Available online at **www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2021, 10(7): 69-77

Maternal Factors Associated with Low Birth Weight among Term Newborns in South Ethiopia: A Case-Control Study

Leila Hussen[1*], BlenKasshun[2], Shemsu Kadir[1], Bahredin Abdala[1] and Mubarak Yesse[1]

[1]College of Health Science and Medicine, Werabe University, Werabe, South, Ethiopia

[2]College of Health Science and Medicine, Wolaita Sodo University, Sodo, South, Ethiopia

Corresponding e-mail: leilahussen66@gmail.com

ABSTRACT

Background: *Low birth weight is an important cause of prenatal mortality and both short and long-term infant and childhood morbidity.* ***Objective:*** *This study aimed to identify maternal factors associated with low birth weight among term newborns in Wolaita Zone hospitals in South Ethiopia.* ***Method:*** *The case-control study design was applied from March 1 to July 30, 2019. A total of 395 mothers (99 cases and 296 controls) were interviewed by trained data collectors using a structured and pretested questionnaire.* ***Results:*** *The mean ± standard deviation of birth weight was 3069 (± 614) grams. Multivariate logistic regression analysis showed an adjusted significant odds ratio for husbands farming occupation (AOR: 3.1; 95% CI; 1.5, 6.3). Having a bank account (AOR: 0.4; 95% CI; 0.2, 0.8) and an income <800 birr (<26 USD) (AOR: 6.5; 95% CI; 1.98, 22). The inter-pregnancy interval less than 24 months (AOR: 5; 95%; CI 2.1, 11.6), a maternal weight less than 50 kg (AOR: 7.09; 95% CI; 3.4, 11.9), and the availability of a separate kitchen room (AOR: 5.5; 95% CI; 3.1, 9.6) were significantly associated with low birth weight.* ***Conclusion:*** *Income, Paternal employment, a maternal weight of less than 50 kg, an inter-pregnancy interval of fewer than 24 months, and not having a separate kitchen room were factors associated with low-birth-weight babies. Efforts should be made to improve the living standard of mothers by designing means of income generation; counselling related to a pregnant mother's specific diet and nutritional education also needs to be emphasized.*

Keywords: Birth weight, Case-control, Pregnancy

Abbreviations: ANC: Antenatal Care, AOR: Adjusted Odds Ratio, CI: Confidence Interval, DHS: Demography and Health Survey, FMOH: Federal Ministry of Health, Kg: Kilogram, LBW: Low Birth Weight, NBW: Normal Birth Weight, OR: Odds Ratio, USD: United States Dollar, WHO: World Health Organization

INTRODUCTION

Low Birth Weight (LBW) is defined as weight at birth less than 2500 g measured in the first hour of life [1]. Globally, out of 139 million live births, about 20 million of them are low birth weight, and 95% of them are in developing countries. Estimates of low birth weight include 28% in South Asia, 9% in Latin America, sub-Saharan Africa accounts for 13% to 15% [2].

Ethiopian Demographic and Health Surveys estimated that 14%-11% of all babies in the country are born at low birth weight. However, only 5% of children were weighed at birth [3,4]. The prevalence of low birth weight has so far been reported as low as 11.2 to 28.3% across the country [5-8]. Weight at birth is a good indicator of maternal and fetal health and nutrition [9]. Low birth weight newborns have a higher risk of dying in the first month of life. Those who survive are more likely to experience inhibited growth, adulthood stunting that, in turn leading to the inter-generational effect of malnutrition, lower cognitive development, and chronic non-communicable diseases later in life. In addition to its direct consequences on physical and mental health, LBW has significant socioeconomic bearings, such as low workplace efficiency and increased costs on healthcare, with adverse impacts on national development [10-12].

In a developing country, low birth weight is primarily caused by poor fetal growth linked to poor maternal nutrition

before and after pregnancy. Mother's health, high prevalence of specific and non-specific infections, pregnancy complications, and physically demanding work during pregnancy also contributes to poor fetal growth [1,9,10,13,14].

LBW is the most important public health concern worldwide and is still one of the leading causes of prenatal and neonatal deaths in Ethiopia. The Ethiopian government targeted to decrease neonatal mortality to 10 per 1000 live births by 2035 [15]. Identifying the risk factors of LBW and addressing the best prevention strategies will help to prevent early childhood morbidity and mortality resulting from LBW. However, little information is available on the risk factors of low birth weight in Ethiopia, specifically in our study area. Therefore, this study aimed to assess the socio-economic, maternal, and environmental risk factors for low birth weight in hospitals in the Wolaita zone.

