



**COLLEGE OF DEVELOPMENT STUDIES**

**CENTER FOR POPULATION STUDIES**

**FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT AMONG RECENT  
DELIVERY IN PUBLIC HOSPITALS, ADDIS ABABA, ETHIOPIA**

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Addis Ababa, Ethiopia




ADDIS ABABA UNIVERSITY  
COLLEGE OF DEVELOPMENT STUDIES  
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I would like to declare that the study conducted on factors associated with Low Birth Weight (LBW) among recent deliveries in public hospitals in Addis Ababa is the original work of the investigator. The study also complies with the regulations of Addis Ababa University and meets the accepted standards concerning originality and quality.

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## ABSTRACT

**Introduction:** Birth weight is one of the most predictive factors of child death in the first few months of life and is an important indicator of Newborns' health. The incidence of low birth weight is estimated to be 16% worldwide, 19% in developing countries, and 7% in the developed countries. Currently, thirteen percent of Ethiopian babies are low birth weight and different studies reported that, the prevalence of low birth weight accounts about 8.8% and 10.5% in Addis Ababa and Tigray region, respectively. This study has primarily aimed to assess the factors associated with newborn birth weight in selected Addis Ababa Public Hospitals.

**Methods and Materials:** Data collection for the present study was conducted in Addis Ababa from March 2021 to April 2021. A facility-based Cross-sectional study was employed among 466 mothers who gave birth in public hospitals during the study period. Primary data was collected using a structured questionnaire which is adopted from previous studies. The sample size was calculated by Epi Info calc using an assumption of 95% CI, 80% power, 20.6 percent exposed, 10.4 percent unexposed and 2.2 adjusted odds ratio. To recruit the study participants, systematic random sampling was used. Univariate, bivariate, & multiple logistic regression analyses were done. Adjusted odds ratios were used to identify the association between the key predictors and the dependent variable. All statistical tests used in this study were two-sided and a significant association was declared at a  $p$ -value  $< 0.05$ .

**Result:** Of the total respondents, 12.4% of them gave birth to low birth weight infants. The median age of the participant was registered to be 28yrs (IQR=7) and 92.3% of them were married. The results of multivariable logistic regression showed the number of ante natal care visit (AOR=0.4, 95% CI 0.17-0.99), presence of abnormal uterine bleeding (AOR=10.9, 95% CI 2.5-15.8), Experiencing of Pre-eclampsia or Eclampsia (AOR 9.5, 95% CI 4.8-10.8), having Anemia (AOR=3.3, 95% CI 3.1-3.6), Chewing khat during recent pregnancy (AOR=7.9, 95% CI 3.9-16.1), and pre-pregnancy maternal nutritional status (AOR=0.2, 95% CI 0.1-0.5) were found to be key determinants of low birth weight among the study population.

**Conclusion:** - Encouraging the pregnant mother to have frequent ante natal care visits, behavioral change communications targeting pregnant mother in improving women's nutritional status, and reducing maternal toxic exposures should be priority areas of interventions to curb the problem.

**Key Words:** - LBW, Associated factors, Recent delivery

## **ACRONYMS AND ABBREVIATION**

ANC	Ante-Natal Care
AOR	Adjusted Odds Ratio
APGAR	Appearance, Pulse, Grimace, Activity, Respiratory
AUB	Abnormal Uterine Bleeding
BMI	Body Mass Index
BW	Body Weight
CI	Confidence Interval
COVID-19	Corona Virus Disease
CSA	Central Statistical Agency
DHIS2	District Health Information Software 2
DM	Diabetic Mellitus
EDHS	Ethiopia Demographic Health Survey
FMoH	Federal Ministry of Health
GA	Gestational Age
HIV	Human Immunodeficiency Virus
HTN	Hypertension
ICF	International Coaching Federation
IQR	Inter Quartile Range
LBW	Low Birth Weight
MUAC	Middle Upper Arm Circumferences
NBW	New born Birth Weight
NRR	Non Response Rate
OR	Odds Ratio
PI	Principal Investigator
PROM	Premature Rupture Of Membrane
SPSS	Statistical Package for social the social sciences
US	United State
USAID	United States Agency for International Development
USD	United State Dolor
WHA	World Health Assembly
WHO	World Health Organization

## **1. INTRODUCTION**

### **1.1. Background**

Birth weight is the newborn weight obtained immediately after birth. It is a good summary measure of multifaceted public health problems that include long-term maternal malnutrition, ill health, and poor health care during pregnancy (CSA and ICF, 2017). Low Birth Weight (LBW) is defined by the World Health Organization (WHO) as weight at birth less than 2500 g (5.5 lb) (WHO, 1992). Newborns with low birth weight are at higher risk of stillbirth, low Appearance, Pulse, Grimace, Activity, and Respiratory (APGAR) score, admission to neonatal intensive care unit, and early neonatal death (Carla et al., 2016). Additionally, low birth weight is associated with a risk of hypertension later in life (Lule et al., 2018)

The incidence of LBW is estimated to be 16% worldwide, 19% in developing countries, and 7% in the developed countries (Ravi et al., 2015). Across the world, neonatal mortality is 20 times more likely for LBW babies compared to Normal Birth Weight (NBW) babies (>2.5 kg) (Ravi et al., 2015). A systematic review of low birth weight in Africa showed that there is an increased risk of death, growth retardation, and delayed neurodevelopment among very low birth weight and extremely low birth weight children (Tchamo and Leandro, 2016). The prevalence of low birth weight in Senegal, Burkina Faso, Malawi, Ghana, and Uganda was 15.7%, 13.4%, 12.1%, 10.2%, and 10% respectively (Zhifei et al., 2018).

In 2014, there were 27,243 deaths due to low birth weight accounting for 4.53% of the total early deaths in Ethiopia (Carla et al., 2016). Currently, thirteen percent of Ethiopian babies are low birth weight (CSA & ICF, 2016). As reported by the 2016 Ethiopian Demographic Health Survey (EDHS), infant mortality for children who were reported to be small or very small at birth is 56 deaths per 1,000 live births compared with 43 deaths per 1,000 live births for children who were reported to be average or larger at birth (CSA and ICF, 2016). According to a recent WHO report (2017), deaths due to low birth weight in Ethiopia reached 23,091 or 3.63% of total deaths. The age-adjusted death rate was reported to be 14.01 per 100,000 population which ranks Ethiopia 48<sup>th</sup> in the world (WHO, 2018).

There are substantial regional disparities in the prevalence of LBW. For instance, a study conducted in the Tigray region reported a rate of 10.5% for the region (Hayelom et al., 2017).

The prevalence of LBW was reported as 8.8% in Addis Ababa (Hirut et al., 2017). The Addis Ababa health bureau report, generated from District Health Information Software 2 (DHIS2) reporting tool, indicated that there was about 6.9% of live births measured under 2500gm and LBW is the 4<sup>th</sup> cause of under one-year children death in Addis Ababa (FMoH DHIS2, 2019/2020). Therefore, to reduce the prevalence of LBW which is a highly contributing factor to future newborn health, evidence-based intervention is important for stakeholders and this study aims to address the major determinants of LBW in public hospitals in Addis Ababa.

## **1.2. Statement of the problem**

Birth weight is one of the most important predictors of mortality in the first few months of life and is an important indicator of newborns' health (Amosu and Dagon, 2014). Low birth weight (newborns weighing less than 2,500 grams at birth), because of prematurity and/or restricted growth in utero, is a major contributor of newborn and child deaths, as well as disability and non-communicable diseases globally (USAID, 2019). Neonatal morbidity and mortality, particularly relating to the LBW babies are still unacceptably high in the Sub-Saharan countries including Ethiopia which is associated with increased odds of perinatal mortality in some regions (Gezehagn and Yifru, 2015).

According to the most recent EDHS report, LBW increased from 11% in 2011 to 13% in 2016 (CSA & ICF, 2016) which needs prompt and intensified intervention to decrease the infant death related to low birth weight. Birth weight is not the only determinant of child survival, growth, and development, but also an important indicator of maternal health, nutritional status, and quality of life (Roy et al., 2009) which may be addressed by such type of study thereby indicating the relationship among them (maternal health, nutritional status, Quality of life and Birth weight).

In general, many factors may be accountable for newborn birth weight. As a result of globalization and city development, the lifestyle of the population, living environment, nutritional status of the community, and health-seeking behavior of the community is being changed. In addition, from time to time there is an expansion of technologies which may have both positive & negative impacts on the human life; especially those are living constantly in the town. Differently from other community groups, this situation impose a double burden on

women in the reproductive age group during the pregnancy period because of the impact has on both mothers and the natural growth of the newborn infants.

As reported by previous studies the normal intrauterine growth of the fetus could be affected by different factors. Of the different factors supposed to be associated with newborn weight, most of them are easily manageable through continuous follow-up and counseling during Antenatal care/ ANC. Hence, identifying the existence of this problem and its key predictors is very important to provide appropriate early intervention and attention to those mothers at risk, which in turn helps us to reduce the prevalence of LBW and the national Infant mortality rate. In the past few years, different researchers had conducted different studies on associated factors of LBW in different parts of the country as well in parts of Addis Ababa. However, most previous studies were limited in both scopes of the predictors they included and mostly depended on all births (both recent and remote birth reporting) using secondary data. In this study, the researcher used primary data to assess factors associated with low birth weight among recent deliveries in Addis Ababa.

## **2. OBJECTIVES**

### **2.1. General Objectives**

The major objective of the study is to assess factors associated with low birth weight among recent deliveries in public hospitals, Addis Ababa, Ethiopia, 2021

### **2.2. Specific Objectives**

The specific objectives of this study were to:-

- a) Assess the relationship between maternal health status and neonatal birth weight among mothers with recent birth in study area.
- b) Identify the association between maternal nutrition and newborn birth weight among mothers with recent birth in study area
- c) Examine the effects of key maternal socio-demographic characteristics on LBW in study area
- d) Assess the effects of maternal obstetric factors on LBW in study area.
- e) Assess the association of pregnancy period maternal toxic exposure and LBW in study area.

### **2.3. Significance of the study**

Despite significant improvements in health service coverage, accessibility, and utilization, LBW is persisting cause of death of under one year children in Addis Ababa (FMoH DHIS2, 2019/2020). Hence, this study provides a possible recommendation for intervention that will help decision-makers, interested stakeholders, Partners, and communities to take appropriate measures and prevent or minimize the prevalence of LBW in Addis Ababa which plays a great role in minimizing the Infant Mortality Rate. Moreover, the result of this study may also help the interested researcher to use it as a reference to conduct different qualitative or quantitative studies on this area.

