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ORIGINAL RESEARCH

Determinants of Low Birth Weight Among Newborns Delivered in Silte Zone Public Health Facilities, Southern Ethiopia: A Case-Control Study

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Background: Low birth weight is a challenging public health problem, which has wide range of both short- and long-term consequences particularly in developing countries. Although several studies have been conducted in different countries including Ethiopia, most of the studies did not consider the food security status, environmental-related and maternal dietary diversity-related factors. Therefore, this study aimed to identify contextual determinant factors of low birth weight.

Method: A facility-based unmatched case-control study design was employed among 84 cases and 168 controls in selected public health facilities of the Silte Zone. Cases were newborns with birth weight less than 2500gm and controls were newborns with birth weight greater than 2500gm. The data were collected using a semi-structured, pretested interviewer-administered questionnaire. Multivariable logistic regression analysis was carried out to identify independent determinants of low birth weight with a p-value <0.05.

Results: The mean birth weight was 2154.94gm ± 233.43 gm SD for cases and 3022.92gm ± 311.88 gm for controls. Mothers who did not receive iron and folate supplementation during pregnancy (AOR = 4.17, 95% CI: (1.44, 12.3)), not taking additional meal (AOR = 3.09, 95% CI: (1.28, 7.5)), maternal hemoglobin level <11g/dl (AOR = 5.213, 95% CI (1.92, 14.13)), household food insecurity (AOR = 6.85, 95% CI: (3.01, 15.61)) and women's inadequate minimum dietary diversity score (AOR = 4.13 (1.4, 12.16)) were found to be independent determinants of low birth weight.

Conclusion: Missing of iron and folate supplementation during pregnancy, maternal meal frequency during pregnancy, maternal hemoglobin level, food insecurity, and women's inadequate minimum dietary diversity score were significant determinants of low birth weight. Thus, public health intervention in the field of maternal and child health should be addressed by strengthening multi-sectoral efforts, which improve women's dietary diversity, adherence of iron folate, additional meal and food security.

Keywords: low birth weight, preterm, newborn

Introduction

According to the World Health Organization (WHO), low birth weight is a term used to describe babies who are born weighing less than 2500 grams. The low birth weight rate at the population level is a good indicator of a public health problem that includes long-term maternal malnutrition, poor health care and ill health. On an individual basis, low birth weight is an essential and important predictor of newborn health and survival. The UNICEF-WHO low birthweight estimates indicate that one in seven live births – 20.5 million babies globally suffered from low birth weight in 2015.[1]

Low birth weight is a global challenging public health problem and the most significant risk factor for adverse health outcomes including common infant and childhood morbidity. Globally, low birth weight contributes to 60% to 80% of all neonatal deaths.[2] In both developed and developing countries, LBW is an important cause of perinatal mortality and both short- and long-term infant and childhood morbidity. Deaths of LBW infants are 30 times more frequent than deaths of newborns of normal birth weight and they are many times more likely to end up with long-term handicapping

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conditions.[3] They are also at higher risk of perinatal death, adulthood stunting which in turn leads to the intergenerational effect of malnutrition in the affected community.[4]

Low- and middle-income countries have a disproportionate burden of low birth weight which accounts over 91% of the world's LBW infants of which 9.3 million of them are in South Asia and 3.1million in sub-Saharan Africa.[5] Africa was home to about 25% of all low birth weight newborns, with the majority born in Eastern and Western Africa, 11% and 14%, respectively.[6] According to Ethiopian demographic health survey (EDHS) 2016 estimates, 13% of neonates weighed less than 2.5kg at birth. Moreover, 14% LBW in 2005, 11% in 2011, according to mother's report, 16% of births are very small, 10% are smaller than average.[7–9]

In Ethiopia, the prevalence of under-five mortality ranges from 53 to 169 per 1000 live births out of this neonatal mortality which is mainly attributed by LBW accounts for the largest portion. In Ethiopia, in 2014, there were 27,243 deaths due to low birth weight accounting for 4.53% of the total deaths.[10] LBW individuals had lower IQs compared with the normal birth weight group.[11] Moreover, it is the risk for childhood morbidity, growth impairment, a range of poor health outcomes, and chronic diseases later in life.[12] According to different studies in different parts of developing and developed countries: socio-demographic, medical and obstetric factors, nutritional related factors, behavioral related factors, infant and environmental-related factors are potential risk factors for the occurrence of low birth weight.[3,4,10,13–15]

World Health Assembly set a policy target to reduce LBW by 30% by the end of 2025. The packages give emphasis on care provided at the prenatal, ante-natal, intra-natal, and post-natal period interventions to prevent low birth weight, their associated morbidity and mortality on community settings.[16]

