hand, the proportion of mothers who have avoided raw vegetable, meat and fats and oil was 6%, 4% and 2.5%, respectively. Regarding respondent's dietary diversity score (DDS), 102 (42.1%) of them have inadequate DDS based on the 24-hours dietary recall.

Maternal characters	Response categories	Frequency	Percentage
ANC visit	< Six times	59	24.4
	> Six times	183	75.6
Gravidity	One-two	48	19.8
	Three-four	122	50.4
	> Four	72	29.8
Inter-pregnancy gap	First child	47	19.4
	< Two year	56	23.1
	Two-four year	89	36.8
	> Four year	50	20.6
Contraceptive	Yes	193	79.8
	No	49	20.2
Hemoglobin	> 11 mg/dl	74	30.6
	< 11 mg/dl	168	69.4
Weight at first visit	50 Kg or less	62	25.6
	> 50 kg	180	74.4
MUAC at 37 weeks of gestation	> 23 cm	137	56.6
	23 - 21	95	39.0
	< 21	10	4.0
Received supplement	Yes	207	85.5
	No	35	14.5
Meal frequency	2 - 3 times	113	46.7
	4 times (1 additional meal)	83	34.3
	5 times (2 additional meals)	45	19.0
Fasting	Yes	158	65.3
	No	84	34.7
Foods avoided	No	211	87.5
	Raw vegetables	15	6.0
	Meat	10	4.0
	Milk	6	2.5
Dietary diversity score (DDS)	Adequate (> 5 food groups)	140	57.9
	Inadequate (< 5 food groups)	102	42.1

Table 2: *Reproductive health history and dietary practices of mothers delivered at ALERT center.*

Magnitude of low birth weight

As demonstrated in figure 1, the percentage of new born with low birth weight was 19.4% (n = 47). In terms of gender, one hundred twenty (49.6%) of them were males and 122 (50.4%) were females nearly comparable. There were 10 (4%) newborns with congenital malformation such as club foot and cleft lip (Data no shown).

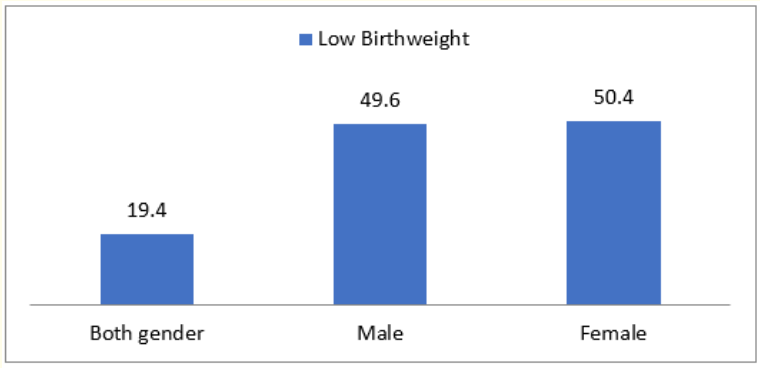

Figure 1: *Magnitude of low birth weight by gender of newborns delivered in ALERT center.*

Factor associated with low birth weight

Although the number of ANC follow-up, inter-pregnancy gap, supplement, hemoglobin level, maternal MUAC, frequency of milk and vegetable consumed, gestational hypertension, dietary diversity score were crudely associated with low birth weight, they were dropped in the multivariate analyses. After adjusting for covariates, the ORs of LBW remained consistent with frequency of more than six times antenatal care (ANC) visit, fasting during pregnancy, receiving prenatal supplement and adequate intake of dietary diversity score.

Pregnant mothers who have less than six times ANC visit were 2.3 times significantly more likely to have low birth weight babies than mothers who have greater than six times ANC (AOR = 2.3; 95%CI = 1.037-5.231). Likewise, those pregnant mothers who were Fasting during their current pregnancy was 3.1 times significantly more likely to deliver low birth weight babies than those who did not (AOR 3.1; CI = 1.203 - 8.182). Similarly, mothers who did not take prenatal supplement were 2.6 times significantly more likely to deliver low birth weight than those who took prenatal supplement (AOR = 2.63; 95%CI = 1.03 - 6.74). Mothers with inadequate dietary diversity score were 3.4 times significantly more likely to have low birth weight babies than those who have adequate dietary diversity (AOR = 3.48; 95% CI = 1.49 - 8.13). Although not significantly, the proportion of low birth weight babies was 2.2 times higher among anemic mothers than their counter groups (AOR = 2.20; 95%CI = 0.99 - 4.88).