## 2.4. The scope of the study

This study is intended to assess the factors associated with LBW in public hospitals of Addis Ababa city administration among women with recent deliveries. Socio-demographic factors, maternal morbidity, nutritional factors, maternal toxic exposure history, and obstetric factors were assessed and compared to birth weight. The analysis of this study was based on the data created from mothers with the most recent birth and those who gave births in the Public Hospitals of Addis Ababa.

## 2.5. Operational definition

**Birth Weight:** - The measurement of the newborn immediately after delivery in gram

**Low birth weight:** - The immediate weight of newborn <2500gm after delivery

**Maternal Nutrition:** - Is the nutritional status of the mothers during pregnancy which is measured by types of food consumed, frequency of food intake, weight gain during pregnancy, BMI measurement before pregnancy, and MUAC measurement after delivery.

**Maternal Morbidity:** -any illness the mother faced and is confirmed by clinicians/physicians during pregnancy period; maybe chronic illness or acute infection

**Chronic illness:** This stands for any chronic illness mothers experienced such as HTN, HIV, chronic kidney disease, Diabetic Mellitus (DM), heart disease, etc.

**Acute infection:** Stands for illness during pregnancy such as respiratory tract infection, urinary tract infection, malaria, COVID-19, etc....

**Maternal toxic exposure:** - any toxic agents that the mother was exposed to due to behavioral need or environmental exposure or medical measurements.

**Recent delivery:** - Mothers who give births in selected hospital and did not discharged yet during data collection time.

**Undernourished/ underweight:**-Mothers with BMI measurement of less than  $18.5\text{kg/m}^2$  or MUAC measurement of <23cm

**Normal weight:** - Mothers with BMI measurement of  $18.5\text{kg/m}^2$ - $24.9\text{kg/m}^2$  or MUAC measurement of 23-24.9cm

**Overweight:** - Mothers with BMI measurement of greater than  $24.9\text{kg/m}^2$  or MUAC measurement of  $\geq 25\text{cm}$

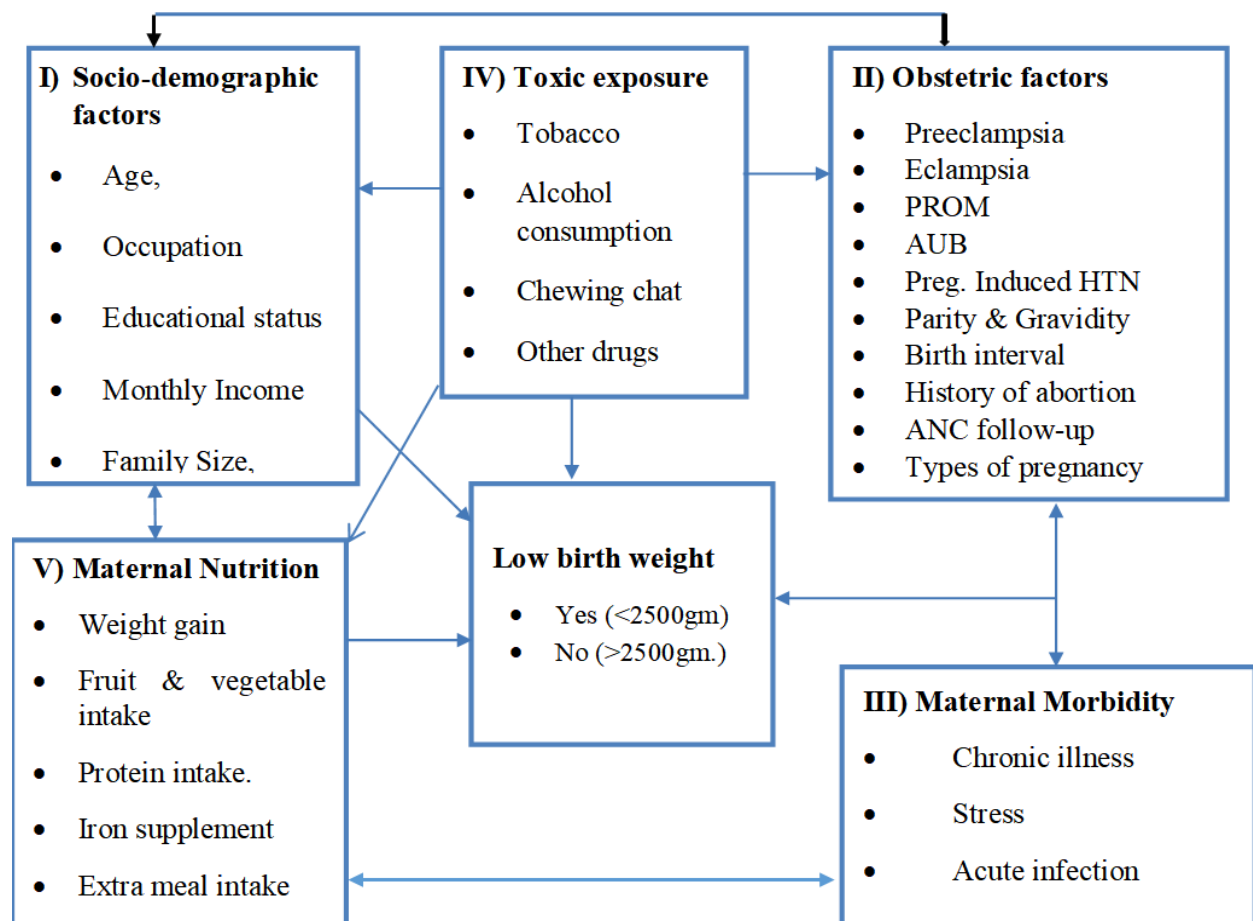
**Primigravida:** - is a woman who is pregnant for the first time or has been pregnant one time.

**Multigravida:** - is a multigravida is a woman who has been pregnant more than one time.

**Other pregnancy-induced danger signs:** - Mothers with a history of one of the following are labeled as other pregnancy-induced danger signs. Headache, blurred vision with no evidence of anemia, edematous, morning sickness, hyperemesis, decreases fetal movement, etc.....

### 3. LITERATURE REVIEW

Newborn birth weight is by different factors during pregnancy. Most of them are easily preventable and few are unpreventable due to the nature of the factors. Among commonly addressed factors, socio-demographic factors (which include parental educational status, maternal age during pregnancy, parental monthly income, maternal occupations, etc) are majorly affect birth weight indirectly as they should pass through one or more of the proximate variables. In addition to this, maternal exposure to a toxic environment is the other factor that has a significant effect on birth outcomes. On the other hand, obstetric factors, maternal health during pregnancy, and maternal nutritional status are factors that are directly affecting birth weight.



**Figure 1** Conceptual Framework for Low birth weight and associated factors

### **3.1. Maternal Socio-demographic characteristics and LBW**

Maternal Socio-demographic status is one of the factors that have either direct or indirect contribution to newborn birth weight. A different study reported that newborn weight may be significantly influenced by maternal age (especially younger than 16 years of age or older than 40 years) (Samantha et al., 2017). A Case-Control study conducted in Nepal in 2011 shows that hard physical work during pregnancy and the younger age of the mother was significantly associated with LBW. A mother who is exerting hard physical work during pregnancy was 1.5 times more likely to give birth to a low birth weight baby. In addition, the odds of having a low birth weight baby were found to be two times more among younger mothers in Nepal (Sudesh et al., 2011). On the other hand, a study conducted in Bale zone hospitals, South-East Ethiopia,(2013) also reported similar finding where the odds of low birth weight was found to be three times higher among mothers who gave birth at an early age, i.e. <20yrs when compared to mother of age 21-35yrs (Habtamu et al., 2015). On the other hand, a child born of mothers with a height of <150cm is more likely to have low birth weight as is reported by a similar study (Habtamu et al., 2015).

Maternal educational status is another socio-demographic factor that affects birth weight. A study conducted in Woliata Soda shows that mothers who have an education level of primary and less were 5.8 more likely to have low birth weight newborns than those having secondary and higher educational level (Samson et al., 2018). In addition to these, a study done in Bale Zone hospitals reported low family monthly income ( $\leq 26$ USD/month) was significantly associated with a newborn birth weight where infants born to mothers with Low monthly income is 3.8 more likely to have low birth weight compared to a baby born to mother with a monthly income of  $>79$ USD (Habtamu et al., 2015).

### **3.2. Obstetric Factors and LBW**

Maternal Obstetric history and Pregnancy complications are the other factors mostly affecting the pregnancy birth weight. The study conducts in West Iran reveals that children born from mothers who have a history of bleeding during pregnancy are more likely to have low birth weight (Ghobad et al., 2017). A different study conducted in Ethiopia on Factors affecting Newborn birth weight in different hospitals revealed that birth weight is significantly affected by pregnancy-related complications, mode of delivery, birth interval, and ANC visit during

pregnancy. Among these, a Case-control study conducted in Amhara regional state referral hospital shows that mothers who had any pregnancy-related problems during their current pregnancy were more likely to have a low birth weight baby as compared to mothers who didn't have any health problems (Getnet et al., 2018). In addition, the study conducted in the Amhara region Debrebirhan Hospital reported the odds of having a Low Birth weight baby was found to be 2.7 higher among Mothers those experiences any pregnancy complication when compared to mothers with no pregnancy complication (Lema and Deresse, 2018). A similar study conducted in Dessie town, Amhara region also reported that those Mothers who have a complication during delivery have a high risk of having LBW newborns (Getnet et al., 2018).

On the other hand, the study showed that the odds of being low birth weight were also 2.3 times higher among mothers who didn't attend ANC as compared to mothers who attended ANC follow-up in the current pregnancy (Getnet et al., 2018). Another study conducted in Bale zone hospitals, South-East Ethiopia, reports similar effects of pregnancy ANC to follow up upon birth weight (Habtamu et al., 2015). In this study, the Birth interval was also found to be other significantly associated risk factors with birth weight as it is reported that birth interval of fewer than two years was negatively affected newborn birth weight (Habtamu et al., 2015). In addition to the aforementioned obstetric factors, the gravidity of mothers has been reported as associated factors in the study conducted in the North Wollo zone which indicates that the odds of LBW was 64% less among multi-gravida mothers when compared to primigravida (Tsefahun et al., 2019). Pregnancy type is also the other obstetric factor that is found to be significantly associated with Birth weight. The study conducted in Adwa general hospital, North Ethiopia reported that, wanted pregnancy is less likely tend to result in low birth weight than unwanted pregnancy (Yisak et al., 2017)

### **3.3. Maternal Morbidity and LBW**

Maternal health during pregnancy is a key prerequisite to have a healthy baby and could be troubled by either chronic illness or acute infection which has direct negative effects on birth weight. The study conducted in India shows the fetal weight is a parameter that is directly related to the health of the mother, it is a parameter to survive and experience healthy growth and development (Jyotishi et al., 2014). Another study conducted in Nepal shows Mother's

hemoglobin level less than 11gm/dl is significantly associated with low birth weight (Sudesh et al., 2011).