Similarly, Ethiopia has adopted the WHO recommendations and similar strategies have been implemented. There is a comprehensive care that is provided for women and newborns from pregnancy to the postnatal period.[17] Additionally, there is also information that provides insights into the health workforce, health policies, health information, and community mobilization relevant to preterm birth and low birth weight. Moreover, support for adequate feeding with breast milk, continuous skin to skin contact, antibiotics, and antenatal corticosteroids is provided.[17]

Despite the enormous prevention options and efforts, LBW remains a formidable public health challenge for the 21st century and more detailed research is needed to illuminate factors affecting LBW. However, only scanty studies have been conducted regarding maternal nutritional status, food insecurity, dietary practices, and environmental-related factors concerning risk for low birth weight in Ethiopia. Therefore, this study aimed to identify contextual determinants of low birth weight in the study area.

Materials and Methods

Study Area and Period

Silte zone has a total population of 1,731,806 from which 949,753 females. The reproductive age group was 256,721, expected pregnancies were 76,924, under-five children 171,992. The zone has 224,858 households. This Zone comprises 34 urban and 142 rural health posts with 82 and 163 health extension workers, respectively. Thirty-seven health centers that provide different health services including delivery and four public hospitals have a neonatal intensive care unit that admits and treats LBW newborns. Regarding delivery services, the zone has achieved 81% skill attendant delivery services (Zone achievements report 2019). The study period was from March 15 to June 16, 2020.

Study Design

The facility-based unmatched case-control study design was employed.

Source Population

All neonates are delivered to public health facilities of the Silte zone.

Study Population and Study Unit

Cases: Neonates delivered with a low birth weight of <2500 gm in Silte zone public health facilities during the study period.

Controls: Neonates delivered with a normal birth weight of ≥2500 gm in Silte zone public health facilities during the study period.

Inclusion Criteria for Cases

For cases: live-born singleton baby with birth weight less than 2500 gm at birth during the study period.

For control: live born, singleton baby with birth weight 2500 gm or more at birth during the study period.

Exclusion criteria for both cases and controls: Neonates whose mother was mentally ill, critically ill/unable to communicate, placenta previa, abruptio placenta were excluded.

Sample Size Determination

The sample size was determined based on the consideration of a formula for two population proportions and calculated by Epi info version 7 statistical software package by considering that the percent of controls exposed Height ≤1.5 m among the controls and exposure are 6% and 19.1%, respectively.[18] Adjusted Odds Ratio of 4.12, 95% confidence level, 80% power of the study and control to case ratio of 2:1 was assumed to estimate the required sample size. Accordingly, after adding 5% for non-response rate the final sample size became 255, of which 85 cases and 170 controls were involved in the study.

Sampling Procedure

There are 4 hospitals and 37 health centers are found in the Silte zone which gives delivery services. Three hospitals and 10 health centers were selected randomly based on 30% on the minimum criteria of representativeness. Then, proportional allocation of newborns to each hospital and health center was determined based on the number of deliveries within the study period. The cases and controls were defined according to the birth weight in the labor rooms of the facilities. Consecutive live births of less than 2500 grams in each hospital and health center were selected as cases and two normal birth weight babies succeeding each case were selected as controls during the study period.

Data Collection Tools and Procedures

Interviewer administered semi-structured and pretested questionnaires adapted from different related kinds of literature were used to collect the data by face-to-face interview. The questionnaire was designed to capture the dietary, food security-related, iron-folate, behavioral, socioeconomic, environmental, medical and obstetric, and infant-related factors associated with low birth weight from the participant. Iron and folate supplementation along with a history of ANC were asked for each mother. In addition to the questionnaire, the hemoglobin level of each mother was taken from the card as hemoglobin is routinely done for each mother receiving delivery service in each public service to determine anemia. Data were collected by 6 midwiferies and supervised by two health officers.

Food Insecurity

The HFIAS questions were used which is validated for developing country Questions relate to three different domains of food insecurity. A. the uncertainty about the household food supply and their anxiety B. Insufficient quality of food in terms of variety and preferences. C. low intake of food and its physical consequences. We asked each question to recall one month. The participant was first asked about the existence of food; that is, whether the condition in the question happened at all in the past four weeks (yes or no). If the participant answers "yes" to an occurrence question, a frequency-of-occurrence question was asked to determine whether the condition happened once or twice (rarely), three to ten times (sometimes), or more than ten times (often) in the past one month.

Wealth index: The 2016 Ethiopian demographic Health Survey tool for wealth index was used. All study participants were asked about the ownership of fixed assets in their household with a score of 1 given to those who own the asset and a score of "0" given to those who did not own it. Then, principal component analysis was used to develop the wealth index and categorize it into 3 tertiles.