Variable	Category	Low birth weight	Normal birth weight	COR (95%CI)	AOR (95%CI)	P-value
ANC	Three-six	25	42	2.261 (1.14-4.46)	2.329 (1.04-5.23)	0.041
	> Six	23	154	1	1	
Inter pregnancy gap	First pregnancy	13	32	2.349 (0.84-6.53)	2.707 (0.83-8.78)	0.097
	< Two year	17	39	2.678 (1.01-7.14)	1.621 (0.51-5.08)	0.408
	Two-four year	10	81	0.778 (0.27-2.19)	0.575 (0.17-1.84)	0.353
	> Four year	7	43	1	1	

Fasting	Yes No	38 9	120 75	2.582 (1.18-5.64) 1	3.137 (1.20-8.18) 1	0.019
Took Supplement	Yes No	34 13	173 22	1 3.007 (1.38-6.55)	1 2.635 (1.03-6.74)	0.043
Frequency of Vegetable use	Three times a week One-two time a week Once a month-none	11 19 17	69 54 72	1 2.395 (1.06-5.39) 1.325 (0.56-3.08)	1 1.041 (0. 37-2.92) 0.387 (0.13-1.12)	0.940 0.080
Frequency of Milk use	Three times a week One-two time a week Once a month-none	11 10 26	75 40 80	1 1.685 (0.66-4.30) 2.303 (1.06-4.98)	1 0.814 (0.24-2.73) 1.586 (0.56-4.28)	0.740 0.364
Maternal MUAC	< 21 cm 21 - 23 > 23	5 24 18	5 71 119	6.611 (1.74-25.12) 2.235 (1.13-4.40) 1	1.386 (0.26-7.29) 1.460 (0.64-3.33) 1	0.700 0.369
Hemoglobin	> 11 mg/dl < 11 mg/dl	27 20	47 148	1 2.782 (1.41-5.45)	1 2.204 (0.99-4.88)	0.052
Dietary diversity score	Adequate Inadequate	19 28	121 74	1 3.810 (1.93-7.51)	1 3.483 (1.49-8.13)	0.004

Table 3: *Factors associated with low birth weight among mothers delivered at ALERT center.*

Discussion

Globally, about 7 - 15% of all live births delivered each year are of low birth weight, a gestational outcome that is considered a major public health problem and is more prevalent in countries with poor financial resources [1]. As in most developing countries, nearly one in four births delivered in the studied center had inadequate birth weight. This finding compared with some local study, done in Debre Markos referral hospital in east Gojam it is relatively lower (19.4% vs 26.3%) probably due to the exclusion of premature deliveries in our study as opposed to the Gojam study in which they included all delivery types such as gestational age < 37 weeks and multiple pregnancies which are predisposing factors for low birth weight [11]. Like in some previous studies done elsewhere, the magnitude of low birth weight was found to be significantly associated with the frequency of antenatal care follow up, fasting during pregnancy, prenatal supplementation and poor dietary diversity score.

Studies have shown that the risk of LBW decreases with an increase in the number of ANC visits, with the risk being further reduced when the first ANC occurred in the first trimester of pregnancy [12,17]. Our findings highlighted an insight to the center as well as to line ministry that frequent ANC visit are important to improve maternal and neonatal health outcomes. Similar to our findings, the study done in referral hospital in Northwest Ethiopia indicated a significant association between lack of ANC follow up and LBW. Mothers who had no history of ANC follow up were almost three times as likely to deliver LBW babies when compared to those who had at least one ANC follow up [12]. Similarly in the current study mothers who have less than six ANC visit were 2.3 times significantly more likely to deliver low birth weight babies. Such success stories are attributed to the substantial efforts made by the Ethiopian government who created free frequent ANC visits and delivery services in a health facility [23].

In this study, most of the mothers who fasted in the third trimester had higher risk of delivering low birth weight babies by 3 folds. This is logical to explain since a lower intake of the nutrients considered important for fetal growth, such as B vitamins and iron obtained from animal products are not consumed or avoided during fasting. In addition fasting decrease the meal frequency despite the high

nutritional demand needed during third trimester when the baby maximally increases in weight. Similar to our finding, some other large scale studies done elsewhere [26-28] also showed the negative effects of fasting on the in size and weight of the newborns). On the other hand some other international studies with low sample sizes showed no significant difference between the weight of the newborn among fasting and non-fasting mothers deserves further study [29].