Maternal morbidity such as chronic maternal conditions (e.g. hypertensive disorders of pregnancy and Diabetic Mellitus), infections (eg, malaria, urinary tract infections, Genital tract infections), and other infectious and noninfectious illness during pregnancy period is the other factors affecting the newborn birth weight either directly from the disease or indirectly secondary to a drug taken during illness (Accrombessi et al., 2018). A case-control study conducted in Iran in 2016 shows the babies born for mother with gestational hypertension, and Iron deficiency anemia is found to be 6.1 times and 23.8 times more likely to have low birth weight than the counterpart respectively (Ghobad et al., 2017). Similarly, the study conducted in the Tigray region showed that mothers who have chronic illness during pregnancy are more likely to give birth to low birth weight baby than those do not have a chronic illness (Meresa et al., 2015). The presence of Anemia during pregnancy has also negative effects on newborn weight as the study conducted in Axum town, Tigray region. Babies born to Mothers who have Anemia during pregnancy are 14.5 times more likely to have low birth weight than those who do not have anemia (Wondim et al., 2018). In addition, the study conducted in Dessie town reported the same significant association between Anemia during pregnancy and birth weight (Semira et al., 2018).

#### **3.4. Maternal Toxic exposure during pregnancy**

Maternal toxic exposure may be due to environmental exposure to toxic agents such as polluted air (related to work area/factories), Behavioural exposure to Alcohol, cigarettes, and Khat...etc. All of these toxic factors have either direct or indirect contributions to birth weight especially if the exposure is during Pregnancy. A Systematic Review and Meta-analysis study conducted in America shows Active maternal smoking was significantly associated with low birth weight, contributing two times more to have low birth weight compared to those who do not smoke (Pereira et al., 2017). On the other hand, the study conducted in Bale, Oromia region shows the odds of being low birth weight is found to be higher among mothers who chew Khats during pregnancy (Habtamu et al., 2015). In addition in this study not having a separate kitchen was reported as a significant contributing factor to low birth weight (Zhifei et al., 2018). Another study conducted in Axum town, Tigray region shows the odds of being Low birth weight is higher among baby born to Mothers who have habits of drinking alcohol during pregnancy (Wondim et al., 2018).

### 3.5. Maternal Nutrition and LBW

Maternal Nutritional status at the pregnancy period is the other determinant of birth weight. Maintaining good nutrition and a healthy diet during pregnancy is very important for the health of the mother and new born child. That is why in 2012, the World Health Assembly (WHA) endorsed a Comprehensive Implementation Plan on Maternal, Infant and Young Child Nutrition, which specified six global nutrition targets, including a 30% reduction in the number of LBW live births between 2012 and 2025 (WHO, 2014). The study conducted in North Shoa zone Oromia region indicates that the odds of having low birth weight was 4.4 times more likely among mother who have insecure food status than those who have secured food status during pregnancy (Berhanu and Samson, 2018). Again, this study also reported that the Odds of being Low birth weight to a newborn is 3.3 times higher among mothers who got dietary counseling during pregnancy period when compared to the counterpart (Berhanu and Samson, 2018). In addition, the study conducted in Dessie town Northern Ethiopia showed the same association between Nutritional counseling during pregnancy and Birth weight (Semira et al., 2018).

Iron foliate supplement is advisable to all pregnant mothers during pregnancy to prevent the possible occurrence of iron deficiency anemia. The study shows the odds of low birth weight were found to be higher among mothers who did not take iron foliate supplements as compared to mothers who took iron supplement during the current pregnancy. Maternal anthropometry during pregnancy is also the other contributing factor to newborn birth weight. Accordingly, it is reported that mothers who had MUAC below 23 cm were found to be at higher risk for newborn low birth weight (Getnet et al., 2018). Another similar study conducted in Bale zone hospitals, South-East Ethiopia, also showed that, mothers with a BMI of  $<18.5$  are prone to have low birth weight babies than those with a BMI of  $\geq 18.5$  (Habtamu et al., 2015).

Additional meal during pregnancy is other important habits to have normal birth weight. The study conducted in Dessie town, Northern Ethiopia reported that the odds of having low birth weight baby is 3.2 times higher among mothers who have no habits of having additional meal per day than those have a habit of an additional meal (Semira et al., 2018). Eating fruits, Vegetables, Milk, and Meat products during pregnancy are other required diets for a pregnant woman to have well-nourished new babies. The study done in Wolayta Sodo town shows mothers who do not eat fruits daily during pregnancy are more likely to have low birth weight babies (Samson et al., 2018).

In summary, different studies have been conducted in Ethiopia and out of our country on Factors associated with Low birth weight revealing different factors are contributing to the birth weight. Of these, maternal-related factors, Environmental factors, and Institutional related factors are the majorly identified as determinants of newborn birth weight. This shows the newborn birth weight and overall health status of the child is the sum of different factors that could be faced during the pregnancy period and before. Even though a lot of studies conducted yet in Ethiopia as well in Addis Ababa, most of them were used secondary data and whole deliveries (late and recent). Therefore, differently from the previous study to assess the factors associated with low birth weight in Addis Ababa this study used primary data and recent delivery.

## 4. METHODS & MATERIALS

### 4.1. The study context

Addis Ababa is one of the city administrations of Ethiopia which is located at the center of the country is administered by the city council. The city serves as the hub for many national and international offices such as the African Union. Most of the people lead their life as being civil servants, merchants, and daily laborers. Addis Ababa is administratively divided into 11 Sub-Cities and 121 Woredas.

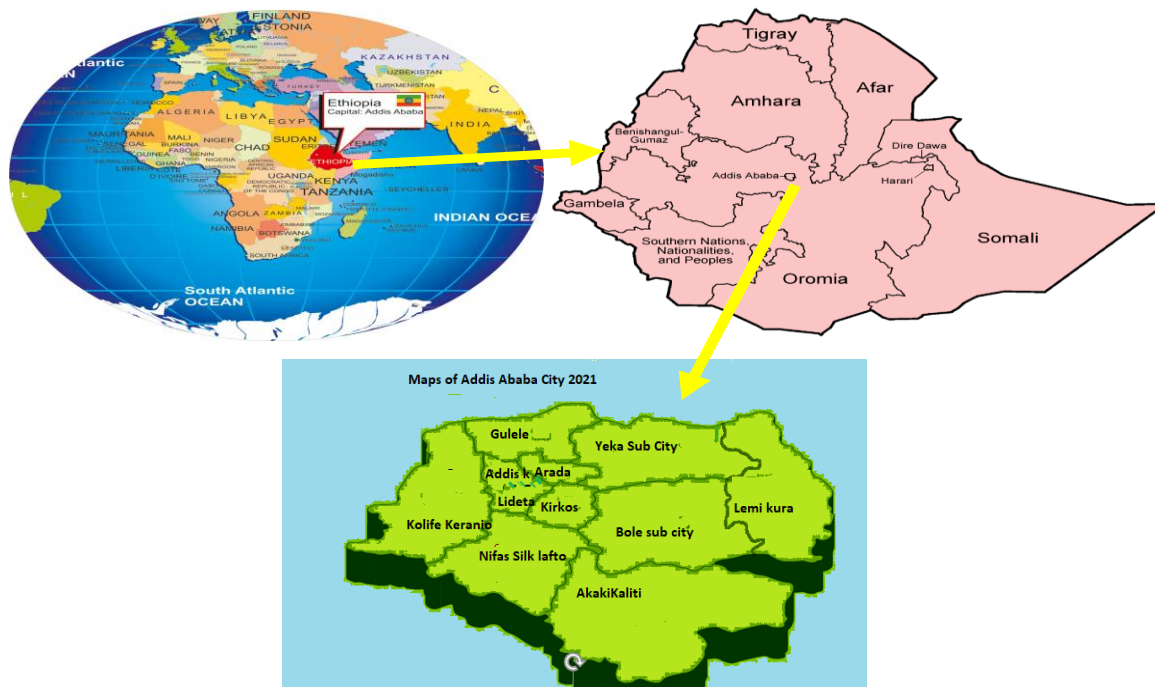


Figure 2 Addis Ababa City Administration Map

Source: <http://www.mapsnworld.com/ethiopia> and Arc GIS

According to the last census, the total population of Addis Ababa was about 3,770,554, as projected for 2020/2021 (CSA, 2007), of which females account for 51.5%. Of the total female population found in the reproductive age group (33% of the total population), 87,854 of them are expected to be pregnant in 2020/2021. Addis Ababa Health Bureau is responsible for the overall leading of the health sector in the city administration. The city administration has three-tier health system structures. The structures follow the strategy of health promotion and disease prevention. There are more than 1000 health facilities in Addis Ababa including 12 Public Hospitals, 33 private hospitals, 102 health centers, and several higher or medium clinics.

## **4.2. Study Period**

The data were collected from March 2021 to April 2021

## **4.3. Study Design**

A facility-based analytic Cross-sectional study was employed to assess factors affecting birth weight among recent delivery in public hospitals, Addis Ababa.

## **4.4. Target Population**

All mothers who give births in Addis Ababa Public Hospitals were considered as the target population.

## **4.5. Study population**

All mothers who give births in Addis Ababa Public Hospitals from March 07, 2021, to April 07, 2021, were used as the study population.

## **4.6. Study Unit**

Mothers with recent birth in selected Public Hospitals in Addis Ababa during the study period were recruited for interview.

## **4.7. Sample size determination**

The sample size was calculated by Epi Info version 7.1.1 was used to determine sample size using the double population proportion exposure difference formula. Different variables were reported as determinants of birth weight in previous studies such as Iron supplements during pregnancy, alcohol use, maternal weight, ANC follow up and maternal mortality. All sample size was calculated at 95% CI and power of 80% using percent exposed and percent unexposed to the independent variables and the variables with a higher number of sample size (ANC follow up which is 475 sample including 10% non-responder rate) is selected for this study (Table 1).

The following formula was used:-

$$n = (Z_{\alpha/2} + Z_{\beta})^2 * (p_1(1-p_1) + p_2(1-p_2)) / (p_1 - p_2)^2$$

where  $Z_{\alpha/2}$  is the critical value of the normal distribution at  $\alpha/2$  (e.g. for a confidence level of 95%,  $\alpha$  is 0.05 and the critical value is 1.96),  $Z_{\beta}$  is the critical value of the normal distribution at  $\beta$  (e.g. for a power of 80%,  $\beta$  is 0.2 and the critical value is 0.84) and  $p_1$  and  $p_2$  are the expected sample proportions of the two groups (Abebe et al., 2019).