Anthropometric Measurements

Anthropometric measurements were done using standardized techniques. Before the real anthropometric data collection, a standardization exercise was performed during the training to capture the technical error of measurement (TEM) based on the coefficient of variation.

The weight of the newborns was measured within one hour upon delivery using a salter scale (Germany brand). The weight scale was calibrated at 0 with no object on it and placed on a level surface before measurement carry out. Every morning and when the instruments move apart, calibration and validation have checked the scales by 2kg metal iron sheet to keep their reliability. The height of the mother was measured using a height board in bare feet. The height of the mother was measured using a standard procedure (Frankfurt position, ankle, buttock, and shoulder touching the height board) in a standing position using a height measuring board Stadiometer to the nearest 0.1 cm. The mid-upper arm circumference (MUAC) of the mother was measured right after delivery using a flexible non-stretchable standard tape at the left-hand mid-point between the tip of the acromion process of the scapula and the olecranon process of the ulna. Measurement was taken while the left arm was hanging down at the side and relaxed to the nearest 0.1cm.

Dietary Assessment

Women mean dietary diversity (MDD-W) was collected using the 24-hour recall method based on the guideline of MDD-W.[19] Concisely, the pregnant women were asked to recall the foods they had consumed in the previous 24 h (sunrise to sunrise). First, by probing to ascertain that no meal or snack was left out. A list of all foods or ingredients in the dishes, snacks, or other foods consumed was generated to enable better classification of mixed dishes. Finally, the foods were categorized into 10 food groups, those who consumed above five were considered as adequate MDD-W, and those who consumed below five were considered as inadequate MDD-W.

Data Processing and Analysis

After the data collection, the data were checked for its completeness every day, edited, coded, entered into Epi data version 3.1, and finally exported to SPSS version 20 and checked for missing values before analysis. A pregnant woman was assigned in the inadequate minimum dietary diversity if the score is <5 and adequate if the score is ≥5. Principal Component Analysis was employed for wealth index and all assumptions like sample size, a ratio of variables to cases, the variables included were dichotomous, a measure of sampling adequacy (KMO and Anti-Image ≥0.5), Bartlett test of sphericity is statistically significant ($P < 0.05$), and no complex structure was seen and explained variation was also satisfied. Frequency distribution was done to check for outliers, inconsistencies and to identify missing values. Descriptive statistics such as frequencies, percentages, summary measures, tables, and graphs were used to describe the results of the respondents. Bivariate logistic regression analysis was fitted for each exposure variable with the dependent variable to identify candidates for multivariate logistic regression. Variables with a p-value <0.25 were entered into the multivariate logistic regression. Adjusted odds ratio (AOR) with 95% CI and p-value were used to measure the strength of association with low birth weight. Variables with a P-value <0.05 were declared significant. Moreover, the presence of multicollinearity was checked by employing the parameter of variance inflation factor (VIF) >10. Finally, model fitness was checked by using the Hosmer Lemeshow test with p-value = 0.518.

Ethical Consideration

Ethical clearance was obtained from the research and ethical committee of Jimma university institute of health ethics review board. A support letter was obtained from the Silte zone health department. Necessary permission was obtained from each woreda health office, Hospital, and health center authorities. Written informed consent was obtained from the study participants after explaining the purpose of the study following Declaration of Helsinki.

Result

Sociodemographic Characteristics

From a total of 255 sample size, 252 mothers (84 cases and 168 controls) were included in the interviews which made the response rate of 98.8% for both cases and controls. The Mean ± SD of birth weight was 2154.94 gm ± 233.43 for cases and 3022.92 gm ± 311.88 for controls. A higher proportion of newborns were females both in cases and controls that account for 57.1% and 54.8%, respectively. The Mean ± SD of maternal age among the cases was 28.4 ± 8.6 years and it was 27.72 ± 6.403 years among controls. The majority, 72.6%, of mothers among the controls and 67.9% among cases were in the age group of 21–35 years. Most of 79.8% of mothers of LBW babies had no formal education and 61.3% among the mothers of normal birth weight (NBW) babies are not formally educated. Moreover, 71.4% of mothers among cases and 69.6% among controls were living in a rural setting (Table 1).

Medical, Obstetric, and Infant Related Characteristics

Proportions of antenatal care follow-up among cases and controls were 61.9% and 92.3%, respectively. Whereas 43.1% among cases and 10.6% among control had ANC follow-up of <4 times. Moreover, maternal chronic hypertensive disease among cases was 2.4% while controls had 3%. Few mothers among cases and controls, reactive for HIV test. The majority of mothers both in cases and controls were multigravida (73.8% and 69%). Preterm delivery was observed among 13.1% of mothers in cases and 9.5% of controls (Table 2).

