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ASSOCIATION BETWEEN MATERNAL DIETARY DIVERSITY AND BIRTH WEIGHT IN ADDISALEM HOSPITAL, BAHIR DAR, NORTHWEST ETHIOPIA, 2024 GC.

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By MOHAMMED DAWED ENDRES

A THESIS SUBMITTED TO THE SCHOOL OF RESEARCH AND GRADUATE STUDIES OF BAHIR DAR UNIVERSITY, INSTITUTE OF TECHNOLOGY, FACULTY OF CHEMICAL AND FOOD ENGINEERING, DEPARTMENT OF APPLIED HUMAN NUTRITION IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER'S DEGREE IN APPLIED HUMAN NUTRITION

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A Thesis Submitted to the School of Research and Graduate Studies of Bahir Dar University, Institute of Technology, Faculty of Chemical and Food Engineering, Department of Applied Human Nutrition in Partial Fulfillment of The Requirements for the Master's Degree in Applied Human Nutrition

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Approval of thesis for defense result

I hereby confirm that the changes required by the examiners have been carried out and incorporated in the final thesis.

Name of Student: **Mohammed Dawed** Signature _____ Date 07/12/2016 E.C

As members of the board of examiners, we examined this thesis entitled "Association between Maternal Dietary Diversity and Birth Weight in Addisalem Hospital, Bahir Dar, 2024 G.C." by Mohammed Dawed Endres. We hereby certify that the thesis is accepted for fulfilling the requirements for the award of the degree of Masters of science in "Applied Human Nutrition".

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This is to certify that this thesis entitled "Association of maternal dietary diversity and infant birth weight in Addisalem Hospital, Bahir Dar, Northwest Ethiopia." submitted in partial fulfillment of the requirements for the award of the degree of Master (MSC) in "Applied Human Nutrition" to the Graduate Program of College of Chemical & Food Engineering, Bahir Dar University by Mr. Mohammed Dawed Endres (ID. No. 1000049 PE) is an authentic work carried out by him under our guidance. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of our knowledge and belief.

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DEDICATION

This work is dedicated to my parents, my beloved late father, Shah Dawed Endres Shefaw, and my mother, Momina Hassen Ahmed, who laid the foundation for my education. Their unwavering support and guidance have been instrumental in shaping my academic and personal growth.

Secondly, this work is also dedicated to my beloved children, Harris Mohammed Dawed and Anas Mohammed Dawed, as well as to the mother of my children, Hayat Ahmed Wale. Their love, encouragement, and patience have been a constant source of motivation, inspiring me to accomplish this academic endeavor.

ABSTRACT

Background: Dietary diversity is defined as the number of different foods or food groups consumed over a given reference period. Malnourished mothers often lack the capacity to effectively combat diseases and provide adequate nutrients to their children, which can have detrimental effects on the overall socioeconomic development of a country. Given the importance of dietary diversity in supporting maternal and child health, understanding the extent of dietary diversity among this population is crucial for designing effective strategies and interventions to address the problem.

Objective: To assess the dietary diversity status and its association with infant birth weight among pregnant mothers attending antenatal care at Addisalem Hospital in Bahir Dar town.

Methods: This was an institution-based cross-sectional study was conducted from September 02, 2022, to September 02, 2023 GC. Data were collected using a 24-hour dietary recall method and weight measurements after delivery. The collected data were entered, cleaned, and analyzed using SPSS version 21 software. Binary logistic regression model was employed to determine the association between dietary diversity score and infant birth weight. Odds ratios with 95% confidence intervals and p-values less than 0.05 were used to test the statistical significance of the associations.

Result: The study found that 32.4% (n=77) of the pregnant women had inadequate minimum dietary diversity for women (MDDS-W), while 67.6% (n=161) had adequate MDDS-W. Nearly all (97.9%) of the women consumed grains, white roots, tubers, and plantains. The majority (85.7%) consumed pulses, but a large proportion (75.6%) did not consume nuts and seeds. Half (50.8%) reported dairy consumption. Almost two-thirds (63%) did not have meat, poultry, or fish, and over half (52.9%) did not consume eggs. For vitamin A-rich and other plant-based foods, the majority (76.1%) did not have dark green leafy vegetables. The majority (92%) of participants had normal birth weight infants, while 8% delivered low birth weight infants. Infants born to mothers with inadequate MDDS-W had 10 times higher odds of low birth weight compared to infants born to mothers with adequate MDDS-W (OR = 9.6, 95% CI: 5.956-15.776, $p<0.001$).

Conclusion: The study found that a relatively higher proportion of pregnant women had adequate dietary diversity scores. Improved dietary diversity is associated with increased micronutrient intake and better pregnancy outcomes. The findings of this study suggest an association between maternal minimum dietary diversity (MDD-W) score and low birth weight (LBW), where mothers with low DDS had higher odds of having a low-birth-weight child compared to those with high DDS scores.

Keywords: Woman Dietary diversity, Pregnancy, birth weight; Addisalem Hospital.