**Table 1** Sample size determination from different study result and assumption

Factors	%LBW Exposed	% LBW unexposed	AOR (95% CI)	Sample size	NRR (10%)	Final Sample size
Iron supplement during pregnancy ( <i>Hirut et al., 2016</i> )	67.5%	87.4%	0.3	158	16	174
Maternal Wt<50 ( <i>Samantha et al., 2017</i> )	21.2%	10.8%	2.26	408	40.8	449
Presence of maternal chronic illness ( <i>Samantha et al., 2017</i> )	27.3%	14.1%	2.28	324	32.4	356
ANC follow up ( <i>Abebe et al., 2019</i> )	20.6%	10.4%	2.2	432	43	475
Alcohol use ( <i>Eyasu and Robera, 2019</i> )	31.25%	68.75%	0.2	64	6	70

Note: AOR=adjusted odds ratio taken from the study

NRR: None responder rate

#### 4.8. Sampling Technique

A total of four public hospitals (Minilik II hospital, Gandhi Memorial Hospital, Tirunesh Beijing Hospital, and Alert Hospital) were selected by lottery method among 12 public hospitals currently functioning in Addis Ababa. Then, the estimated sample size was distributed proportionally for the four selected hospitals according to the skilled delivery performance of the hospitals in the previous year (2019/2020). Finally, depending on the average daily performance of each hospital and the expected number of sample sizes to be taken from each hospital, 475 mothers who fulfilled the inclusion criteria were selected using a systematic sampling method among pregnant mothers who gave live births in selected public hospitals during the study period. Of the total delivery attended in the hospital per day, every other five mothers were selected for the interview (Figure 2).



**Figure 3** Diagrammatic representation of sampling technique

#### **4.9. Inclusion and Exclusion criteria**

##### **4.9.1. Inclusion criteria**

The study included all mothers with term delivery who gave births during the study reference period (March 07-April 07, 2021).

##### **4.9.2. Exclusion Criteria**

- ✓ Newborn with any congenital anomalies was excluded
- ✓ Mothers who had multiple births (twin) was excluded
- ✓ Mothers who are seriously ill during the data collection period and those who are unable to communicate were excluded from the study

#### 4.10. Study Variables

The outcome variable of the study was birth weight. The study considered a range of potential predictors/independent variables based on a review of the literature and model-building criteria. The following table provides the list of the exposure and outcome variables of the study.

Dependent Variable	Independent Variables
<p><b>Low birth weight</b></p> <ul style="list-style-type: none"> <li>• Yes (&lt;2500gm)</li> <li>• No (&gt;2500)</li> </ul>	<p><b>I) Socio-demographic factors</b></p> <ul style="list-style-type: none"> <li>• Age, occupation, educational status, monthly household income, household size, mother’s weight &amp; Height, marital status</li> </ul> <p><b>II) Obstetric factors</b></p> <ul style="list-style-type: none"> <li>• Parity, gravida, birth interval, History of Abortion</li> <li>• Prior stillbirth, ANC follow up, preeclampsia, Eclampsia, Premature Rupture Of Membrane (PROM)</li> <li>• AUB, Pregnancy Induced HTN</li> </ul> <p><b>III) Maternal Morbidity</b></p> <ul style="list-style-type: none"> <li>• DM, HTN, Anemia, Thyroid disorder, Stress, Acute infection</li> </ul> <p><b>IV) Toxic exposure</b></p> <ul style="list-style-type: none"> <li>• Tobacco, alcohol consumption, Chewing Khat, other drugs</li> </ul> <p><b>V) Maternal Nutrition</b></p> <ul style="list-style-type: none"> <li>• Weight gain</li> <li>• Fruit, vegetable, &amp; Protein intake</li> <li>• Iron Supplement, Extra meal intake</li> </ul>

#### **4.11. Data Collection Tools and Procedures**

A structured Questionnaire, which was adopted from different reports, was used to collect data from selected mothers. The questionnaire was categorized into five groups (Socio-demographic factors, maternal morbidity during pregnancy period, maternal nutrition during Pregnancy period, Obstetric factors during pregnancy and maternal toxic exposure). To create a Common understanding among the data collectors, half-day orientation was provided for data collectors before the beginning of data collection.

Interviewer-administered data collection methods were employed. Two midwives or other health personnel working in the delivery room were selected for data collection per Hospital. Selected mothers were interviewed immediately after they give birth and admitted to the post-natal ward depending on inclusion and exclusion criteria.

#### **4.12. Data processing and statistical analysis**

Data was checked for completeness and inconsistencies, coded and entered to SPSS version 23. Data cleaning was done before subsequent analysis by SPSS. Univariate (frequency) analysis was used to describe the characteristics of the study sample. Bivariate and multiple logistic regression analyses was done to examine the association between the independent variables and the dependent variable (birth weight). The association between dependent and independent variables was checked using the Chi-Square test (Cross tabulation) and AOR in Multiple logistic regression. To minimize possible confounders, a number of control variables were included in the analysis. The sets of independent variables that have a p-value less than 0.2 in the bivariate logistic regression analysis was re-entered into multiple logistic regressions analysis. All statistical tests were two-sided and a significant association was declared at a p-value less than 0.05.

#### **4.13. Data Quality Assurance**

Data quality was ensured during data collection, coding, entry, and analysis by supervision, data cleaning, and cross checking each questionnaire to avoid double coding and entry. Orientation was given to the data collectors and supervisors to prevent any confusion and have a common understanding of the study. Before the starting of data collection, pretest of the instrument was

conducted on 10% of our sample size to ensure the validity of the questionnaire. Each questionnaire was checked for its consistency, provision of full information, and completeness. Supervision of data collectors included observation of how the data collectors are collecting the data was done by supervisors. The filled questionnaire was checked for completeness by data collectors, supervisors, and Principal Investigator (PI) daily. Consequently, any problem encountered was discussed and was solved immediately. An incomplete Questionnaire was discarded and counted with non-respondent.

#### **4.14. Ethical Clearance**

Ethical clearance was attained from the Addis Ababa University, **CDS** ethical review committee and Addis Ababa regional Health bureau Research department ethical review committee. Accordingly, an official permission letter written from Addis Ababa City Administration Health Bureau was submitted to each Hospital. Informed consent was taken from the study participants. Any information related to personal identification was not used on the report and the confidentiality of the participant was kept throughout the study.

#### **4.15. Result Dissemination**

The result of this research will primarily be disseminated to Addis Ababa University College of development studies center for population studies and the Addis Ababa Health Bureau research department. Furthermore, if the researcher found an opportunity it will be presented at national or international scientific conferences and publicized in journals for the view of the scientific community.

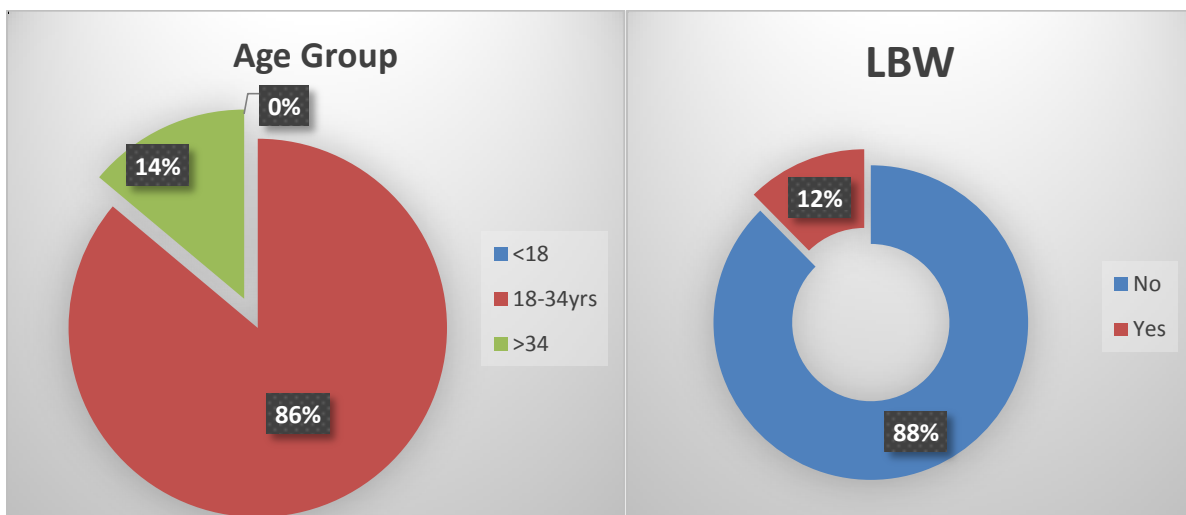
## 5. RESULT AND DISCUSSION

### 5.1. Result

A newborn baby's birth weight is the sum of different internal and external factors that affect mothers during pregnancy. This study was conducted to identify main predictors of birth weight of newborn children based on data collected from 466 mothers from Addis Ababa public hospitals with singleton live births over the study period. During this study, a different group of factors was assessed to identify their association with birth weight. These are - Socio-demographic factors, obstetric factors, maternal morbidity, maternal toxic exposure, and maternal nutrition during pregnancy.

#### 5.1.1. Background characteristics

The overall response rate was 98%. Of the total mothers who participated in the study, 401(86.1%) of them were among the age group of 18-34yrs while the rest were above 34yrs old. The median age of the participant was 28yrs (IQR= 7). A total of 58 (12.4%) mothers give births to Low birth weight children during the study period (Figure 3).



**Figure 4** Participants' Age group and newborn birth weight, Addis Ababa, Ethiopia, 2021

Of the total respondents, 430 (92.3%) were found to be currently married and 71 (15.2%) of the participants were illiterate or has no education. On the other hand, the Majority of mothers, (62.7%) were either not employed or were housewives (Table 2).