Nutritional and Anthropometric Related Factors

The mean ± SD of maternal height for cases and controls was 1.588 (0.09), 1.63 (0.07) meters, respectively. The proportion of mothers who did not take additional food in cases was 79.8% while, 38.7% among controls. Undernourished mothers were 26.2% and 10.7% among cases and controls, respectively. Mothers who had not received iron and folate supplementation during pregnancy were 36.9% and 9.5% among cases and controls, respectively (Table 3).

Table 1 Distribution of Socio-Economic and Demographic Characteristics Among Mothers of LBW Case and NBW Controls in Silte Zone Public Health Facilities, Southern Ethiopia, 2020

Variables	Categories	Cases N (%)	Controls N (%)	Total N (%)
Infant sex	Male	36 (42.9)	76 (45.2)	112 (55.6)
	Female	48 (57.1)	92 (54.8)	140 (44.4)
Maternal age	≤ 20	15 (17.9)	22 (13.1)	37 (14.7)
	21–35	57 (67.9)	122 (72.6)	179 (71)
	≥ 35	29 (14.3)	24 (14.3)	36 (14.3)
Residence	Rural	60 (71.4)	117 (69.6)	177 (70.2)
	Urban	24 (28.6)	51 (30.4)	75 (29.8)
Marital status	Married	81 (96.4)	159 (94.6)	240 (95.2)
	Divorced	1 (1.2)	4 (2.4)	5 (2)
	Widowed	2 (2.4)	5 (3)	7 (2.8)
Educational status	Not formal education	67 (79.8)	103 (61.3)	170 (67.5)
	Formal education	17 (20.2)	65 (38.7)	82 (32.5)
Occupation of the mothers	Government employed	5 (6)	12 (7.1)	17 (6.7)
	Private employed	4 (4.8)	11 (6.5)	15 (6)
	Merchant	10 (11.9)	34 (20.2)	44 (17.5)
	Housewife	65 (77.4)	111 (66.1)	176 (69.8)
HH family size	≥5	28 (33.3)	43 (25.6)	71 (28.2)
	<5	56 (66.7)	125 (74.4)	181 (71.8)
Wealth index	Lower	45 (53.6)	96 (57.1)	141 (56)
	Middle	31 (35.7)	51 (30.4)	81 (32.1)
	Upper	9 (10.7)	21 (12.5)	30 (11.9)

Table 2 Distribution of Infant, Medical, and Obstetrics Characteristics Among Mothers, of LBW Cases and NBW Controls in Silte Zone Public Health Facilities, Southern Ethiopia, 2020

Variables	Category	Cases N (%)	Controls N (%)	Total N (%)
Gravidity	Primigavida	22 (26.2)	52 (31)	74 (29.4)
	Multigravida	62 (73.8)	116 (69)	178 (70.6)
Parity	Primipara	24 (32.9)	46 (39.7)	70 (37)
	Multipara	49 (67.1)	70 (60.3)	119 (63)
History of abortion	Yes	17 (20.2)	40 (23.8)	57 (22.6)
	No	67 (79.8)	128 (76.2)	195 (77.4)
History of Pre term delivery	Yes	11 (13.1)	16 (9.5)	27 (10.7)
	No	73 (86.9)	152 (90.5)	225 (89.3)
Birth interval	≤2years	19 (30.6)	33 (28.4)	52 (29.2)
	>2years	43 (69.4)	83 (71.6)	126 (70.8)
Type of pregnancy	Planned	62 (73.8)	133 (79.2)	195 (77.4)
	Unplanned	22 (26.2)	35 (20.8)	57 (22.6)
Attend ANC	Yes	52 (61.9)	155 (92.3)	207 (82.1)
	No	32 (38.1)	13 (7.7)	45 (17.9)
Frequency ANC Visit	≥4 times	37 (56.9)	135 (89.4)	172 (79.6)
	<4 times	28 (43.1)	16 (10.6)	44 (20.4)
Chronic HTN	Yes	2 (2.4)	5 (3)	7 (2.8)
	No	82 (92.9)	163 (98.8)	245 (97.2)
HIV status	Reactive	2 (2.4)	6 (3.6)	8 (3.2)
	Non-reactive	82 (97.6)	162 (96.4)	244 (96.8)
Chew khat	No	58 (69)	135 (80.4)	193 (76.6)
	Always	21 (25)	26 (15.6)	37 (18.7)
	Sometimes	5 (6)	7 (4)	12 (4.7)
Drink alcohol	No	83 (98.8)	164 (97.6)	247 (98)
	Sometimes	1 (1.2)	4 (2.4)	5 (2)

Environmental Related Factors

Mothers who delivered low birth weight babies had no separate kitchen, it was around 40.5% and mothers who had no separate kitchen among controls were 44%. Most of the mothers were using firewood for cooking among both cases and controls (65.4% and 60.7%), respectively (Table 4).