MATERIALS AND METHODS

Study Area, Design, and Period

Wolaita Zone is one of the fourteen zones of the Southern Nations, Nationalities, and People's Region (SNNPR) and is located 327 km from the Ethiopian capital Addis Ababa. Hospital-based case-control study design was conducted in three hospitals in Wolaita Zone from March 1 to July 30, 2019.

Study Population

All mothers who gave birth in the three hospitals were the source population. Mothers who gave live births weighing less than 2500 g were considered as cases and live births weighed 2500 g and above as controls. Birth outcomes such as congenital malformations, mothers who had diabetes mellitus, hypertension, and an unknown last normal menstrual period were excluded.

Sample Size Determination and Sampling Techniques

The sample size was determined using the proportion difference approach with the following assumptions: level of confidence 95% ($Z\alpha/2=1.96$), power 80% ($Z\beta=0.84$), and the ratio of control to case 3 to1 the odds ratio to be detected greater than 2 and 20% of the control group to be exposed [16]. With the anticipation of a 10% non-response rate, the final sample size was 403, which are 101 cases and 302 controls. It was proportionally allocated based on the number of previous childbirth attendance. The weight of all live births delivered in the selected hospitals of the Wolaita zone during the study period was measured. According to the case definition, those mothers who gave live births weighed less than 2500 g included in the study as cases. For each case, three consecutive controls were included.

Data Collection Procedure

Data were collected with structured and pretested questionnaires through face-to-face interviews. The tool was adapted from the Ethiopian Demographic Health survey and other peer-reviewed articles [3,4,16]. The questionnaire was composed of three parts. The first part pertained to the socio-demographic background. The second section assesses maternal conditions such as; food consumption pattern, meal frequency, birth interval, number of children, obstetric health problems, and maternal ANC follows up. The third part includes environmental conditions to households like energy sources, availability of separate kitchens. The questionnaire was initially prepared in English and then translated to Amharic and back-translated to English to observe its consistency. In addition, a pretest was done with 20 respondents who were later not included in the main study. Six data collectors were trained on: the different components of the questionnaire, participants' selection, maternal anthropometric (MUAC, height, and weight), and birth weight measurements, and ethics. Anthropometric measures were standardized for technical Errors against an expert measurer and always checked and zeroed before weighing each newborn. Weights of newborns were measured within an hour after birth with a digital weight scale. Maternal height was measured barefoot using a height measuring board in a standing position to the nearest centimeter. Maternal weight was measured using a digital weight measuring scale to the nearest gram. The Mid Upper Arm Circumference (MUAC) of the non-dominant hand was measured to the nearest millimeter with a non -stretch tape.

Data Processing and Analysis

Data were entered into Epi-Info (Version 6.0), cleaned, and exported to IBM SPSS for Windows (Version 20.0) for analysis. Descriptive statistics such as means and standard deviations, frequency, percentages, and cross-tabulations were computed for the case and control groups. Bi-variable binary logistic regression was applied to see the crude

effect of each independent variable (socio-economic, maternal/obstetric, and environmental factors) on the dependent variable (birth weight). Variables with p-values <0.25 were taken for multivariable logistic regression analysis. Finally, a multivariate logistic regression analysis was done to control for potential confounders and identify independent predictors of the outcome. Consequently, we reported AORs as effect measures with 95% CIs, and statistical significance was declared at p-value <0.05.

Ethics Approval and Consent to Participate

We obtained ethical clearance for the study from the ethical review committee at the College of Health Sciences and Medicine Wolaita Sodo University in Ethiopia. Permission letters were secured from the Wolaita Zone Health Bureau and each hospital. Data collectors explained the objective, benefit, and risks, voluntary nature of participation in the study, and confidentiality of the information collected. Finally, written consent was obtained from each mother before the interview.