**Table 2** Distribution of Socio-demographic factors among recent delivery in Public Hospitals of Addis Ababa, Ethiopia, 2021(n=466)

<b>Variables</b>	<b>Frequency</b>	<b>Percent</b>
<b>Marital status</b>		
Currently Married	430	92.3
Divorced/widowed	17	3.6
Single	19	4.1
<b>Mother's education</b>		
Illiterate	71	15.2
Primary (1-8)	166	35.6
Secondary(9-12)	136	29.2
Higher education	93	20.0
<b>Mother's Occupation</b>		
Housewife/Unemployed	292	62.7
Employed	76	16.3
Self-employed	98	21.0
<b>Household Size</b>		
<5 member	422	90.6
≥ 5 members	44	9.4

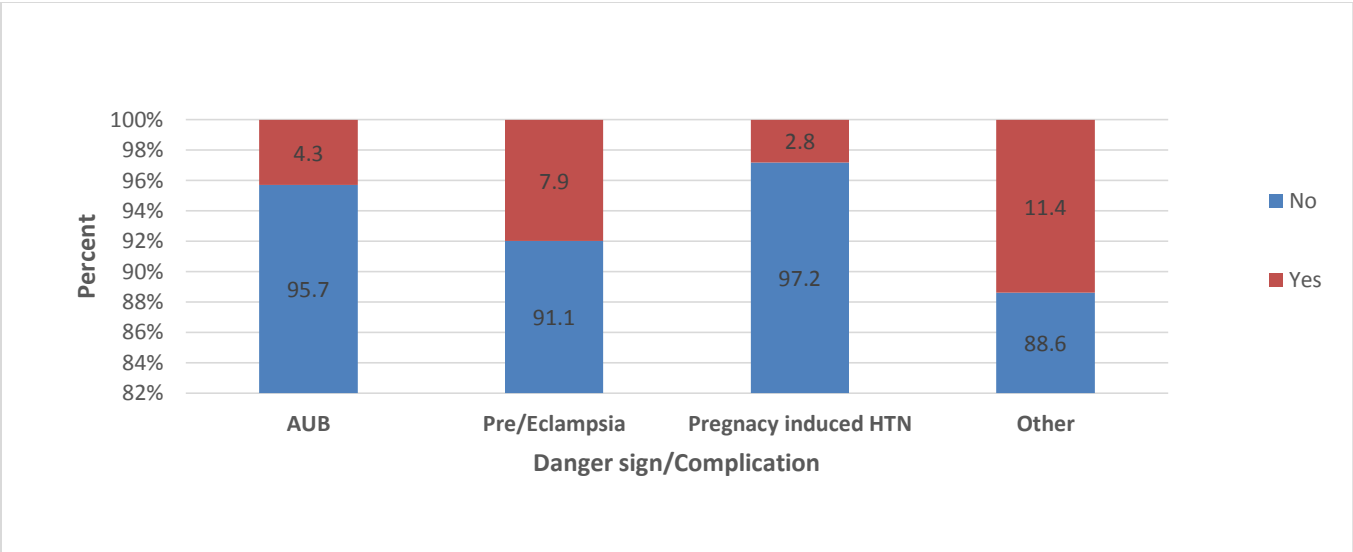
### **5.1.2. Obstetric factors**

Obstetric history is one of the predictors of healthy birth outcomes. Of the total mothers interviewed, 76 (16.3%) of them reported that their pregnancy was unplanned. On the other hand, about 201 (43.1%) of the mothers were prim gravida. Further, 155 (33.3%) of them did not receive counseling on pregnancy period danger signs. On the other hand, 103 (25.5%) of them had experienced at least one pregnancy-related danger sign ranging from mild to severe (Table 3).

**Table 3** Distribution of Obstetric factors among recent delivery in Public hospitals of Addis Ababa, Ethiopia, 2021(n=466)

<b>Category</b>	<b>Frequency</b>	<b>Percent</b>
<b>Pregnancy type</b>		
Planned	390	83.7
Unplanned	76	16.3
<b>ANC follow up during recent pregnancy</b>		
No	41	8.8
Yes	425	91.2
<b>Number of ANC visit during recent pregnancy</b>		
<4 times	160	34.3
≥4 times	306	65.7
<b>Gravidity</b>		
Prim gravidity	196	42.1
Multigravidas	270	57.9
<b>Counseled on danger sign</b>		
No	155	33.3
Yes	311	66.7
<b>Experienced any danger sign during pregnancy</b>		
No	347	74.5
Yes	119	25.5

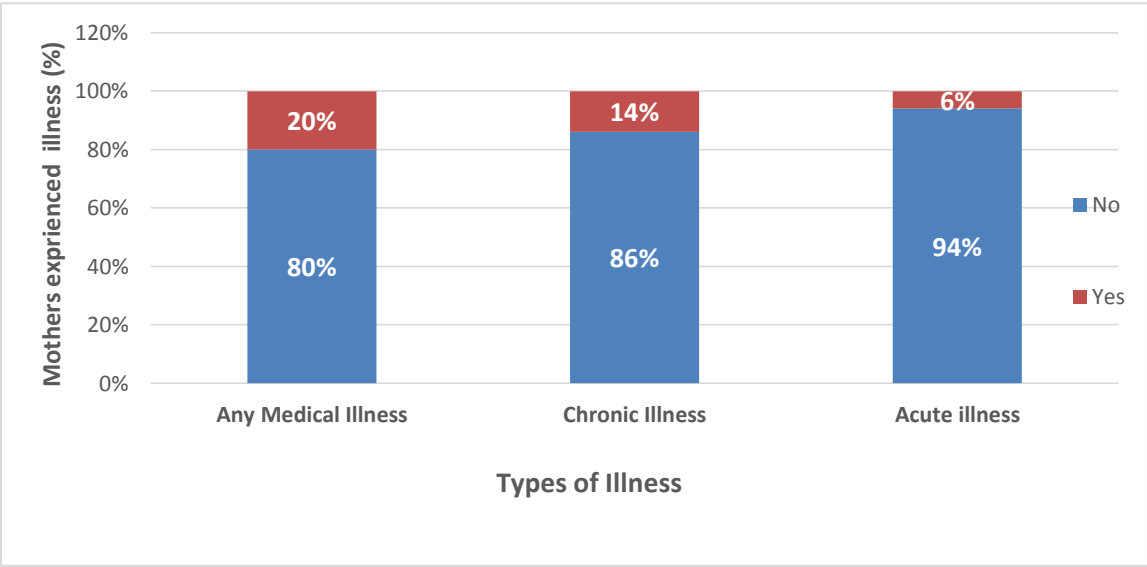
Of the total mothers who participated in this study, 20 (4.3%) had experienced Abnormal Uterine Bleeding (AUB) during pregnancy while 37 (7.9%) of them developed either preeclampsia or eclampsia, 13 (2.8%) and 53 (11.4%) had pregnancy-induced hypertension (HTN) and other danger sign, respectively (Figure 4).



**Figure 5** Types of danger sign that pregnant mothers had experienced during their current pregnancy, Addis Ababa, Ethiopia, 2021(n=466)

**5.1.3. Maternal Morbidity**

Of the total participants, 374 (80%) did not experience any medical illness during their current pregnancy while 64(14%) of them had no history of chronic illness during pregnancy (Figure 5).



**Figure 6** Number of mothers experienced Medical illness during recent pregnancy, Addis Ababa, Ethiopia, 2021(n=466)

#### 5.1.4. Maternal Toxic Exposure during recent pregnancy

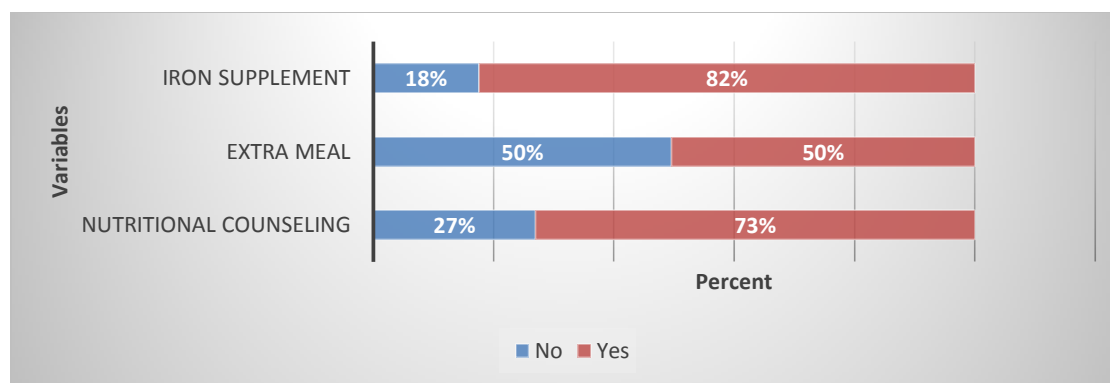
As it is shown in the table below, 36(7.7%) of the mothers participated in this study had a history of taking medication during their most recent pregnancy while none of them had habits of smoking cigarette. In addition, 35 (7.5%) of them were working in a carbon dioxide-producing factory during the pregnancy period (Table 4).

**Table 4** Maternal toxic exposure history during recent Pregnancy, Addis Ababa, Ethiopia, 2021(n=466)

Category	Frequency	Percent
<b>Taken Medication during pregnancy</b>		
No	430	92.3
Yes	36	7.7
<b>Smoking during pregnancy</b>		
No	466	100.0
Yes	0	0
<b>Chewing Khat</b>		
No	460	98.7
Yes	6	1.3
<b>Alcohol consumption</b>		
No	392	84.1
Yes	74	15.9
<b>The main source of energy for food preparation</b>		
Kerosene	29	6.2
Charcoal (wood)	130	27.9
Electricity/other	307	65.9
<b>Work in CO<sub>2</sub> producing factory</b>		
No	431	92.5
Yes	35	7.5

#### 5.1.5. Maternal Nutrition

Among the study participants, 340 (73%) of them reported getting counseling services during pregnancy on the importance of a balanced diet while only half of them, 231(50.4%), got extra meals (more than three times per day). On the other hand, to prevent the potential risk of Anemia during pregnancy and subsequent adverse pregnancy outcomes, an Iron supplement is highly recommended for all pregnant Mothers during the pregnancy period. However, about 82 (18%) of them did not get Iron supplements during their recent pregnancy (Figure 6).