Candidate Variables for Low Birth Weight

The candidate variables for LBW were the educational status of the mother, household family size ≥5, household food insecurity, no ANC visits, no additional food, MDD-W score <5, no Iron folate supplementation during pregnancy, height of the mother <1.5m, MUAC of the mothers <23cm, Not counseling about diet and hemoglobin <11g/dl become statically significant with low birth weight at p-value <0.25 in 95% CI.

The Final Determinants of LBW in Multivariate Logistic Regression

In this study, mothers who did not receive iron and folate supplementation during pregnancy (AOR = 4.17, 95% CI: (1.44, 12.3)), not taking additional meal (AOR = 3.09, 95% CI: (1.28, 7.5)), maternal hemoglobin level <11g/dl (AOR = 5.213, 95% CI (1.92, 14.13)), household food insecurity (AOR = 6.85, 95% CI: (3.01, 15.61)) and women's inadequate minimum dietary diversity score (AOR = 4.13, 95% CI: (1.4, 12.16)) were found to be independent determinants of low birth weight (Table 5).

Discussion

LBW is a global challenging public health problem. Its high priority stems from the fact that it is the major predictor of infant morbidity and mortality.

Table 3 Nutritional and Anthropometric Characteristics Among Mothers, of LBW Cases and NBW Controls in Silte Zone Public Health Facilities, Southern Ethiopia, 2020

Variables	Category	Cases N (%)	Controls N (%)	Total N (%)
Additional food	Yes	17 (20.2)	103 (61.3)	120 (47.6)
	No	67 (79.8)	65 (38.7)	132 (52.4)
Food avoidance	Yes	21 (25)	39 (23.2)	60 (23.8)
	No	63 (75)	129 (76.8)	192 (76.2)
Fasting	Yes	21 (25)	39 (23.2)	60 (23.8)
	No	63 (75)	129 (76.8)	192 (76.2)
MDD W	Inadequate	78 (92.9)	105 (62.5)	183 (72.6)
	Adequate	6 (7.1)	63 (37.5)	69 (27.4)
Eating out of home	Yes	12 (14.3)	22 (13.1)	34 (13.5)
	No	72 (85.7)	146 (86.9)	218 (86.5)
Food insecurity	Yes	68 (81)	61 (36.3)	129 (51.2)
	No	16 (19)	107 (63.7)	123 (48.2)
Counseling about diet	Yes	20 (23.8)	102 (60.7)	122 (48.4)
	No	64 (76.2)	66 (39.3)	130 (51.6)
Maternal hemoglobin	<11	28 (33.3)	11 (7.7)	39 (15.5)
	≥11	56 (66.7)	157 (92.3)	213 (84.4)
Maternal height	≤1.5m	23 (27.4)	8 (4.8)	31 (12.3)
	>1.5m	61 (72.6)	160 (95.2)	221 (87.7)
Maternal MUAC	<23cm	22 (26.2)	18 (10.7)	40 (15.9)
	≥23cm	62 (73.8)	150 (89.3)	212 (84.1)
Iron folate	Yes	53 (63.1)	157 (93.5)	210 (83.3)
	No	31 (36.9)	11 (6.5)	42 (16.7)

Table 4 Environmental-Related Characteristics Among Mothers, of LBW Cases and NBW Controls in Silte Zone Public Health Facilities, Southern Ethiopia, 2020