Prenatal supplementation with multiple micronutrients had a greater positive impact on birthweight than supplementation with iron/folic acid alone. Our data suggest that prenatal supplementation with multiple micronutrients as part of a antenatal care package in addition to interventions to promote improved maternal health is an important strategy to increase birthweight and reduce the incidence of low birthweight [30-33]. Similar observation was also documented by the study done in northern Ethiopia where a lower incidence of LBW among mothers supplemented with micronutrients was observed [8]. The use of multivitamins and/or iron supplements by pregnant women however must take into account maternal age, maternal diet and maternal nutritional status including their hemoglobin level to avoid excessive weight in pregnant women and fetal macrosomia [32].

Dietary diversity is one of the strategies proposed to tackle the problem of micro/macronutrient malnutrition by many organizations including World Health Organization, the FAO of the United Nations and Harvest Plus [34,35]. In this study maternal dietary diversity was observed to have a strong association with the magnitude of low birth weight. Mothers with inadequate dietary diversity (less than five MDD-W) were nearly three folds likely to deliver low birth weight babies. A prospective cohort study done in Arsi, Ethiopia showed that pregnant mother's dietary diversity score to have an effect on birth outcome. Women having inadequate dietary diversity had a 2-fold risk of LBW than those who had adequate dietary diversity group [22]. In the same breadth, the Desse, Ethiopia study also showed mothers with inadequate dietary diversity had about three times higher odds of giving birth to LBW babies than those mothers with adequate dietary diversity [36].

According to a systematic review done by Ana., *et al*. [37], maternal anemia was documented to be significantly associated with the risk of low birth weight deliveries. In contrast to this, the case control study done in one of the Ethiopian referral hospital showed no significant difference in the mean hemoglobin level of mothers between cases (mothers who deliver low birth weight babies) and controls (mothers with normal birth weight babies) [22]. Our present findings are also in agreement with the former study though higher number of LBWs was observed among women with low hemoglobin. It is worth to note that such findings although was marginally significant ($p = 0.05$) the finding would still be of clinical importance in the prevention of LBW incidence. On the other hand, even though multi gravidity and parity were observed to have no significant association with magnitude of low birth weight the findings need to be interpreted cautiously.

Conclusion

One in four delivered babies had experienced LBW in the center. The major contributory factors to LBW contextually were Fasting during pregnancy, number of more antenatal care visit, taking prenatal supplement and having adequate dietary diversity score. To combat the issue under caption and improve the maternal care continuum, a multi-facetted approach involving the line ministry and other allied health sectors through appropriate health and nutrition counseling, early detection and treatment of anemia is recommended.

Strength and Limitations of the Study

The study attempted to delineate the magnitude of the LBW problem in the center and generated evidences for plausible intervention with 100 percent response rate. In addition, we used the new dietary diversity indicator MDD-W to measure the dietary diversity of pregnant women, a simple proxy indicator for global use to reflect one key dimension of diet quality such as micronutrient adequacy. We have also elucidated the key factors that need multi-faceted approach to combat the problem. Nonetheless, the dietary approach employed to measure the absolute intake for specific nutrients which mostly relies on respondent's memory was prone to recall and social desirability bias is to some extent the limitation of this study.

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Authors' Contributions

Mahlet Asefa was responsible for project inception and has collected the data and drafted the manuscript as part her fulfillment for the Requirement for the Degree of Masters of Public Health in Public Health Nutrition; while Professor Jemal Haidar supervised the entire research work and wrote the final manuscript. All authors read and approved the final manuscript.

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Availability of Data and Materials

All data generated or analyzed are included in this published article.

Ethics Approval and Consent to Participate

Ethical clearance was secured from research and ethics committee of Addis Ababa health bureau and Santé medical college. Permission from ALERT center administration was also obtained before commencing the data collection processes. In addition, informed written consent from all participants was obtained after being introduced to the purpose of the study and informed about their rights to interrupt the interview at any time. Confidentiality was maintained at all levels of the study. All the procedures were done in accordance with relevant guidelines and regulations. In addition, all participants were debriefed on their hemoglobin as well as their newborn birth weight. Other than this, heath/nutrition advice was given to all mothers with low hemoglobin/anemic and those respondents with LBW were linked to the obstetric/pediatric departments of the center.

Consent for Publication

Not applicable.

Competing Interests

The authors declare that they have no competing interests.

Annex 1: The Minimum dietary diversity women ten food groups

Roll no	Food group	Food item	Yes = 1 No = 0
1	Grains, roots, and tubers		
2	Pulses		
3	Nuts and seeds		
4	Dairy		
5	Meat, poultry, fish		
6	Egg		
7	Dark, green and leafy vegetables		
8	Other vitamin A rich fruits and vegetables		
9	Other vegetables		
10	Other fruits		

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