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ACRONYMS AND ABBREVIATIONS

FAO	Food and Agriculture organization.
UN	United Nations.
DDS	Dietary Diversity Score.
MDD-W	Minimum Dietary Diversity for women
WFP	World Food Program.
WHO	World Health organization.
EDHS	Ethiopian Demographic and Health Surveys.
IUGR	Intrauterine Growth Retardation
ANC	Anti Natal Care
OR	Odds ratio

Chapter 1. INTRODUCTION

1.1 Background of the Study

Pregnancy is a crucial nutritionally demanding period for women. The high demand of nutrients to support the development of new maternal and fetal tissues, as well as increased energy requirements, makes pregnant women more vulnerable to malnutrition (Goldberg *G. et.al.*, 2002).

Dietary diversity (DD) is an indicator of dietary quality and overall nutritional adequacy. The Minimum Dietary Diversity for Women (MDD-W) is a validated population-level indicator of diet diversity for women of reproductive age (15-49 years) group. The MDD-W is a dichotomous indicator based on 10 food groups and is considered the standard for measuring population-level dietary diversity in this population (Tsimbos C. *et.al.*, 2011).

Lack of dietary diversity is a severe problem in the developing world, where diets are predominantly based on starchy staples with limited intake of animal products, fruits, and vegetables. A non-diversified diet can have negative consequences on individuals' health, well-being, and development, primarily by reducing physical capacities and resistance to infection (Lillian K. *et.al.*, 2013).

In developing countries, ensuring dietary diversity is a challenge for pregnant women. Limited access to adequate and diversified diets has been identified as a severe problem among poor populations, resulting in various forms of nutritional problems (Ekesa B. *et al.*, 2011).

Ethiopia is one of the countries with a high burden of maternal and child under nutrition. Malnutrition during pregnancy can have short- and long-term effects on infant health, including programming of infant development and an increased risk of non-communicable diseases in later life (CSA, 2012). Malnourished women are more vulnerable to diseases, encounter more failures, and give birth to underweight children whose survival is at risk (Isolauri E. *et al*., 2011; Koletzko B. *et al.*, 2012).

Appropriate nutrition and weight gain during pregnancy are crucial for meeting the demands of the developing fetus, the mother's own body needs, and preparing for lactation. Low weight gain during pregnancy is a risk factor for the delivery of infants too small for gestational age, leading to neonatal mortality and morbidity, failure to grow, slow cognitive development, and chronic diseases in adulthood (Taleb S. *et al.*, 2011).

According to the World Health Organization (WHO), low birth weight (LBW) is defined as the weight of live-born infants of less than 2500 grams, regardless of gestational age or other influencing factors. In addition, a child's birth weight is an important indicator of their vulnerability to childhood illnesses and chances of survival. Understanding the impact of maternal nutrition, including dietary diversity, on

perinatal outcomes is crucial for informing public health policies and interventions aimed at optimizing maternal and infant health during pregnancy (Global nutrition report, 2016). Thus, this study was aim to assess the association of maternal dietary diversity and birth weight of the infant in Addisalem Hospital, Bahir Dar town, Northwest Ethiopia.

1.2 Statement of the Problem

Maternal malnutrition during pregnancy can have both short-term and long-term adverse effects on infant health. Malnutrition can lead to the programming of infant development, which in turn increases the risk of non-communicable diseases such as obesity, type 2 diabetes, hypertension, and cardiovascular disease later in life. Malnourished mothers are also more vulnerable to diseases, experience higher rates of miscarriage, and give birth to underweight children whose survival is at greater risk. From a public health perspective, maternal nutrition is an important and modifiable factor, making it a target for potential interventions (Global nutrition report, 2016).

Inadequate dietary diversity during pregnancy, characterized by a limited intake of a variety of foods, has been linked to poorer birth outcomes. Specifically, a diet high in processed foods, sugars, and unhealthy fats has been associated with lower infant birth weight and an increased risk of delivery complications (Global nutrition report, 2016).

Notably, the global prevalence of low birth weight (LBW) is estimated to range between 15 to 20%, accounting for approximately 20 million infants born annually. Furthermore, around one-third of neonatal deaths worldwide are attributable to LBW (Global nutrition report, 2016). In the Ethiopian context, the prevalence of LBW is also significant. According to national data, the prevalence of LBW in Ethiopia was reported to be 11%, while in the Amhara region specifically, the rate was 11.2% (CSA, 2016). However, these figures may underestimate the true burden, as only 5% of children in Ethiopia are weighed at birth (USAID, 2014).

To address this challenge, Ethiopia has set a goal to achieve a 30% reduction in the number of infants born with a weight less than 2500 grams by the year 2025, requiring a 3.9% relative reduction per year between 2012 and 2025 (CSA, 2016). During pregnancy, there is a tendency for some women in Ethiopia to decrease their food intake compared to their pre-pregnancy levels. This is reported to occur for two main reasons: firstly, some women experience nausea and aversions to certain foods; and secondly, during the later stages of pregnancy, some women deliberately reduce their food intake in an effort to have a smaller fetus and an easier delivery. This practice, known in the nutrition literature as "eating down," has been previously documented in Ethiopia and other countries (USAID, 2014).

Low birth weight (LBW) is associated with a range of adverse health outcomes for the infant. Infants born with LBW are at an increased risk of impaired growth and development (WHO, 2014). LBW has

also been linked to higher rates of neonatal mortality, elevated morbidity, impaired mental development, and an increased risk of chronic diseases later in life (UNICEF & WHO, 2019).