Variables	Category	Cases N (%)	Controls N (%)	Total N (%)
Hand washing	Yes	75 (89.3)	162 (96.4)	237 (94)
	No	9 (10.7)	6 (3.6)	15 (6)
Source of drinking water	Protected	77 (91.7)	151 (89.9)	228 (90.5)
	Unprotected	7 (8.3)	17 (10.1)	24 (9.5)
Time take to fetch water	Less than an hour	36 (42.9)	102 (60.7)	138 (54.8)
	One hour or more	43 (51.2)	55 (32.7)	98 (38.9)
	Water on-premises	5 (6)	11 (6.5)	16 (6.3)
Solid waste disposal	Collect by municipality	5 (6)	36 (21.4)	41 (16.2)
	Collected by private s	17 (20.2)	1 (0.6)	18 (7.1)
	Dumped in open field	60 (71.4)	49 (29.2)	109 (43.3)
	Burned	2 (2.4)	82 (48.8)	84 (33.3)
Availability of latrine	Yes	79 (94)	154 (91.7)	233 (92.5)
	No	5 (6)	14 (8.3)	19 (7.5)
Hand washing	Water with soap	32 (49.2)	110 (65.5)	142 (60.9)
	Water with ash	10 (15.4)	26 (15.5)	36 (15.5)
	Water only	23 (35.4)	32 (19)	55 (23.6)
Separate kitchen room	Yes	50 (59.5)	94 (56)	144 (57.1)
	No	34 (40.5)	74 (44)	108 (42.9)
Source energy for cooking	Electricity	12 (14.3)	39 (23.2)	51 (20.2)
	Kerosene	12 (14.3)	20 (11.9)	32 (12.7)
	Firewood	60 (71.4)	109 (64.9)	169 (67.1)

Table 5 Determinants of LBW in Multivariable Logistic Regression Analysis for Newborns Delivered in Silte Zone Public Health Facilities, Southern Ethiopia, 2020

Variables	Category	Cases N (%)	Controls N (%)	COR (95% CI)	AOR (95% CI)	P value
Additional food	Yes	17 (20.2)	103 (61.3)	1	1	
	No	67 (79.8)	65 (38.7)	6.245 (3.37, 11.56)	3.1 (1.28, 7.5)	0.012
Iron folate received	Yes	53 (63.1)	157 (93.5)	1	1	
	No	31 (36.9)	11 (6.5)	8.348 (3.92, 17.76)	4.17 (1.44, 12.13)	0.009
Hemoglobin	<11	28 (33.3)	11 (7.7)	7.14 (3.33, 15.28)	5.21 (1.92, 14.13)	0.001
	≥11	56 (66.7)	157 (92.3)	1	1	
MDD-W	Adequate	6 (7.1)	63 (37.5)	1	1	
	Inadequate	78 (92.9)	105 (62.5)	7.8 (3.21, 18.94)	4.13 (1.4, 12.16)	0.01
Food insecurity	Yes	68 (81)	61 (36.3)	7.45 (3.97, 13.981)	6.85 (3.01, 15.61)	<0.001
	No	16 (19)	107 (63.7)	1	1	

The present study revealed that the risk of low birth weight was higher among mothers who did not receive additional food during their current pregnancy as compared to mothers who did receive additional food during the current pregnancy. These findings were in line with the studies conducted in Jimma, Kembata, Dangla, Amhara regional state, Nepal showed that missing additional food during pregnancy was directly associated with low birth weight.[20–24] This is because nutrition and weight management before and during pregnancy have a profound effect on the development of infants. Moreover, pregnancy is a critical time for healthy fetal development as infants rely heavily on maternal stores and nutrients for optimal growth and health outcomes later in life.

Intake of iron and folate supplements during pregnancy had a significant association with LBW. Mothers who did not take iron and folate supplementation were more likely to deliver low birth weight babies than mothers who did take iron and folate supplementation during pregnancy. A randomized controlled trial in the USA shows that iron folate supplementation significantly lower the incidence of low-birth-weight infants which is 4% in the treatment group 17%; in the placebo group.[25] Moreover, this finding is in line with a study done in Adwa, Amhara regional state, Kembata, Nekemtie.[21,23,26,27] This may mean women can develop iron deficiency anemia from the loss of blood during menstruation and repeated pregnancies; it can also be caused by a lack of iron in the diet. During pregnancy, women may develop anemia because the growing fetus draws upon the mother's iron for the development of red blood cells and other tissues. Intake of iron supplements during pregnancy was also found to have a protective effect for term LBW.

Moreover, mothers who consumed inadequate MDD-W were more likely to develop LBW babies compared to mothers who consumed adequate MDD-W. Inadequate women's dietary diversity during pregnancy independently and significantly affected low birth weight in this study. This finding was in line with a study done in Wolaita Ethiopia, in which women in the inadequate MDD-W group had an increased risk of LBW and PTB compared with women in the adequate MDD-W group.[28]

Furthermore, in this study, the odds of LBW were 6.8 times higher among mothers from food-insecure households as compared to food-secure households with corresponding. This finding is in line with a case-control study finding in Iran and a finding in Kembata Tembaro.[23,29] This finding is further supported by a prospective cohort study in Pakistan which shows food insecurity in pregnancy is associated with low birth weight in neonates. Food insecure women had a higher increased risk of delivering a low birth weight neonate.[30] A possible explanation for the significant association between food insecurity and low birth weight may be food insecurity reduces the quality and quantity of food available to mothers, limits diversified food, reduces weight gain, and impair the nutritional status of the mother which subsequently reduces weight at birth. Food in secured mothers may often restrict their food and scarify their nutrition to protect their children from hunger, which in turn impairs the nutritional status of the mother and consequently reduces weight at birth. Another possible explanation may be women from food in secured households may be at risk of depression and stress which are potential determinants of the term LBW as documented in some studies.