RESULTS

Socio-Demographic Characteristics of Respondents

From a total of 403 sample sizes, 395 mothers (99 cases and 296 controls) were involved in the study, with a response rate of 98%. The mean age (± SD) of respondents was 26.5 (± 5.1) which ranged from 16-39 years. About three-fourths 78 (78.8%) of cases and 83.1% of controls were aged 20-34 years. The majority (83.8%) of cases and about half of the controls were rural residents. 65.7% of cases and about 27.4 % of controls had no formal education. Concerning monthly family income; a third of the cases and 11% 0f controls had an income less than 800 ETB (26$) (Table 1).

Table 1 Socio-demographic characteristics of mothers involved in low birth weight study in hospitals at Wolaita zone in South Ethiopia, July 2019 (n=395)

Variables	Categories	Low birth weight		Normal Birth weight	
		Frequency	Percent	Frequency	Percent
Mothers age (year)	<20	17	17.2	18	6.1
	20-34	78	78.6	246	83.1
	35 and above	4	4.2	32	10.8
Residence	Rural	83	83.8	150	50.7
	Urban	16	16.2	146	49.3
Educational status of the mother	No formal education	65	65.7	81	27.4
	Primary school	25	25.2	124	41.9
	Secondary school and above	9	9.1	91	30.7
Maternal occupation	Non -working	75	75.8	221	74.7
	Working	24	24.3	73	25.4
House holds monthly income	<800 ETB* ($26)	29	29.3	34	11.5
	800-1500 ($26-46.8)	30	30.3	79	26.7
	1501-3000($47-93)	37	37.4	88	29.7
	>3000($93)	3	3	95	32.1
Sex of new born	Male	21	21.2	79	26.7
	Female	78	78.8	217	73.3
Family size	≤ 5	27	27.3	205	69.3
	>5	72	72.7	91	30.7
ETB*: Ethiopian birr					

Obstetric Characteristics of Participants

The mean gestational age (± SD) and birth weight (± SD) were 37.8 (± 1.29) weeks and 3069 (± 614) grams respectively. About a third of cases (37.4%) and 79 (26.7%) of controls were primiparous. More than two-thirds, 43 (69.4%) of mothers in the cases and 26.9% of the controls gave birth to the current newborn within two years (≤ 24 months) after

previous childbirth. Sixty-six mothers (89.6%) in the cases weighed below 50 kg during their pregnancy and about two-thirds, 66 (66.7%) of cases stayed with pre-pregnancy weight (Table 2).

Table 2 Maternal/Obstetric characteristics of respondents involved in low birth weight study in hospitals of Wolaita zone, south Ethiopia July 2019 (n=395)

Variables	Categories	Low birth weight		Normal birth weight	
		frequency	percent	frequency	Percent
Number of pregnancy	1	37	37.4	79	26.7
	2-4	41	41.4	162	54.7
	5 and above	21	21.2	55	18.6
Birth interval (month) (n=278)	≤ 24	43	69.4	58	26.9
	>24	19	30.6	158	73.1
ANC* follow up	Yes	97	98	296	100
	No	2	2	0	0
Number of ANC Visit	1	14	14.1	1	0.3
	2-4	83	83.8	268	90.5
	>4	-	-	27	9.3
Gestational age at first visit (month)	≤ 3	2	2.1	33	11.1
	2-4	82	82.8	247	83.4
	>6	13	13.1	16	5.4
Diagnosed health problem	Yes	27	27.3	10	96.6
	No	72	72.2	286	3.4
Dietary counseling during Antenatal care visit	Yes	4	4	137	46.3
	No	95	96	159	53.7
Maternal weight (kg)	<50	66	89.6	11	3.7
	≥ 50	33	10.4	285	96.3
Maternal height (cm)	≤ 150	12	12.1	2	7
	>150	87	87.9	294	99.3
Weight gain at current pregnancy	Yes	33	33.3	280	94.6
	No	66	66.7	16	5.4
In the birth interval, 117 mothers were pregnant for the first time ANC*: Antenatal Care					

Dietary, Environmental, Lifestyle and Nutritional Status of Respondents

In this study majority, 95 (96%) of cases and about a third of controls 99 (315) had MUAC less than 23 cm (undernourished). In almost all cases, 98 (99%) consumed less than 3, or 3 meals per day; a majority, 87 (87.9) of mothers in the cases and two-third of the controls consumed more than three cups of coffee per day. The majority, 89 (89.9%) of cases and 2.4% of controls had no separate room for the kitchen. Based on this study, most of the respondents (94.9%, cases 76% controls) utilize firewood for cooking (Table 3).