Infants with LBW at birth have been found to have a four-fold higher risk of neonatal death compared to those with normal birth weights (Levy & Pilpel, 2017). Furthermore, the more severe the intrauterine growth retardation (IUGR), the greater the risk of mortality for the LBW infant (WHO, 2014). LBW, particularly when associated with IUGR, is also a strong predictor of smaller size and stunted growth in later childhood. Studies have shown that LBW/IUGR infants rarely achieve catch-up growth to reach normal size during childhood, leading to long-term impacts on physical development (WHO, 2014).

However, the evidence on the association between maternal dietary diversity and birth weight of the infant in Ethiopia remains inconsistent. Some studies have found that a healthier dietary pattern in pregnancy is associated with higher birth weight (Ali F. *et al.*, 2014; Mekonnen S. *et.al.*, 2015; Taddese A. *et.al.*, 2016). Conversely, other studies have found no association despite using similar study methodologies (Gemeda D. *et al.*, 2013; Abel A. *et al.*, 2014; Amanuel N. *et al.*, 2018). Furthermore, studies exploring the specific association between maternal dietary diversity during pregnancy and birth weight of the infant in Bahir Dar are rare. Thus, this study aimed to assess the association of maternal dietary diversity and birth weight of the infant in Addisalem Hospital, Bahir Dar town, Northwest Ethiopia.

1.3 Objectives of the Study

To assess association of maternal dietary diversity during pregnancy and birth weight in Addisalem Hospital, Bahir Dar City, from September 02, 2022 to September 02, 2023 GC.

1.4 Research Question

The study had been guided by the following research question: Is there an association between pregnant women dietary diversity (DD) & birth weight of the infant (BW)?

1.5 Significance of the Study

The findings from the study may lead to the development of tailored interventions to support pregnant. In addition, it can inform the provision of targeted nutritional education and support for pregnant women in Bahir Dar City and the surrounding Amhara region. The study results can help healthcare providers, such as antenatal care (ANC) clinicians and community health workers, to better understand the role of maternal dietary diversity in determining birth outcomes. Healthcare providers can use the findings to inform their nutrition-focused counseling and support for pregnant women during ANC visits, enabling them to provide more targeted and effective interventions.

Moreover, the collaboration between the researchers and the local healthcare system can strengthen the capacity of Addisalem Hospital and the Amhara Regional Health Bureau to conduct and utilize research for evidence-based decision-making and program planning. The successful completion of the study can establish a framework for future research collaborations between the hospital, the regional health bureau, and academic institutions, further enhancing the local healthcare system's research capacity and its ability to address pressing public health challenges.

Overall, the significance of this study lies in its potential to generate evidence-based insights that can inform policies, programs, and practices to improve maternal nutrition, birth outcomes, and ultimately, the health and well-being of mothers and infants in the Bahir Dar City and the Amhara region of Ethiopia.

1.6 Scope and Limitation of the Study

The study had focused only on pregnant dietary diversity and birth weight among pregnant woman in Addisalem hospital, Bahir Dar.

1.7 Organization of the Study

This research study is organized into nine chapters.

Chapter 1 introduces the study, providing background information, the statement of the problem, research objectives, questions, the significance of the study, as well as the scope of the study. Chapter 2 presents a review of the relevant literature, informing the reader about the existing knowledge in this area of study. Chapter 3 outlines the methodology employed in conducting the research. Chapter 4 reports the results and key findings of the study. Chapter 5 discusses the implications and interpretations of the findings. Chapter 6 offers the conclusions drawn from the study and provides recommendations.

Chapter 7 lists the references cited throughout the document. Chapter 8 includes supplementary appendix materials used for the study. The final chapter, Chapter 9, provides a biographical note about the principal investigator. In summary, the study focuses specifically on the relationship between pregnant women's dietary diversity and infant birth weight at Addisalem Hospital in Bahir Dar, Ethiopia, and is structured in a comprehensive manner to guide the reader through the research process and findings.

Chapter 2. LITERATURE REVIEW

2.1 Dietary diversity

The existing literature has documented the importance of dietary diversity for pregnant women. Studies have shown that a lack of dietary diversity, defined as consuming four or fewer food groups out of ten, is associated with a 9.1% incidence of low birth weight (citation). Research conducted in Pakistan found that while dietary diversity is a good proxy indicator for micronutrient adequacy in pregnant women, the practice was relatively low. The study reported that 89% had medium dietary diversity (4-5 food groups), 5% had low dietary diversity (less than 4 food groups), and 6% had high dietary diversity (more than 5 food groups) (Ali F. *et al.*, 2014).

In the Ethiopian context, the literature indicates poor dietary diversity practices among pregnant women. A study in Wollega showed that only 33.9% of pregnant women had good nutritional practices, with 35.8% avoiding certain foods due to religious, culture, or perceived effects on the baby's size. More than half of the respondents had a dietary frequency of only 1-2 meals per day (Gemeda D. *et al.*, 2013). Another study in Gondar found that 59.9% of pregnant women had poor dietary practices, while 40.1% had good dietary practices (Mekonnen S. *et al.*, 2015). Further research in West Gojam, Ethiopia revealed that a large proportion of women (98.3%) had low dietary diversity scores, with only 10.2% scoring high (DDS > 6). The consumption of essential micronutrient-rich foods such as vitamin A and iron was very low. While in Bahir Dar town showed only 39.3% of the pregnant women had good dietary practice and the rest 60.7% of pregnant women reported poor dietary practices (Amanuel N. *et al.*, 2018).