Finally, this study showed that mothers' hemoglobin <11mg/dl was higher odds to deliver LBW neonates compared to mothers whose hemoglobin ≥11mg/dl. This finding is consistent with other studies done in Nepal, Malaysia, India,[20,31,32] and studies conducted in Ethiopia like Adwa, Debretabor, and Debremarkos[27,33,34] revealed that mothers who had normal hemoglobin status were 98% less likely to give birth to LBW babies than those who had abnormal hemoglobin status. This may be the low intake of food due to anemia which reduces the appetite. So, consistent low food intake may affect the weight of fetuses.

Strength and Limitation of the Study

The present study has strengths; taking newborn weight within one hour of delivery and considering different variables related to maternal nutrition. However, the study has some limitations like private health facilities were not included in this study. Moreover, there might be recall bias regarding dietary diversity, gestational age, number of ANC visits, number of iron tablets consumed even though we tried to remind participants to start with the nearest meal and their last date of menstruation by the calendar to minimize biases.

Conclusion

Not taking an additional diet during pregnancy, no iron folate supplementation, no dietary diversity, household food insecurity, and hemoglobin of <11 mg/dl were significantly associated with term low birth weight. Therefore, the key elements of iron intake, additional food, dietary diversity that are likely to improve low birth weight need to be addressed in this study setup. Thus, public health intervention in the field of maternal and child health should address these determinants. For instance, strengthening multisectoral efforts which improve women's dietary diversity and food security. Furthermore, health professionals in each health facility working at ANC clinic consistently advise the pregnant mothers towards the use and adherence of iron folate, additional meal, and dietary diversity.

Data Sharing Statement

The data set used for this study was primary data.

Ethical Approval

Ethical approval and clearance were obtained from Jimma University ethical review board with reference number IRB00058/2020.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the manuscript has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflicts of interest in relation to this work.