Table 3 Dietary, Environmental, lifestyle and nutritional status of respondents in hospitals of Wolaita zone, south Ethiopia July 2019 (n=395)

Variables	Categories	Low birth weight		Normal birth weight	
		Frequency	Percent	Frequency	Percent

Number of meals(per day)	≤ 3	98	99	182	61.5
	>3	1	1	114	38.5
The habit of Dietary intake during pregnancy	Less than usual	63	63.6	2	0.7
	As usual	35	35.4	150	50.7
	More than usual	1	1	144	48.6
Having a separate room for kitchen	Yes	10	10.1	289	97.6
	No	89	89.9	7	2.4
Type of fuel mainly used for cooking	Wood	94	94.9	225	76
	Charcoal	4	4	20	6.8
	Electricity	1	1	51	17.2
Mid Upper Arm Circumference of the mother (cm)	<23	95	96	93	31.4
	≥ 23	4	4	203	68.6

Factors Associated with Low Birth Weight

The results the of multivariable logistic regression model showed that the husband's occupation was established to be significantly associated with low birth weight. Farmer fathers were three times more likely to have low birth weight (AOR: 3.1; 95% CI 1.5, 6.3). Mothers who have bank accounts were about 60% less likely to have low birth weight infants (AOR: 0.41; 95% CI: 0.2, 0.8). Additionally, mothers who earn less than 800 birrs per month had a higher chance of having low birth weight infants (AOR: 6.5; 95% CI: 1.98, 22).

Women who had inter-pregnancy intervals less than 24 months were five times more likely to deliver low birth weight infants compared to the interval of 24 months and above (AOR: 5; 95% CI: 2.1, 11.6). On the other hand, maternal weight during pregnancy was another variable that was significantly associated with low birth weight. Mothers who weighed less than 50 kg had about seven times at a higher risk of giving birth to low-birth-weight newborns (AOR: 7.09; 95% CI: 3.4, 11.9). The frequency of meals per day was significantly associated with low birth weight; Mothers who had three or fewer times day meals were about three times more likely to deliver LBW babies than those who had four and more meals per day (AOR: 2.7; 95% CI 1.2, 6.9).

The odds of giving low birth weight babies were higher among mothers with Mid-Upper Arm Circumference (MUAC) less than 23 cm as compared to mothers with MUAC 23 cm and above(AOR: 11.7; 95% CI: 5.5, 21.9).

From household environmental factors availability of separate kitchens, rooms were significantly associated with low birth weight (AOR: 5.5; 95% CI: 3.1, 9.6) (Table 4).

Table 4 Bivariate and multivariate logistic regression analysis of factors associated LBW among term newborn in Wolaita zone hospitals South Ethiopia, July 2019 (n=395)

Factors	Categories	Birth weight N (%)		COR (95%CI)	AOR (95%CI)
		Low N (%)	Normal N (%)		
Husband occupation	Farmer	75(75.8)	138(46.6)	5.3(2.1-13.1)	3.1(1.5-6.3)**
	Government	8(8.1)	73(24.7)	1	
	Merchant	4(4.0)	60(20.3)		
	Daily laborer	9(9.1)	12(4.1)	6.1(3.1-11.5)	2.4 (0.8-6.4)
	Others a	3(3.0)	13(4.4)		
Presence of bank account	No	67(67.7)	97(32.8)	1	
	Yes	32(32.3)	199(67.2)	0.23(0.14-0.37)	0.41(0.2-0.6)*

Monthly income	<800 ETB* ($26)	29(29.3)	34(11.5)	8.1(3.5-18.3)	6.5(1.9-22)*
	800-1500 ($26-46.8)	30(30.3)	79(26.7)	3.4(1.6-7.5)	2.2 (0.68-7.1)
	1501-3000($47-93)	37(37.4)	88(29.7)	3.3(1.5-7.2)	1.2(0.62-5.9)
	>3000($93)	3(3.0)	95(32.1)	1	
Birth interval	<2 years	43(69.4)	58(26.9)	6.1(3.3-11.4)	5.2 (2.1-11.6)***
	≥ 2 years	19(30.6)	158(73.1)	1	
Meal frequency	>3	1(1)	114(38.5)	1	
	≤ 3	98(99)	182(61.5)	5.5 (2.7-11.1)	2.7(1.2-6.1)**
Maternal weight	≤ 50	66(89.6)	11(3.7)	8.3(5.8-16.4)	7.2 (4.4-14.3)***
	>50	33(10.4)	285(96.3)	1	
MUAC	<23cm	95(96)	93(31.4)	14.1(7.7 25.8)	11.7(5.5-21.1)***
	>23cm	4 (4)	203(68.6)	1	
Having separate kitchen for cooking	Yes	10(10.1)	289(97.6)	1	1
	No	89(89.9)	7(2.4)	6.8(4.1-11.3)	5.5(3.1-9. 6)***