In summary, the existing literature highlights the critical importance of dietary diversity during pregnancy and the suboptimal practices observed in various regions of Ethiopia, underscoring the need for targeted interventions to improve maternal nutrition and birth outcomes.

2.2 Birth weight

The global nutrition landscape is dire, with an estimated 2 billion people suffering from micronutrient deficiencies, 800 million experiencing calorie deficiency, and 2 billion adults being overweight or obese. Among children under 5 worldwide, 159 million are stunted, 50 million are wasted, and 41 million are overweight (Global Nutrition Report, 2016). Birth weight is a critical determinant of infant and lifelong health. Both low and high birth weight have been associated with increased risks of obesity, diabetes, and other adverse outcomes in childhood, adolescence, and adulthood. Studies have also linked birth

weight to cognitive development, with higher birth weights correlating with higher intelligence scores (WHO, 2011).

The situation is particular in Ethiopia, where the 2016 Demographic and Health Survey found that 38% of children under 5 are stunted, 10% are wasted, and 24% are overweight This highlights the urgent need for comprehensive nutrition interventions to address the multifaceted burden of malnutrition in the country (CSA, 2016)..

Factors influencing birth weight include gestational age, maternal pre-pregnancy weight, socioeconomic status, and maternal education. Higher maternal education is positively associated with birth weight among native populations but negatively associated among immigrant mothers (Fuster & Annals, 2013). Interventions such as supplementation with iron, folic acid, multiple micronutrients, and food supplements have been shown to help reduce the incidence of low birth weight (Tadese A. *et al.*, 2016).

2.3 Association of dietary diversity and birth weigh

Research has assessed the relationship between maternal dietary diversity and infant birth weight. Rammohan *et al.* (2019) investigated 230 newly delivered women in India and reported that women with low dietary diversity had a significantly higher proportion of LBW babies compared to those in the medium or high dietary diversity category. In a study of 578 singleton pregnant women in Ghana, Abubakari and Jahn (2016) found that mothers with lower dietary diversity scores (DDS) had significantly low-birth-weight (LBW) infants. Similarly, Quansah *et al.* (2020) conducted a study involving 420 mothers in Ghana and found that among those with low DDS, the number of LBW infants was about two-fold that of normal-birth-weight (NBW) infants. Additionally, the risk of LBW was four times higher in the low DDS group compared to the high DDS group. Madlala *et al.* (2017) also observed a significant negative correlation between maternal dietary diversity and infant birth weight.

Similarly, Tela *et al.* (2019) assess d singleton pregnant mothers in Northern Ethiopia and showed that mothers' DDS was significantly associated with mean birth weight, with those having high DDS having significantly larger infants than those with low DDS. Similarly, Zerfu TA. *et al.*, (2016) studied 374 pregnant women in Northern Ethiopia and found that women with inadequate DDS had a significantly higher risk of LBW, and their infants' mean birth weight was significantly lower. Ahmed *et al.* (2018) studied 279 singleton live births in Dessie town and reported that mothers with low DDS had about seven times higher odds of having LBW babies. However, three of the included studies did not find a relationship between maternal DDS and newborn LBW.

Jamalzehi *et al.* (2018) studied 121 pregnant women (19 LBW, 102 NBW) in India and reported no difference in maternal DDS between the LBW and NBW groups. Manerkar and Gokhale (2017) assess d 66 infants (32 LBW, 34 NBW) in Haiti and found no difference in mean DDS between mothers of LBW and NBW infants, although the number of mothers with low DDS was non-significantly higher in the LBW group. Alemu and Gashu (2020) also reported that maternal low dietary diversity is not associated with LBW in Ethiopia.

Overall, the majority of the reviewed studies suggest a significant association between maternal dietary diversity and infant birth weight, with lower maternal DDS being linked to a higher risk of LBW. However, some studies did not find this relationship, highlighting the need for further research in this area.

2.4 Conceptual framework on Infant's birth weight

Figure 1: Conceptual framework of the study, adapted from literature (Rammohan A. *et al.*, 2019, Kheirouri, S. *et al.*, 2021)

Chapter 3. RESEARCH METHODOLOGY

3.1 Description of the Study Area

The study area, Addisalem Hospital, is located in Bahir Dar, Amhara Regional State, and north-western Ethiopia. The region is situated in the north western part of the country at a distance of 560 km away from Addis Ababa.

Bahir Dar is a city in north-western Ethiopia. It is the capital of the Amhara Region and the leading tourist's destination in Ethiopia. With a Varity of attraction in the nearby Lake Tana and Blue Nile River. The city is known for its wide avenues lined with palm trees and a Varity of color full flowers. In 2002 it was awarded the UNESCO cities for peace prize for addressing the challenges of rapid urbanization.

The total population in the Bahir Dar Special Zone is 649,429 (2012 estimation). Bahir Dar which is found 560 km far from Addis Ababa, the capital city of Ethiopia. Addisalem hospital presents around Abaymado Ate-Tewodros sub-city, and total population of the sub-city will be around 104,970(2017/18estimation) and from these 16221 households live in the sub-city of Ate-Tewodros. Hospital had been scored 1128 delivery (2022/23 G.C) and in this number the Hospital serves for 94 pregnant for ANC per month.