References

1. World Health Organization, UNICEF. WHO low birthweight estimates: levels and trends 2000–2015; 2019.
2. World Health Organization. Guidelines on optimal feeding of low birth- weight infants in low-and middle-income countries, World health organization, 2011; 2011.
3. Goldenberg RL, Culhane JF. Low birth weight in the United States. *Am J Clin Nutr*. 2007;85(2):584–590. doi:10.1093/ajcn/85.2.584S
4. Ramakrishnan U. Nutrition and low birth weight: from research to practice. *Am J Clin Nutr*. 2004;79(1):17–21. doi:10.1093/ajcn/79.1.17
5. Doherty T, Kinney M. Low birthweight: will new estimates accelerate progress? *Lancet Glob Heal*. 2019;7(7):e809–10. doi:10.1016/S2214-109X(19)30041-5
6. United Nations Children's Fund and World Health Organization. *Low Birthweight: Country, Regional and Global Estimates*. New York: UNICEF; 2004.
7. Central Statistical Agency. Ethiopia demographic and health survey. 2016: 161–162.
8. Central Statistical Agency. Ethiopia demographic and health survey; 2011: 135–137.
9. Central Statistical Agency. Ethiopia demographic and health survey; 2005: 127–129.
10. Bililign N. A review of low birth weight in Ethiopia: socio-demographic and obstetric risk factors abstract magnitude of low birth weight. *iMedPub J*. 2018;5:1–5.
11. Sicuri E, Bardají A, Sigauque B, et al. Costs associated with low birth weight in a rural area of Southern Mozambique. *PLoS One*. 2011;6(12):e28744. doi:10.1371/journal.pone.0028744
12. Jacob CM, Baird J, Barker M, Cooper C, Hanson M. The importance of a life course approach to health: chronic disease risk from preconception through adolescence and adulthood. World Health Organization White Paper; 2017: 1–41.
13. Tatiana C, Barreto G. Factors associated with low birth weight in indigenous populations: a systematic review of the world literature. *Rev Bras Saude Matern Infant*. 2019;19(1):7–23.
14. Tellapragada C, Eshwara VK, Bhat P, Acharya S, Kamath A. Risk factors for preterm birth and low birth weight among pregnant Indian women: a hospital-based prospective study. *J Prev Med Public Health*. 2016;49(3):165–175. doi:10.3961/jpmph.16.022
15. Manikkam L, Burns JK. Antenatal depression and its risk factors: an urban prevalence study in KwaZulu-Natal. *South African Med J*. 2012;102(12):940–944. doi:10.7196/SAMJ.6009
16. World Health Organization. WHA global nutrition targets 2025: low birth weight policy brief; 2012.
17. Ethiopia: Profile of preterm and low birth weight prevention and care; 2015. Available from: https://reliefweb.int/report/ethiopia/ethiopia-profile-preterm-and-low-birth-weight-prevention-and-care. Accessed June 30, 2022.
18. Siyoum M, Melese T. Factors associated with low birth weight among babies born at Hawassa University comprehensive specialized hospital, Hawassa, Ethiopia. *Ital J Pediatr*. 2019;45(1):1–7. doi:10.1186/s13052-019-0637-7
19. Food and Agriculture Organization of the United Nations. FAOSTAT; Food and agriculture data. Available at: https://www.fao.org/faostat/en/#home. Accessed June 30, 2022.
20. Sharma SR, Giri S, Timalsina U, Bhandari S. Low birth weight at term and its determinants in a tertiary hospital of Nepal: a case-control study. *PLoS One*. 2015;10(4):e0123962. doi:10.1371/journal.pone.0123962
21. Asmare G, Berhan N, Berhanu M. Determinants of low birth weight among neonates born in Amhara Regional state referral hospitals of Ethiopia: unmatched case control study. *BMC Res Notes*. 2018;1–7. doi:10.1186/s13104-017-3088-5
22. Tema T. Prevalence and determinants of low birth weight in Jimma zone, Southwest Ethiopia. *East Afr Med J*. 2006;83(7):366–371. doi:10.4314/eamj.v83i7.9448
23. Etiopija J, Alemu S, Workicho A. Determinants of low birth weight in public health facilities, of Kambata Tembaro Zone, South Ethiopia. *PONS-Medicinski Cas*. 2018;648(63):66–74.
24. Talie A, Taddele M, Alemayehu M. Magnitude of low birth weight and associated factors among newborns delivered in Dangla primary hospital, Amhara Regional State, Northwest Ethiopia, 2017. *J Pregnancy*. 2019;2019:1–6. doi:10.1155/2019/3587239
25. Parvanta I, Yip R. Iron supplementation during pregnancy, anemia, and birth weight. *Am J Clin Nutr*. 2003;78(4):773–781.
26. Girma S, Fikadu T, Agdew E, et al. Factors associated with low birthweight among newborns delivered at public health facilities of Nekemte town, West Ethiopia: a case control study. *BMC Pregnancy Childbirth*. 2019;19(1):1–6. doi:10.1186/s12884-019-2372-x
27. Gebregzabiherher Y, Haftu A, Weldemariam S, Gebrehiwet H. The prevalence and risk factors for low birth weight among term newborns in Adwa general hospital, Northern Ethiopia. *Obstet Gynecol Int*. 2017;2017:1–7. doi:10.1155/2017/2149156
28. Kastro S, Demissie T, Yohannes B. Low birth weight among term newborns in Wolaita Sodo town, South Ethiopia: a facility based cross-sectional study. *BMC Pregnancy Childbirth*. 2018;18(1):160. doi:10.1186/s12884-018-1789-y
29. Khorshidi M, Nooshirvanpour P, Najafi S. Incidence of low birth weight in Mazandaran Province, Northern Iran. *Oman Med J*. 2013;28(1):39–41. doi:10.5001/omj.2013.09
30. Saeed A, Naqvi M, Javed A. Effects of maternal food insecurity on birth weight of neonates: a prospective cohort. *Ann King Edw Med Univ*. 2018;23(4):524–530. doi:10.21649/akemu.v23i4.2233
31. Sutan R, Mohtar M, Mahat AN, Tamil AM. Determinant of low birth weight infants: a matched case control study. *Open J Prev Med*. 2014;2014(03):91–99. doi:10.4236/ojpm.2014.43013
32. Ganesh Kumar S, Harsha Kumar HN, Jayaram S. Determinants of low birth weight: a case control study in a district hospital in Karnataka. *Indian J Pediatr*. 2010;77(1):87–89. doi:10.1007/s12098-009-0269-9
33. Gebrehawerya T, Gebreslasie K, Admasu E, Gebremedhin M. Determinants of low birth weight among mothers who gave birth in Debremarkos Referral Hospital, Debremarkos Town, East Gojam, Amhara Region, Ethiopia. *Neonatal Pediatr Med*. 2018;4(1):1–6. doi:10.4172/2572-4983.1000145
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;45(1):86. doi:10.1186/s13052-019-0683-1