COR: Crude Odds Ratio, AOR: Adjusted Odds Ratio, ETB: Ethiopian birr, MUAC: Mid Upper Arm Circumference
*: Significant at p-value <0.05, **: Significant at p-value <0.01 and ***: Significant at p-value <0.001

DISCUSSION

Birth weight can be influenced by socioeconomic, maternal malnutrition, ill health, poor health care during pregnancy, and environmental factors. This study identified some socioeconomic, obstetric, and nutritional factors for low birth weight in the study area. This study documented that paternal employment had an association with birth weight; farmer fathers had higher odds of giving birth to low birth weight babies as compared to those who had other occupational engagements. In favor of our finding, a study from Nigeria revealed an increased risk of low birth weight among the paternal status of being a manual employee [17]. This could be due to socioeconomic factors (income, education). The Ethiopian Demographic and Health Survey (EDHS) reported that the husband's educational status was significantly associated with low birth weight [7]. This study exposed that mothers who were in the lower-income level were strongly associated with low birth weight. This finding is also supported by studies conducted in the bale zone southeast Ethiopia, showing that those mothers with a monthly income of less than 26$ were four times more likely to give LBW babies [16]. These findings were also supported by a similar study done in Lahore [18]. The possible clarification could be the deprived economic status of the mothers in the study area with increased costs of living might hold back to care for pregnant mothers about nutrition and healthcare.

In this study having a bank account/savings is also significantly associated with LBW; pregnant women who had a bank/savings account were about 60% less likely to have LBW. This might be associated with economic status.

The pregnancy interval was also found to have a significant association with low birth weight; mothers with a birth spacing of fewer than 2 years were more likely to deliver low birth weight babies than mothers who delivered with a birth interval of 2 or more years. This finding is in line with a study done in Tanzania, Qatar, and Turkey that showed a birth interval of <2years was at higher risk of delivering low birth weight babies [19-21]. These findings were also consistent with similar studies done in the south-east and western Ethiopia [6,22]. A possible explanation could be, it is believed that a short inter-pregnancy interval does not provide the mother with sufficient time to recover from the nutritional burden and stress of the previous pregnancy, and lactation depletes maternal nutrient stores leads to reduced fetal growth. Pregnancy weight gain is among the strongest predictors of delivery of a low birth weight infant, and also an important indicator of maternal nutrition in pregnancy. This study revealed that the risk of having LBW was sevenfold for women weighing less than 50 kg compared to mothers with greater than or equal to 50 kg bodyweight. This is in line with a study conducted in India and Pakistan [23,24]. Also consistent with similar studies done in southern and northern Ethiopia [5,25]. The maternal diet is an important predictor of LBW, and the World Health

Organization recommends that pregnant women have at least two snacks between meals [13]. Nevertheless, this study found that mothers who had three and fewer meals a day were about three times more likely to give LBW than those who had four and above. This might be due to the availability of food, which relies on socioeconomic status, or lack of awareness of the need for extra food during pregnancy.

Anthropometric measurements directly or indirectly measure nutritional status. Malnourished mothers and underweight gave rise to higher proportions of low birth weight babies [11,26]. In this study, the odds of giving low birth weight babies were about eleven times higher among mothers with Mid-Upper Arm Circumference (MUAC) less than 23 cm as compared to mothers with MUAC 23 cm and above. Similarly, a cohort study done in the Oromia region, Kersa district showed that maternal MUAC less than 23 cm is associated with 60% higher odds of LBW [27]. However, this finding is indifferent to a cross-sectional study done in Addis Ababa that showed maternal anthropometric characteristics such as MUAC, BMI, height, pregnancy, and term weight had no significant effect to determine the risk of low birth weight. This inconsistency could be due to the study design, and the lower prevalence of malnutrition in this study area (MUAC ≤ 20cm was 0.7%) [28].