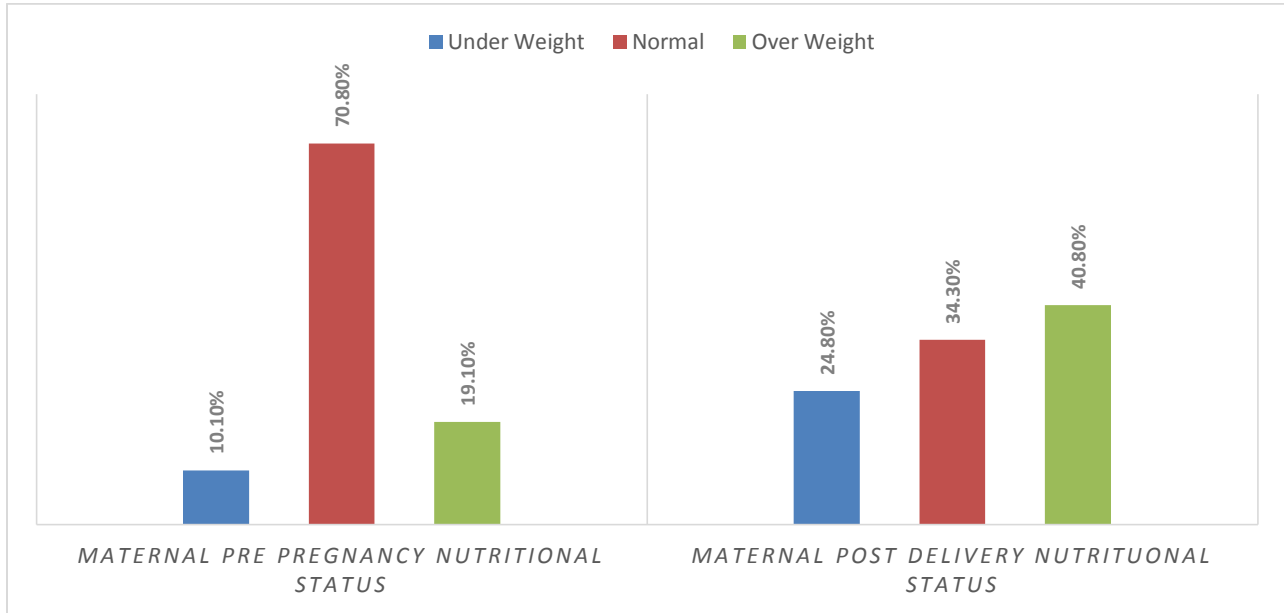
**Figure 7** Nutritional Counseling and Iron Supplement intake during Pregnancy for Pregnant mothers, Addis Ababa, Ethiopia, 2021(n=466)

Of the total participants, about 283 (60.7%) of them were able to get fruits every day while only 17 (3.6%) of them consumed meat and meat products regularly (Table 5).

**Table 5** Maternal Nutritional status during recent pregnancy in Addis Ababa, Ethiopia, 2021(n=466)

Variables	Frequency	Percent
<b>Frequency of meat and meat product intake</b>		
Daily	17	3.6
At least one/ week	229	49.1
At least once / month	162	34.8
Not at all	58	12.4
<b>Frequency of milk and milk product intake</b>		
Daily	73	15.7
At least once/ week	218	46.8
At least once / month	113	24.2
Not at all	62	13.3
<b>Frequency of vegetable intake</b>		
Daily	116	24.9
At least once/ week	249	53.4
At least once / month	85	18.2
Not at all	16	3.4
<b>Frequency of fruit intake</b>		
Daily	283	60.7
At least one/ week	97	20.8
At least once / month	24	5.2
Not at all	0	0

It is also noted that about 47 (10.1%) of them were found to be underweight, having BMI measurement less than 18.5kg/m<sup>2</sup>. On the other hand, Post-delivery maternal weight/weight gain or MUAC measurement is another indirect indicator of maternal nutrition during pregnancy (Figure 7).



**Figure 8** Pre and Post Maternal Nutritional Status during recent pregnancy, Addis Ababa, Ethiopia, 2021(n=466)

### 5.1.6. Determinants of Low Birth Weight

To assess the association of selected independent variables and the outcome of interest, a total of 41 predictors were cross-tabulated with the dependent variables (low birth weight). Of the socio-demographic factor hypothesized to have an association with LBW, none of them were found to have a significant association with LBW (Table 6).

**Table 6** Cross-tabulation of Socio-demographic factors with low birth weight among recent delivery, Addis Ababa, Ethiopia, 2021(n=466)

Variables	LBW (n=466)		$\chi^2$ test	P-values
	No [n (%)]	Yes [n (%)]		
<b>Marital status</b>				
Currently married	376 (92.2)	54(93.1)	3.713	0.156
Divorced/widowed	17(4.2)	0(0)		
Single	15(3.6)	4(6.9)		
<b>Age group</b>				
<18yrs	0	0	1.567	0.233
18-34yrs	348 (85.3)	53 (91.4)		
>34	60 (14.7)	5 (8.6)		
<b>Maternal education level</b>				
Illiterate	59 (14.5)	12(20.7)	5.768	0.123
Primary (1-8)	140 (34.3)	26(44.8)		
Secondary (9-12)	124 (30.4)	12(20.7)		
Higher Education	85 (20.8)	8(13.8)		
<b>Household size</b>				
<5 member	369 (90.4)	53 (91.4)	0.052	0.999
$\geq$ 5 member	39 (9.6)	5 (8.6)		
<b>Maternal Occupation</b>				
Housewife/Unemployed	253 (62.0)	39 (67.2)	0.699	0.705
Employed	67 (16.4)	9 (15.5)		
Self-employed	88 (21.6)	10 (17.2)		

*n = Number of Participants*

Obstetric-related Variables were cross-tabulated with low birth weight among recent deliveries and having ANC follow up, Number of ANC Visit, and experiencing danger sign during pregnancy are found to have a significant association to Low birth weight (Table 7).

**Table 7** Cross-tabulation of obstetric related factors with low birth weight among recent delivery, Addis Ababa, Ethiopia, 2021.

Variables	LBW (n=466)		Chi-Square test ( $\chi^2$ )	P. Value
	No [n (%)]	Yes [n (%)]		
<b>Type of pregnancy</b>				
Planned	345(84.6)	45(77.6)	1.81	0.126
Unplanned	63(15.4)	13(22.4)		
<b>Gravity</b>				
Prim gravidity	176 (43.1)	20 (34.5)	1.56	0.256
Multigravidas	232 (56.9)	38 (65.5)		
<b>ANC follow up</b>				
No	30(7.4)	11(19.0)	8.53	0.007
Yes	378(92.6)	47(81.0)		
<b>Number of ANC visit</b>				
<4 times	126 (30.9)	34 (58.6)	17.33	0.000
≥4 times	282 (69.1)	24 (41.4)		
<b>Counsel on danger sign</b>				
No	140 (34.3)	15 (25.9)	1.63	0.235
Yes	268 (65.7)	43 (74.1)		
<b>Experienced danger sign</b>				
No	316 (77.5)	31 (53.4)	15.38	0.000
Yes	92 (22.5)	27 (46.6)		
<b>Abnormal Uterine bleeding</b>				
No	389 (95.3)	38 (65.5)	58.90	0.000
Yes	19 (4.7)	20 (34.5)		
<b>Pre/Eclampsia</b>				
No	377 (92.4)	41 (70.7)	25.90	0.000
Yes	31 (7.6)	17 (29.3)		
<b>Pregnancy-induced HTN</b>				
No	395 (96.8)	58 (100.0)	1.90	0.385
Yes	13 (3.2)	0 (0.0)		
<b>Other danger sign</b>				
No	359 (88.0)	54 (93.1)	1.32	0.282
Yes	49(12.0)	4(6.9)		

*n* = Number of Participants

In this study, of the selected maternal illness during recent pregnancy, history of having any medical illness during pregnancy, developing any chronic illness, and having a history of anemia during pregnancy is found to have a significant association with low birth weight in Bivariate analysis (table 8).

**Table 8** Cross-tabulation of maternal morbidity with Low birth weight during recent pregnancy, Addis Ababa, Ethiopia, 2021.

Variables	LBW (n=466)		Chi-Square test ( $\chi^2$ )	P values
	No [n (%)]	Yes [n (%)]		
<b>Has any medical illness</b>				
No	374 (84.8)	35 (60.3)	20.37	0.000
Yes	62 (15.2)	23 (39.7)		
<b>Has any chronic illness</b>				
No	364 (89.2)	38 (65.5)	24.07	0.000
Yes	44 (10.8)	20 (34.5)		
<b>Has Anemia</b>				
No	396 (97.1)	43 (74.1)	48.8	0.000
Yes	12 (2.9)	15 (25.9)		
<b>Has Hypertension</b>				
No	385 (94.4)	58 (100.0)	3.439	0.096
Yes	23 (5.6)	0 (0.0)		
<b>Has diabetic Mellitus</b>				
No	395 (96.8)	55 (94.8)	0.604	0.435
Yes	13 (3.2)	3 (5.2)		
<b>Has any acute illness</b>				
No	383 (93.9)	55 (94.8)	0.082	0.999
Yes	25 (6.1)	3 (5.2)		
<b>Contract COVID-19</b>				
No	401 (98.3)	58 (100.0)	1.010	0.604
Yes	7 (1.7)	0 (0.0)		
<b>Has HIV infection</b>				
No	394 (96.6)	57 (98.3)	0.475	0.706
Yes	14 (3.4)	1 (1.7)		

*n = Number of Participants*

The effects of certain maternal exposures were also assessed. Nine selected factors were cross-tabulated with low birth weight to identify their association with LBW. Of the total factors entered into bivariate analysis, the only history of medication intake during pregnancy was found to have a significant association with low birth weight (Table 9).

**Table 9** Cross-tabulation of Maternal toxic exposure history during recent pregnancy with Low birth weight, Addis Ababa, Ethiopia, 2021.

Variables	LBW (n=466)		Chi-Square ( $\chi^2$ ) test	P. value
	No [n (%)]	Yes [n (%)]		
<b>Medication for treatment</b>				
No	378 (92.6)	46 (79.3)	11.01	0.003
Yes	30 (7.4)	12 (20.7)		
<b>Smoking during pregnancy</b>				
No	408 (100)	58 (100)	NA	NA
Yes	0(0.0)	0 (0.0)		
<b>Chewing Khat during pregnancy</b>				
No	404 (99.0)	56 (96.6)	2.433	0.164
Yes	4 (1.0)	2 (3.4)		
<b>Alcohol consumption during pregnancy</b>				
No	339 (83.1)	53 (91.4)	2.613	0.125
Yes	69 (16.9)	5 (8.6)		
<b>Separate kitchen</b>				
No	249(61.0)	33(56.9)	0.363	0.568
Yes	159(39.0)	25(43.1)		
<b>Who prepares food regularly?</b>				
Other Family members	135 (33.1)	17 (29.3)	0.330	0.654
Myself	273 (66.9)	41 (70.7)		
<b>The main source of energy for cooking</b>				
Kerosene	27 (6.6)	2 (3.4)	0.918	0.632
Charcoal (wood)	114 (27.9)	16 (27.6)		
Electricity/other	267 (65.4)	40 (69.0)		
<b>Working in CO2 producing factory</b>				
No	380 (93.1)	51 (87.9)	2.298	0.238
Yes	28 (6.9)	7 (12.1)		

*n = Number of participant*

Maternal nutritional status is also the other focus of this study, and in effect, different nutrition-related factors were cross-tabulated with low birth weight to assess their association with the outcome variable. It is noted that nutritional counseling during pregnancy, Iron supplement, fruit consumption during pregnancy, and pre-pregnancy maternal weight were identified to have a significant association with low birth weight (table 10).