3.2 Study Design and period

An institution-based cross-sectional study was conducted using pregnant mothers who had taken inadequate nutrients (WDDS < 5) and those who had taken adequate nutrients (WDDS ≥ 5) (FAO, 2014) was conducted 238 second and third trimester pregnant women's in Addisalem Hospital, Bahir Dar from September 02, 2022 G.C to September 02, 2023 G.C.

3.3 Sampling size calculation

The required sample size was determined using single population proportion formula with the following assumptions: 17% of proportion of low birth weight (*Quansah DY & Boateng D, 2020)* 95% of confidence interval, and 5 % marginal error.

$$n = \frac{Z^2 * p\,(1 - p)}{d^2}$$

Where, n = the sample size

Z^2= 1.96 at 95% confidence interval

p = proportion of low birth weight =17%

d = margin of error (0.05)

$$n = \frac{(1.96)^2 * 0.17(1-0.17)}{(0.05)^2}$$

3.8416*0.1411/0.0025 = 217

Adding a 10% non-response rate, the sample size was 238.

Similarly, taking study participants with inadequate diet diversity (consumed less than or equal to four food groups), the sample size was

The sample size was calculated using double population proportion formula based on the assumption of a 95% confidence interval, 80% power, 5% margin of error, and one-to-one ratio, using the proportion of low birth weight among the exposed group (inadequate dietary diversity), and 91.9% and 8.1% in unexposed groups (adequate dietary diversity), and odd ratio of 6.4 from previous study conducted in Gojjam (Wondemagegn AT. *et al.*, 2022). The final sample size after adding 10% for loss to follow-up was 92 (46 exposed and 46 unexposed).

Therefore, the final sample size of this study was **238** obtained from the single proportion formula.

3.4 Sampling procedure

During the study period, all pregnant women who fulfill the inclusion criteria were invited for the study and those who were voluntary participated in the study until the sample size fulfilled.

3.5 Source population

All pregnant women had ANC follow up with second and third trimester and delivered in the hospital during the study period.

3.6 Inclusion and exclusion criteria

Inclusion criteria

Only pregnant women who were in second and third trimester, having ANC follow up, and delivered in Addisalem hospital, Bahir Dar were included in the study.

Exclusion criteria

Pregnant women had no ANC follow up in Addisalem hospital, Bahir Dar.

Pregnant women had delivered in Addisalem hospital, but did not have ANC follow up in the hospital.

Pregnant women had delivered twins.

Pregnant women who were severely ill.

3.7 Data collection

Instrument for data collection

Data collection tools were developed by reviewing different literature. Translation to the local language, Amharic, and back translation of the tool was done to maintain consistency. A pretest of the tool in 5% of the sample size was conducted before the actual data collection and errors identified were corrected. All data collectors were experienced health professionals, like midwives or nurses with at least a qualified diploma. In the hospital, one supervisor was assigned to oversee data collection. In addition, the investigators made a weekly visit to check the completeness and quality of the data that was collected.

3.8 Data collection procedures

Informed consent

The study was fully explained to participant. Each participant was told as they were free to be out of the study. Health extension workers in the hospital who have been familiar with the study area were recruited as research assistant to assist in data collection.

General information

Socio-demographic was collected through an interviewer-administered structured questionnaire.

Dietary intake assessment

A 24-h food recall was conducted to measure the diet diversity and nutrient adequacy of study subjects. Participants were asked for a complete list of all items used in the preparation of meals. All food items and drinks consumed on the previous day were recorded, using a 24-h recall. Local household food preparing apparatuses including glasses, spoons, cups, and tableware were considered for estimating the number of foods and drinks consumed by the study participants. These local apparatuses served as a visual aid to enhance the precision of portion size estimations. The information on individual food items and portion sizes was then analyzed to estimate nutrient adequacy.

Minimum DD-women indicator

DD for this study was calculated using the minimum DD women (MDD-W) indicator, which is an improved version of the WDD score which considers 10 food groups, and consumption of at least five of which indicates high DD groups (Kovalskys I. *et al.*, 2015). The 10 food groups are as follows: (1) Grains, white roots and tubers, and plantains; (2) Pulses (beans, peas, and lentils); (3) Nuts and seeds; (4) Dairy; (5) Meat, poultry, and fish; (6) Eggs; (7) Dark green leafy vegetables; (8) Other vitamin A rich fruits and vegetables; (9) Other vegetables; and (10) Other fruits. Dietary diversity was measured one times using a 24-h food recall. For each participant, the consumption of food groups in 24 h greater than 20g was given1 point for each food group she ate, and if not consumed were given 0 points. For each study participant, a minimum of 0 and a maximum of 10 points could be gained.

Higher scores direct higher diversity, as more food groups were described to be consumed. In addition, participants consuming at least 20 grams/day from each food group were coded as 1 and those consuming less than 20 grams/day from each food group were coded as 0. A higher score indicates a better quality of diet consumed, as consumption from more food groups may provide a variety of nutrients that probably may not be fulfilled by consumption of limited food groups.

Measurement of pregnancy outcomes

The pregnancy outcomes record was obtained from the physician's notes after delivery.

Administering the questionnaire

When the questionnaire was administered at individual level, the participant was the person who was pregnant and taken ANC in the hospital during the study period, September 2022- September 2023. The participant was asked about all foods eaten inside and outside the home in the previous day and night (24 hours).

3.9 Variables in this Study

Dependent variable

The dependent variables infants' birth weight (BW).