From household environmental factors availability of separate kitchens, rooms were significantly associated with low birth weight. This might be due to the effect of income, which hinders access to nutrition and health care needs during pregnancy.

CONCLUSION

This study identified various socioeconomic, maternal/obstetric, nutritional, and environmental risk factors for low birth weight. From socioeconomic factors, the Husband's occupation, not having a bank account, and having a monthly income of fewer than 800 birrs (26$) were identified as risk factors for low birth weight.

Inter-pregnancy interval less than 24 months, weight less than 50 kg, Mothers who had three or fewer times a day meals, maternal MUAC of less than 23 cm, consuming three or more cups of coffee a day were identified as maternal/obstetric, and nutritional risk factors.

Not having a separate room for cooking was among the environmental conditions that increase the risk of low birth weight babies. Efforts should be done to improve the living standard of mothers by designing income generation means and occupational engagements. In addition, mothers should be a boost to use family planning methods to maximize birth intervals between consequent births.

Health professionals should screen and consulate pregnant mothers who are at risk of having infants with LBW and provide skilled nutritional counselling during ANC visits, including intake of a diversified diet.

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Ethics Approval and Consent to Participate

We obtained ethical clearance for the study from the ethical review committee at the College of Health Sciences and Medicine Wolaita Sodo University in Ethiopia. Permission letters were secured from the Wolaita Zone Health Bureau and each hospital.

Human and Animal Rights

This study was conducted following the Declaration of Helsinki that guides researchers to protect research subjects. The study was approved by an ethical review committee of Wolaita Sodo University.

Availability of Data

The data sets used during the current study are available on request to leilahussen66@gmail.com.

Author Contributions

All authors contributed to data collection, analysis, drafting, and revising the manuscript gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

Acknowledgements

We would like to acknowledge Wolaita Sodo University for giving us an opportunity to work on identified thematic areas and financial support. We want also to thank Wolaita Soddo University Teaching and Referral Hospital, Dubo and Bonbe primary hospital for their cooperation. Lastly, but not least, we would like to thank the study participants, data collectors, and supervisors.

REFERENCES

[1] Unicef. "United Nations Children's Fund and World Health Organization, Low Birthweight: Country, regional and global estimates." *New York: UNICEF*, 2004.

[2] World Health Organization, and UNICEF. "WHO low birthweight estimates: Levels and trends 2000-2015." *World Health Organization,* 2019.

[3] Central Statistical Agency, Addis Ababa, Ethiopia. "Ethiopia demographic and health survey 2016." https://www.usaid.gov/sites/default/files/documents/1860/Ethiopia%20DHS%202016%20KIR%20-%20Final%2010-17-2016.pdf

[4] Central Statistical Agency, Addis Ababa, Ethiopia. "Ethiopia demographic and health survey 2011." https://dhsprogram.com/pubs/pdf/SR191/SR191.pdf

[5] Gebremedhin, Meresa, et al. "Maternal associated factors of low birth weight: A hospital based cross-sectional mixed study in Tigray, Northern Ethiopia." *BMC Pregnancy and Childbirth,* Vol. 15, No. 1, 2015, pp. 1-8.

[6] Tema, T. "Prevalence and determinants of low birth weight in Jimma Zone, Southwest Ethiopia." *East African Medical Journal,* Vol. 83, No. 7, 2006, pp. 366-71.

[7] Alemu, Taddese, and Melaku Umeta. "Prevalence and predictors of" small size" babies in Ethiopia: In-depth analysis of the Ethiopian demographic and health survey, 2011." *Ethiopian Journal of Health Sciences,* Vol. 26, No. 3, 2016, pp. 243-50.

[8] Gebremedhin, Meresa, et al. "Maternal associated factors of low birth weight: a hospital based cross-sectional mixed study in Tigray, Northern Ethiopia." *BMC Pregnancy and Childbirth,* Vol. 15, No. 1, 2015, pp. 1-8.

[9] World Health Organization. "Global Nutrition Targets 2025: Low birth weight policy brief." No. WHO/NMH/NHD/14.5, *World Health Organization*, 2014.