**Table 10** Cross-tabulation of maternal nutritional history during pregnancy and Low birth weight, Addis Ababa, Ethiopia, 2021.

Variables	LBW (n=466)		$\chi^2$ test	p values
	No [n (%)]	Yes [n (%)]		
<b>Nutritional counseling</b>				
No	102 (25.0)	24 (41.4)	6.91	0.011
Yes	306 (75.0)	34 (58.6)		
<b>Eating extra meal</b>				
No	198 (48.5)	33 (56.9)	1.42	0.263
Yes	210 (51.5)	25 (43.1)		
<b>Get Iron supplement</b>				
No	71 (17.4)	21 (36.2)	11.33	0.001
Yes	337 (82.6)	37 (63.8)		
<b>Frequency of getting meat and meat product</b>				
Daily	15 (3.7)	2 (3.4)	0.12	0.990
At least once/ week	201 (49.3)	28 (48.3)		
At least once / month	142 (34.5)	20 (34.5)		
Not at all	50 (12.3)	8 (13.8)		
<b>Frequency of Getting milk and milk product</b>				
Daily	64 (15.7)	9 (15.5)	1.88	0.598
At least once a week	193 (47.3)	25 (43.1)		
At least once / month	100 (24.5)	13 (22.4)		
Not at all	51 (12.5)	11 (19.0)		
<b>Frequency of Getting vegetable</b>				
Daily	102 (25.0)	14 (24.1)	2.88	0.411
At least once/ week	221 (54.2)	28 (48.3)		
At least once / month	73 (17.9)	12 (20.7)		
Not at all	102 (25.0)	14 (24.1)		
<b>Frequency of getting fruits</b>				
Daily	55 (13.5)	7 (12.1)	11.29	0.009
At least one/ week	254 (62.3)	29 (50.0)		
At least once / month	83 (20.3)	14 (24.1)		
Not at all	16 (3.9)	8 (13.8)		
<b>Pre-pregnancy nutritional status</b>				
Underweight	42 (10.3)	18 (31.0)	20.80	0.000
Normal	289 (70.8)	35 (60.3)		
Overweight	77 (18.9)	5 (8.6)		
<b>Maternal post- delivery nutritional status</b>				
Under Weight	96 (23.5)	20 (34.5)	3.50	0.165
Normal	141 (34.6)	19 (32.8)		
Overweight	171 (41.9)	19 (32.8)		

*n* = Number of Participants

In bivariate analyses performed to identify candidate variables for multivariable analysis (Table 6-10 above), variables having p-value < 0.2 were considered as candidates for the multivariable logistic regression model in investigating significant determinants of LBW among study subjects. The results are shown in Table 11 thus included all covariates with p-value < 0.2 in bivariate analyses. Accordingly, of the total independent variables run in multivariable logistic regression, a number of ANC Visit, presence of AUB during pregnancy, presence of pre-eclampsia or Eclampsia, presence of anemia during pregnancy, Chewing Khat, and maternal pre-pregnancy nutritional status were found to be key determinants of low birth weight in this study.

In this study, mothers having ANC visit four times or more (WHO recommended ANC follow up) during current pregnancy were 60% less likely to give birth to LBW compared to those who had ANC visit of fewer than four times (AOR=0.4; 95% CI:0.17-0.99). On the other hand, the likelihood of giving LBW was 3.3 times more among mothers who had anemia during the pregnancy period than those who did not have anemia (AOR=3.3; 95% CI: 3.1-3.6). Pre-pregnancy maternal nutritional status was measured using maternal weight before pregnancy and height which gives BMI measurements. In this study, mothers who had normal weight (BMI 18.5kg/m<sup>2</sup>-24.5kg/m<sup>2</sup>) before pregnancy were found to be 80% less likely to give LBW when compared to underweight mothers (<18.5kg/m<sup>2</sup>) [AOR=0.2; 95% CI: 0.1-0.5) (Table 11).

**Table 11** Multivariable logistic regression analysis for the determinants of LBW among mothers gives births in public Hospitals in Addis Ababa, Ethiopia, 2021(n=466).

<b>Variables</b>	<b>AOR (95% CI)</b>	<b>P. Value</b>
<b>Number of ANC visit</b>		
Less than 4 times	1	
Four times and more	0.4(0.17-0.99)	0.049*
<b>Experienced at least one danger sign</b>		
No	1	
Yes	0.33(0.08-1.29)	0.113
<b>Abnormal Uterine bleeding during pregnancy</b>		
No	1	
Yes	10.9(2.5-15.8)	0.001*
<b>Pre/Eclampsia during pregnancy</b>		
No	1	
Yes	9.5(4.8-10.8)	0.006*
<b>Any medical illness during pregnancy</b>		
No	1	
Yes	1.2(0.08-1757)	0.892

<b>Chronic illness during pregnancy</b>		
No	1	
Yes	0.57(0.02-11.6)	0.718
<b>Anemia during pregnancy</b>		
No	1	
Yes	3.3 (3.1-3.6)	0.003*
<b>Medication for treatment during pregnancy</b>		
No	1	
Yes	1.1(0.16-6.17)	0.992
<b>Chewing Khat</b>		
No	1	
Yes	7.9(3.9-16.1)	0.004*
<b>Nutritional counseling during pregnancy</b>		
No	1	
Yes	0.5(0.2-1.5)	0.209
<b>Get Iron Supplement</b>		
No	1	
Yes	1.2(0.5-3.2)	0.653
<b>Frequency of getting Fruit</b>		
Daily	1	
At least one/ week	1.1(0.3-3.9)	0.891
At least once / month	0.7(0.2-2.7)	0.626
Not at all	1.5(0.2-9.9)	0.702
<b>Pre-pregnancy nutritional Status</b>		
Underweight	1	
Normal	0.2(0.1-0.5)	0.001*
Over weight	0.1(0.1-0.4)	0.003*

**Note:** - \* significant at  $<0.05$ , AOR= Adjusted Odds ratio, 1= reference variables

## 5.2. Discussion

This study has primarily aimed at assessing the main predictors of LBW among the most recent births in selected health facilities in Addis Ababa. Low birth weight (LBW) is a major public health problem due to its association with high morbidity and mortality of children. Newborn mortality and disease are directly related to birth weight (BW), and insufficient or excess weight at birth is always accompanied by an increase of these risk factors (CSA and ICF, 2016). Birth weight could be affected by different conditions that could happen during the pregnancy period. This condition may be maternal factors, environmental and natural factors.

Sometimes a pregnancy may end up with Obstetric Complication or some mothers may experience different types of pregnancy-related danger signs which could negatively affect the outcomes of a newborn. To reduce the potential risk of danger signs during pregnancy and increase the early healthcare-seeking behavior of mothers with any pregnancy-related danger sign, professional counseling is very important during pregnancy, especially during ANC follow-up. The odds of being low birth weight is less likely among mothers who had ANC visits of four and more times during current pregnancy compared to those having less than four times. The finding is consistent with the study conducted in Amhara Regional State Referral Hospitals (Getnet et al., 2018). The odds of giving birth for low birth weights were found to be higher among mothers who experienced either Pre-eclampsia or Eclampsia compared to those without such event. Abnormal uterine bleeding (AUB) is one of the pregnancy-related danger signs. Similar to other study finding, this study also reveals that mothers those have a history of AUB during recent pregnancy are more likely to give birth for low birth weight baby when compared to those have no AUB. This finding is consistent with the study done in west Iran (Ghobad et al., 2016). In additions to this, different studies conducted in different regions of Ethiopia showed that, the odds of having low birth weight baby were higher among those who experienced pregnancy-related complication compared to the counterpart (Lema and Deresse, 2018).

Newborn weight is a parameter that is directly related to the health of the mother and is a parameter to survive and experience healthy growth and development of the newborn (Jyotishi, et al., 2014). A different study shows maternal medical illness during pregnancy was the other factor that could affect the newborn birth outcome. Of these, the study conducted in Ethiopia, Tigray region reveals that mothers with any chronic illness are more likely to have low birth

weight babies compared to those with no chronic illness (Meresa et al., 2015). Similarly, in this study, the odds of having low birth weight are found to be higher among mothers who experienced anemia during pregnancy compared to those who do not have anemia. This finding is also consistent with the study conducted in Iran and Ethiopia, Tigray, and Dessie (Ghobad et al., 2017; Wondim et al., 2018, Semira et al., 2018 respectively).

Smoking, Alcohol, Khat, CO<sub>2</sub>, different medications during pregnancy are some of the toxic agents that are reported to have negative impacts on birth weight (Pereira et al., 2017). In this study, the odds of giving birth to low birth weight are higher among mothers who have habits of chewing Khat during the pregnancy period compared to those who did not have exposure to chewing Khat. This finding is also supported by the study conducted in Bale, Oromia region (Habtamu et al., 2015).

Maternal weight before pregnancy is the other indicator of maternal nutritional status which has a contribution to newborn health and birth weight. In this study, the odds of having a low birth weight baby is less likely among mothers who were normally nourished (BMI of 18.5-24.9kg/m<sup>2</sup>) compared to those who are undernourished (BMI of <18.5kg/m<sup>2</sup>). This study is supported by the study conducted in Bale zone, south Ethiopia (Habtamu et al., 2015).

Furthermore, other maternal nutrition-related factors that are reported to be independent determinants of Newborn birth weight are not found to be significantly associated with low birth weight in this study area. This could be because of the study design difference and most of the mothers who participated in this study (92.6%) had ANC follow up which helps them to get nutritional counseling and contribute to having a balanced diet during their pregnancy period in this study area. In addition, in this study, most of maternal illness have no significant association to Newborn birth weight which may be due to most of the mothers participated in this study have similar health status since this study is conducted in referral hospitals. In the study area, most of the mothers who attended hospitals are those who were referred from primary health care facilities with a possible underlining condition that requires second-level health care setting management.

## **6. STRENGTH AND LIMITATION OF THE STUDY**

### **6.1. Strength**

The present study has some strengths including using primary data as a data source, using recent delivery, and taking newborn weight within a few hours of delivery.

### **6.2. Limitation**

In this study, there are also some limitations worth mentioning. First, the analysis in the present study was based on cross-sectional data, which limits the establishment of the temporality of the exposure and outcome variables. Secondly, the study did not consider private health facilities and primary health care settings which might have introduced some bias as mothers from higher socioeconomic groups usually prefer to attend private health facilities. Also, the completed pre-pregnancy maternal weight and nutritional history were taken from the verbal response of respondents. Finally, there might be recall bias during data collection as respondents had to remember their weights nine months back, provide data for dietary intake, and recall the number of ANC visits.