Independent variables

Women's dietary diversity (MDD-W).

3.10 Operational definition

Minimum dietary diversity for women (MDD-W) score - defined as the number of different food groups consumed by pregnant women members over the last 24 hours.

Birth weight definition- weight of infant measured in grams. It categorized in to three: < 2500 g as low birth weight, (2500 g to 3500 g normal birth weight, and.>3500 g as high birth weight (*WHO, 2011)*.

3.11 Data analysis

Each questionnaire was given a code and entered into the Epi-Data version 3.1 statistical packages and exported to the SPSS version 21 statistical package for analysis. Before analysis, data cleaning using frequency, listing, and sorting was done to identify any outliers and missed values, and then corrections were made by revising the original questionnaire. Descriptive results were presented using percentage, frequency, and graphs for categorical variables. In addition, binary logistic regression model was used to assess the factors associated with infant birth weight as the dichotomous outcome variable. The independent variables included in the analysis were Maternal Dietary Diversity (MDD-W): Categorized as adequate (≥5 food groups) or inadequate (<5 food groups), maternal age: Categorized as <20 years, 20-30 years, and >30 years, maternal residence: categorized as urban or rural, maternal education: categorized as illiterate/read and write, 1-8 years of schooling, and ≥9 years of schooling. Furthermore, a multivariable logistic regression model was then fitted to determine the independent predictors of low birth weight, after adjusting for all other variables in the model. Adjusted odds ratios (AOR) and 95% confidence intervals were reported. Statistical significance was set at $p<0.05$ for all analyses. The Hosmer-Lemeshow goodness-of-fit test was used to assess the model fit. For this study, the ten food groups, recommended by Food and Agriculture Organization of the UN *(FAO, 2016)* has been used to assess minimum dietary diversity for woman (MDD-W) scores.

Table 1: (MDD-W) score

No	Food group	Examples	Yes=1 No=0
1	Grains, white roots and tubers, and plantains	Barley product, maize and maize product, emmer product, wheat and wheat product, sorghum white and sorghum red product, Teff product, wheat and wheat product, Sweet potato, potato Irish.	
2	Pulses (beans, peas and lentils)	Broad beans, kidney beans, chick peas, fenugreek, lentils, peas, vetch,	
3	Nuts and seeds	Nut, nut oil, liquid nut, pumpkin seed, sunflower seed.	
4	Dairy	Fresh whole, low-fat and skim milk when drunk/consumed as such, Reconstituted powdered or evaporated milk or ultra-high temperature (UHT) (boxed) milk consumed as such, Hard cheese (e.g. cheddar, mozzarella, Swiss, parmesan),Soft cheese (e.g. ricotta, cottage, paneer),Kefir Yoghurt/curd.	
5	Meat, poultry and fish	Beef meat, tongue beef, chicken, goat meat sheep meat Fresh, frozen or dried fish, large or small, all species.	
6	Eggs	Chicken eggs, (egg, whole, boiled and egg whole, fried).	
7	Dark green leafy vegetables	Chili greens, Pumpkin greens, Spinach, Sweet potato leaves, Ethiopian kale, Swiss chard, lettuce.	
8	Other vitamin A-rich fruits and vegetables	Carrot, Pumpkin, Sweet potato (orange- or dark yellow-fleshed only), Mango (ripe, fresh and dried), Papaya (ripe, fresh and dried), Red palm fruit, red palm pulp, Tree tomato, citron, grapes, guava, lemon, tangerine, mustard greens, pepper(chili),	
9	Other vegetables	Cabbage (common and red varieties), Corn (fresh, not dried/flour/meal) (green maize), Mushroom, Onion, Tomato,	
10	Other fruits	Apple, Avocado, Banana, Cherries (cornelian), Coconut flesh, Dates (fresh and dried), Grapes, Lemon, Mandarin orange, Orange, , Pineapple, Strawberry, Watermelon,	
Other			
11	Condiments and seasonings	Fish powder, Garlic, Ginger root, Herbs, dried and fresh, all types, Lemon or lime or other juice, added to "bring up flavor" of mixed dishes Spices, dried and fresh, all types, Sugar, Tomato paste, Any other seasoning or flavoring added during cooking, Any garnish added at the end of cooking or when serving (e.g. grated cheese, grated vegetable, seeds or legumes).	
12	Other beverages and foods	Alcohol, all types, Coffee, with or without milk, if unsweetened, Herbal beverages/infusions, Olives, Pickled cucumbers, Tea, with or without milk, if unsweetened, any other food or beverage not included in previous groups/categories.	
Total sum of MDD-W score			

(FAO, 2016; CSA, 2018).

Table 2: MDD-WS description

Characteristic	Description of MDD-W
Recall method and time period	Qualitative 'free' recall of all food/drink consumed by any pregnant during the past 24 hours
Number of food groups used to create the score	10
Number of food type in the questionnaire	>80
Weighting of food groups	Each food group consumed has a value (weight) of 1and not consumed 0
Typical cut-points	Population distribution of scores used to form less than 5 food group inadequate and greater than 5 adequate for analysis of groups.
Includes foods	All foods/drinks consumed by pregnant women during the past 24 hours.
Does not include foods	Any drug and foods not more than a tea spoon.