[10] World Health Organization. "Guidelines on optimal feeding of low birth-weight infants in low-and middle-income countries." *World Health Organization*, 2011.

[11] He, Zhifei, et al. "Prevalence of low birth weight and its association with maternal body weight status in selected countries in Africa: A cross-sectional study." *BMJ Open,* Vol. 8, No. 8, 2018, p. e020410.

[12] Sutan, Rosnah, et al. "Determinant of low birth weight infants: A matched case control study." *Open Journal of Preventive Medicine,* Vol. 2014, 2014.

[13] World, health, organization. "Bulletin of the world health organization." 2009. https://www.who.int/publications/journals/bulletin

[14] Kramer, Michael S. "Determinants of low birth weight: Methodological assessment and meta-analysis." *Bulletin of the World Health Organization,* Vol. 65, No. 5, 1987, pp. 663-737.

[15] The federal democratic republic of Ethiopia Ministry of Health, Health Sector Transformation Plan, Oct. 2015.

[16] Demelash, Habtamu, et al. "Risk factors for low birth weight in Bale zone hospitals, South-East Ethiopia: A case-control study." *BMC Pregnancy and Childbirth,* Vol. 15, No. 1, 2015, pp. 1-10.

[17] Dahlui, Maznah, et al. "Risk factors for low birth weight in Nigeria: Evidence from the 2013 Nigeria Demographic

and Health Survey." *Global Health Action,* Vol. 9, No. 1, 2016, p. 28822.

[18] Anjum, F., et al. "Maternal risk factors associated with low birth weight: A case control study in Lahore." *Annals,* Vol. 17, No. 3, 2005, pp. 1-6.

[19] Mahande, Michael J., and Joseph Obure. "Effect of interpregnancy interval on adverse pregnancy outcomes in northern Tanzania: A registry-based retrospective cohort study." *BMC Pregnancy and Childbirth,* Vol. 16, No. 1, 2016, pp. 1-9.

[20] Saral, Nevsen, and Seval Cambaz Ulas. "The effect of short pregnancy interval on perinatal outcomes in Turkey: A retrospective study." *Pakistan Journal of Medical Sciences,* Vol. 35, No. 5, 2019, pp. 1243-47.

[21] Bener, Abdulbari, et al. "The impact of the interpregnancy interval on birth weight and other pregnancy outcomes." *Brazilian Journal of Maternal and Child Health,* Vol. 12, No. 3, 2012, pp. 233-41.

[22] Adane, Akilew Awoke, et al. "Adverse birth outcomes among deliveries at Gondar University hospital, Northwest Ethiopia." *BMC Pregnancy and Childbirth,* Vol. 14, No. 1, 2014, pp. 1-8.

[23] Aurora S VB, Habibullah S . "Maternal nutrition and birth weight." Indian Journal of Maternal and Child Health, Vol. 5, 994, pp. 73-75.

[24] Abubakari, Abdulai, and Albrecht Jahn. "Maternal dietary patterns and practices and birth weight in northern Ghana." *PloS One,* Vol. 11, No. 9, 2016, p. e0162285.

[25] Wachamo, Tesfahun Mulatu, Nigus Bililign Yimer, and Asmamaw Demis Bizuneh. "Risk factors for low birth weight in hospitals of North Wello zone, Ethiopia: A case-control study." *PloS One,* Vol. 14, No. 3, 2019, p. e0213054.

[26] Zerfu, Taddese A., Melaku Umeta, and Kaleab Baye. "Dietary diversity during pregnancy is associated with reduced risk of maternal anemia, preterm delivery, and low birth weight in a prospective cohort study in rural Ethiopia." *The American Journal of Clinical Nutrition,* Vol. 103, No. 6, 2016, pp. 1482-88.

[27] Assefa, Nega, Yemane Berhane, and Alemayehu Worku. "Wealth status, Mid Upper Arm Circumference (MUAC) and Antenatal Care (ANC) are determinants for low birth weight in Kersa, Ethiopia." *PloS One,* Vol. 7, No. 6, 2012, p. e39957.

[28] Shiferaw, Chalachew Bekele, Walelegn Worku Yallew, and Gizachew Tadele Tiruneh. "Maternal anthropometric measurements do not have effect on birth weight of term, single, and live births in addis Ababa City, Ethiopia." *Journal of Pregnancy,* Vol. 2018, 2018.