## **7. CONCLUSION AND RECOMMENDATION**

### **7.1. Conclusion**

The number of ANC visits the mother had, presence of abnormal uterine bleeding during pregnancy, having a history of pre-eclampsia or eclampsia, anemia, having habits of chewing Khat, and pre-pregnancy nutritional status was found to be the key predictors of low birth weight among the study population.

### **7.2. Recommendation**

The findings imply the importance of encouraging pregnant mothers to have frequent ANC visits, educating mothers to prevent themselves from preventable pregnancy-related danger signs such as AUB, counseling on early health-seeking behavior during experiencing any pregnancy-related danger sign plays a great role in reducing LBW. Moreover, behavioral change communications targeting pregnant mother for improving their nutritional status, and reducing maternal toxic exposures should be used as key strategies by health extension workers and health professionals in each health facility working at ANC clinics to reduce the incidence of LBW babies in Addis Ababa as well in Ethiopia.

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## APPENDICES

### Annex I Consent Format

#### Greeting

Hello, I am \_\_\_\_\_. I am graduate of \_\_\_\_\_ from Addis Ababa University. I have been working in \_\_\_\_\_ as \_\_\_\_\_. I am here to ask you some questions related to Socio demographic information, Nutritional status, presence of any morbidity, and other related issues during this pregnancy period. The purpose of this study is to assess the factors that affect new born weight at birth and I want your opinion to the questions I am going to ask you. Your answer in turn will help us to design the intervention to tackle the prevalence of Low birth weight and to decrease neonatal mortality in our country.

#### Informed consent

Read the following paragraph for the selected person." To conduct our study, I would like to ask you some questions. I kindly request you to give me your sincere and truthful answer. All the information that you are going to give me will remain confidential and you don't need to mention your name." You can deny or discontinue our interview whenever you want. But your full answer has great value for our study and our community as well.

Are you willing to participate in the interview?

Yes\_\_\_\_\_ (continue the interview). No\_\_\_\_\_ (Thank and stop)

Signature\_\_\_\_\_ Date\_\_\_\_\_

Signature of the supervisor \_\_\_\_\_ Date\_\_\_\_\_

## Annex II: - Questionnaire

Questionnaire for the assessment Factors associated with LBW among mothers with recent birth  
in Public Hospitals, Addis Ababa, 2021

Before starting the interview note the inclusion criteria from clinical records or ask the mother:

1. Is the infant born single 1: Yes 2: No
2. Is the infant free of any visible major birth defect 1: Yes 2: No
3. Is the pregnancy is a term on delivery? 1: Yes 2 No

If —No to any of the inclusion criteria, stop the collection of data.

MRN: \_\_\_\_\_

Date: \_\_\_\_\_

S.N	Variable	Option	Skip
<b>Part I Demographics and Socioeconomic information</b>			
Residential area:-Region.....Sub-city.....			
101.	Mother's age (in years)	.....	
102.	Marital status	1. Currently married 2. Divorced/widowed/ Separated 3. Single	
103.	Mother's education	1. Illiterate 2. Primary(1-8) 3. Secondary(9-12) 4. Higher education	
104.	Mothers occupation	1. Housewife 2. Employed 3. Self-employed 4. Unemployed	
105.	Father's education	1. Illiterate 2. Primary (1-8) 3. Secondary (9-12) 4. Higher education	
106.	Father's occupation	1. Employed 2. Self-employed 3. Unemployed	
107.	Household size		
108.	Monthly household income (in birr)		
<b>Part II Obstetric Factors</b>			
201.	Is this Planned or unplanned pregnancy?	1. Planned 2. Unplanned	
202.	Gravidity (Number of previous pregnancies)?	.....	
203.	Parity (Number of previous live births)?	.....	
204.	Inter pregnancy interval in a month?	.....	
205.	How is Newborn Birth weight (gm.)	.....	

S.N	Variable	Option	Skip
206.	Had you ANC follow up during this pregnancy?	1. Yes 2. No	If no, skip to Q 210
207.	What is GA during the first ANC visit?	1. 1 <sup>st</sup> trimester 2. 2 <sup>nd</sup> trimester 3. 3 <sup>rd</sup> trimester	
208.	Total number of ANC visits you had?	.....	
209.	Have you informed about pregnancy-related danger signs during ANC follow-up?	1. Yes 2. No	
210.	Have you experienced any pregnancy-related danger signs/Complications?	1. Yes 2. No	If no skip to Q301
211.	If Yes, If yes, at Trimester did you get ill?	1. 1 <sup>st</sup> trimester 2. 2 <sup>nd</sup> trimester 3. 3 <sup>rd</sup> trimester	
212.	Have you experienced AUB during this pregnancy?	1. Yes 2. No	
213.	Have you experienced Pre-eclampsia during this pregnancy?	1. Yes 2. No	
214.	Have you experienced Eclampsia during this pregnancy?	1. Yes 2. No	
215.	Have you told to have Pregnancy Induced HTN during this pregnancy?	1. Yes 2. No	
<b>Part III Maternal morbidity during pregnancy</b>			
301.	Is there any Medical illness during pregnancy?	1. Yes 2. No	If no, skip to Q 315
302.	If yes, at what Trimester did you get ill?	1. 1 <sup>st</sup> trimester 2. 2 <sup>nd</sup> trimester 3. 3 <sup>rd</sup> trimester	
303.	Have you got RTI during Pregnancy?	1. Yes 2. No	
304.	Have you got UTI during Pregnancy?	1. Yes 2. No	
305.	Have you got Malaria during pregnancy?	1. Yes 2. No	
306.	Have you tested COVID-19 positive during pregnancy?	1. Yes 2. No	
307.	Have you told to have Anemia during this pregnancy?	1. Yes 2. No	
308.	Have you told to have Hypertension during this pregnancy?	1. Yes 2. No	
309.	Have you told to have Chronic kidney disease during this pregnancy?	1. Yes 2. No	
310.	Have you told to have DM during this pregnancy?	1. Yes 2. No	

S.N	Variable	Option	Skip
311.	Have you told to have HIV during this pregnancy?	1. Yes 2. No	
312.	Have you told to have Thyroid disorder during this pregnancy?	1. Yes 2. No	
313.	Have you told to have Heart Disease During Pregnancy?	1. Yes 2. No	
314.	Other illness if any?		
315.	Have you ever taken any medication for treatment during this pregnancy?	1. Yes 2. No	If no Skip to Q 401
316.	If yes, Duration (in the day)	.....	
317.	GA when you take medication?	1. 1 <sup>st</sup> trimester 2. 2 <sup>nd</sup> trimester 3. 3 <sup>rd</sup> trimester	
318.	What types of drugs did you receive?	.....	
<b>Part IV Maternal Toxic Exposure During Pregnancy</b>			
401.	Have you habits of Smoking during the pregnancy?	1. Yes 2. No	If no skip to Q 403
402.	If yes, an average number of cigarettes smoked per day (for smokers)?	.....	
403.	Are there any Smokers in Family members?	1. Yes 2. No	If No, skip to Q 405
404.	Number of cigarettes each member smokes at home per day?	.....	
405.	How many cups of coffee do you consume per day?	.....	
406.	Do you have habits of Chewing kcat during this pregnancy?	1. Yes 2. No	If No, skip to Q 408
407.	If yes, How often?	1. Daily 2. Once a week 3. Occasionally	
408.	Do you have habits of Alcohol consumption?	1. Yes 2. No	If No, skip to Q 410
409.	If yes, How often?	1. Daily 2. Once a week 3. Occasionally	
410.	Have you separate sleeping room and other use rooms from the kitchen?	1. Yes 2. No	
411.	Who mainly prepares foods for your family?	<ul style="list-style-type: none"> <li>• Servant</li> <li>• Myself</li> <li>• Husband</li> </ul>	
412.	What Types of fuels mainly you used for cooking/ food preparation?	1. Kerosene	

		2. Charcoal(Wood) 3. Electricity/other	
S.N	Variable	Option	Skip
413.	Did you Work in CO2 producing factory during your pregnancy period?	1. Yes 2. No	
<b>Part V Nutritional information</b>			
501.	Have you ever received nutritional counseling during the pregnancy period?	1. Yes 2. No	
502.	Do you have habits of eating extra meals during pregnancy?	1. Yes 2. No	
503.	How frequently do you eat Cereals?	1. Daily 2. At least one/week 3. At least once/Month 4. Not at all	
504.	How frequently do you eat Meat and Meat products?	1. Daily 2. At least one/week 3. At least once/Month 4. Not at all	
505.	How frequently do you eat Fruits?	1. Daily 2. At least one/week 3. At least once/Month 4. Not at all	
506.	How frequently do you eat Vegetables?	1. Daily 2. At least one/week 3. At least once/Month 4. Not at all	
507.	How frequently do you get Milk and Milk products?	1. Daily 2. At least one/week 3. At least once/Month 4. Not at all	
508.	Did you get Iron Supplement during this pregnancy?	1. Yes 2. No	
509.	If yes, when did you start?	1. 1 <sup>st</sup> Trimester, 2. 2 <sup>nd</sup> Trimester, 3. 3 <sup>rd</sup> Trimester	
510.	If yes for Q508, For how long did you take? (in a month)	.....	
511.	Working Hours per day?	.....	
512.	Resting Hour per day?	.....	
513.	Perceived physical workload during the pregnancy?	• No work • Moderate	

S.N	Variable	Option	Skip
514.	Mother's pre-pregnancy weight (in kg) (record her wt on the first ANC visit if she could not remember her pre-pregnancy weight)	.....	
515.	Mother's height (in centimeters) before pregnancy (record her Ht on the first ANC visit if she could not remember here pre-pregnancy Ht)	_____	
516.	Maternal MUAC on the begging of ANC follow up	.....	
517.	Mothers pre-pregnancy BMI	.....	
518.	Maternal pre-pregnancy Nutritional classification	1. Underweight 2. Normal weight 3. Overweight	
519.	The very recent maternal weight after delivery?	.....	
520.	Mother's height (in centimeters) after delivery?		
521.	Maternal MUAC after delivery?		
522.	Mothers post-pregnancy BMI?		
523.	Weight gain during pregnancy (kg)?	.....	
524.	Maternal post-pregnancy Nutritional classification	1. Underweight 2. Normal weight 3. Overweight	

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Name of PI **Meron Hailu**

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Name of Supervisor \_\_\_\_\_