(Source: own development, 2023)

3.12 Ethical clearance

Ethical approval was obtained from Bahir Dar University, facility of Chemical and food engineering, department of Applied Human Nutrition. Official letter of support was also secured from the Amhara regional public health institute and Addisalem hospital. Finally, oral consent was acquired from the department of gynecology and obstetrics and study participants.

3.13 Dissemination of result

The findings of this study will be disseminated for Bahir Dar University, facility of Chemical and food engineering, department of Applied Human Nutrition, Amhara regional public health institute and Addisalem hospital. National workshop presentation and publication on the international or local journals will be tried.

Chapter 4. RESULTS

4.1 Socio-demographic characteristics of study participants

The current study included a sample of 238 pregnant women, with a response rate of 100%. More than half (53.8%) were in the 20-30 years age group. In terms of educational status, 45.0% of the respondents had attended high school or above. The majority of participants (80.7%) had a family size of one to five members. The socio-demographic characteristics of the study participants are summarized in Table 3.

Table 3: Socio-demographic characteristics of study participants' in Addisalem hospital Bahir Dar (n=238), 2024.

No	variable	frequency	Percent (%)
1	**Age of the pregnant woman**		
	<20	18	7.6
	20-30	128	53.8
	>30	92	38.7
2	**Nationality of the pregnant woman**		
	Amhara	223	93.7
	Tigre	6	2.5
	Others (Oromo, Guragie, Hadery)	9	3.8
3	**Religion of the pregnant woman**		
	Muslim	43	18.1
	Orthodox	168	70.6
	Others (catholic, protestant, seven days Adventist)	27	11.3
4	**Marital status of the pregnant**		
	Married	230	96.6
	Divorced/separated	6	2.5
	Widowed	2	0.8
5	**Educational level of the pregnant women**		
	Illiterate	44	18.5
	Read and write	23	9.7
	From grade 1 -8	64	26.9
	High school and above	107	45.0
6	**Residence of the pregnant woman**		
	Urban	182	76.5
	Rural	56	23.5
7	**Occupation of the pregnant woman**		
	House wife	97	40.8
	Government employee	7	2.9
	Private employee	102	42.9
	Daily laborer	22	9.2
	farmer	10	4.2
8	**Household size of the pregnant woman**		
	1-5	192	80.7
	6-10	46	19.3

4.2 Minimum Dietary Diversity among pregnant women

Nearly all the women (97.9%) consumed grains, white roots, tubers, and plantains. The majority (85.7%) also consumed pulses. Half of the participants (50.8%) had consumed dairy products within the previous 24 hours. However, a substantial proportion of the women did not meet the recommended intake for certain food groups. Three-quarters (75.6%) had not consumed any nuts and seeds in the previous 24 hours. Similarly, a majority (63%) had not consumed meat, poultry or fish, and over three-quarters (76.1%) had not taken any dark green leafy vegetables.

While the intake of other vitamin A-rich fruits and vegetables was relatively better, with 23.5% of women consuming them, the consumption of other vegetables (41.2%) and other fruits (63.0%) was still suboptimal within the 24-hour recall period. These findings suggest that the dietary diversity and nutrient adequacy of the participants' diets may be suboptimal, which could have implications for maternal and fetal health outcomes.

Table 4: Food groups among pregnant women in Addisalem hospital Bahir Dar (n=238), 2024 GC.

No	Variable	frequency	Percent (%)
1	**Grains, white roots and Tubers, and plantains**		
	No	5	2.1
	Yes	233	97.9
2	**Pulses (beans, peas and lentils)**		
	No	34	14.3
	Yes	204	85.7
3	**Nuts and seeds**		
	N0	180	75.6
	Yes	58	24.4
4	**Dairy**		
	No	121	50.8
	Yes	117	49.2
5	**Meat, poultry and fish**		
	No	150	63.0
	Yes	88	37.0
6	**Eggs**		
	No	126	52.9
	Yes	112	47.1
7	**Dark green leafy vegetables**		
	No	181	76.1
	Yes	57	23.9

8	**Other vitamin A-rich fruits and vegetables**		
	No	182	76.5
	Yes	56	23.5
9	**Other vegetables**		
	No	140	58.8
	Yes	98	41.2
10	**Other fruits**		
	No	88	37.0
	Yes	150	63.0

The dietary diversity of the pregnant women was assessed using a 24-hour dietary recall. The results showed that the mean dietary diversity score (DDS) for the study participants was 3.14.

Further examination of the minimum dietary diversity for women (MDDS-W) indicator revealed that 32.4% of the pregnant women (n=77) had inadequate dietary diversity, while 67.6% (n=161) were classified as having adequate dietary diversity. These findings highlight the distribution of dietary diversity among the pregnant women in the study sample. While a significant proportion of the women demonstrated adequate dietary diversity, a smaller subset exhibited inadequate dietary diversity levels.

This suggests the need to investigate the dietary intake and diversity patterns more thoroughly, as suboptimal dietary diversity can have implications for maternal and fetal health outcomes. Targeted nutrition education and interventions may be warranted to improve dietary diversity, particularly among the women with inadequate MDDS-W.

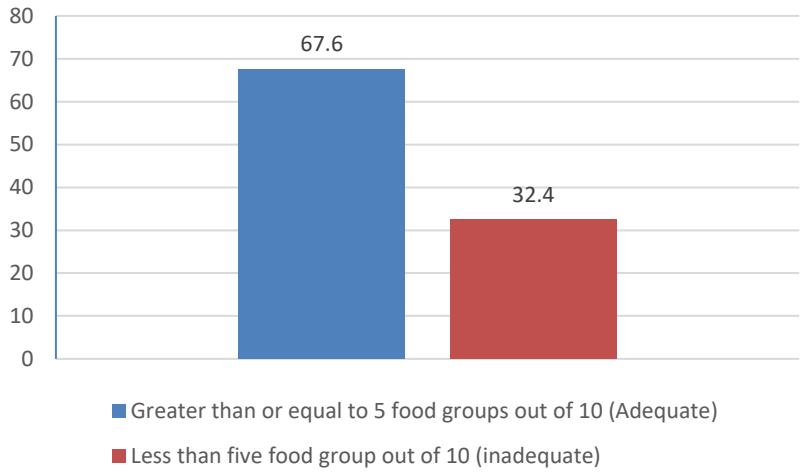

Figure 2: Minimum dietary diversity score for pregnant woman in Addisalem hospital Bahir Dar, 2024

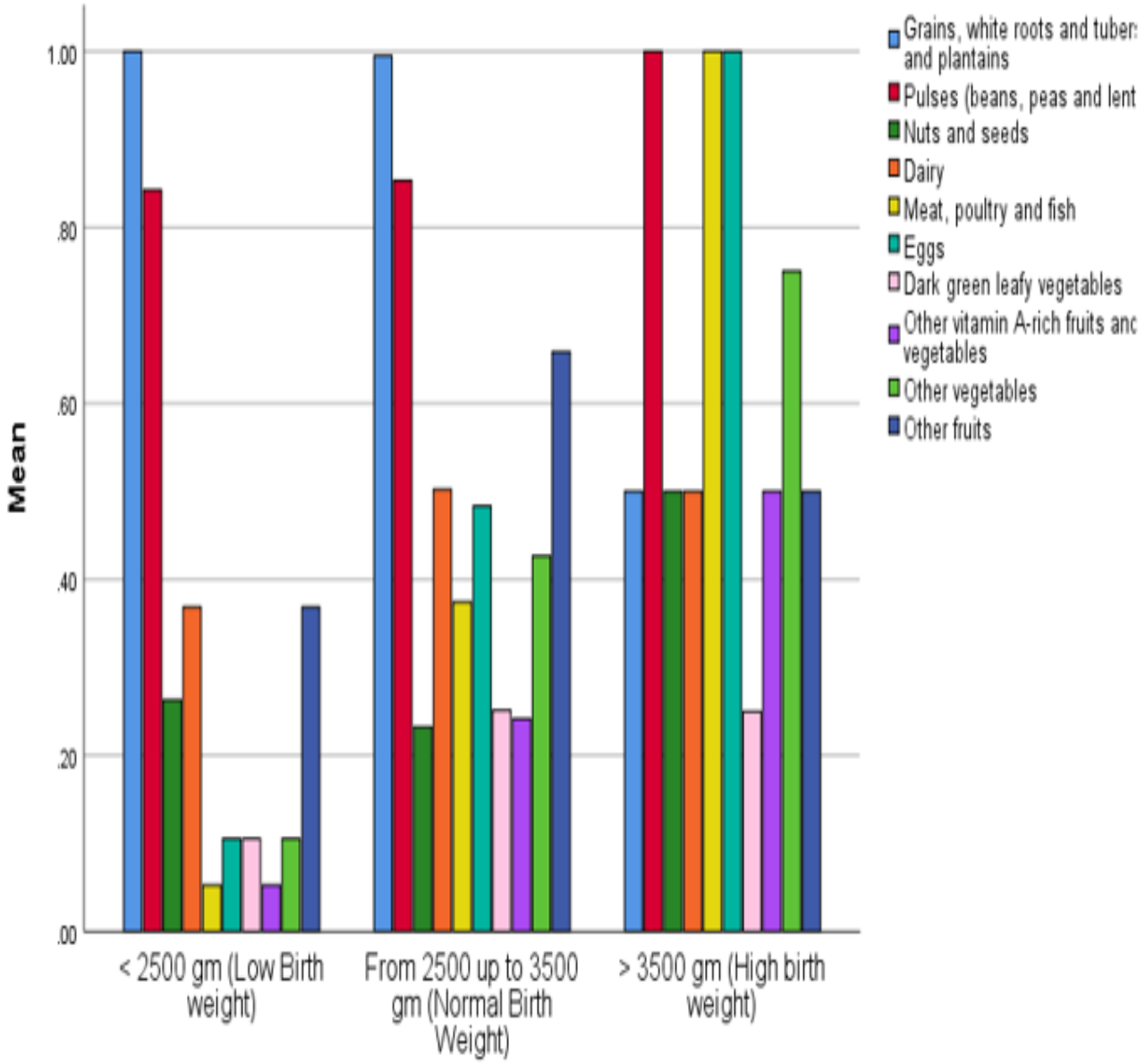

Figure 3: Ten food groups' consumption distribution among pregnant women and infant birth weight in Addisalem hospital Bahir Dar, 2024.

Furthermore, as we see from the result there is no infant delivery with high birth outcome, in the pregnant mother with the score of inadequacy. This indicated that woman dietary diversity highly associated with birth outcome. But little number of pregnant women those wear score adequate dietary diversity score deliver low birth weight infant. This maybe some other factors highly affect birth outcome.

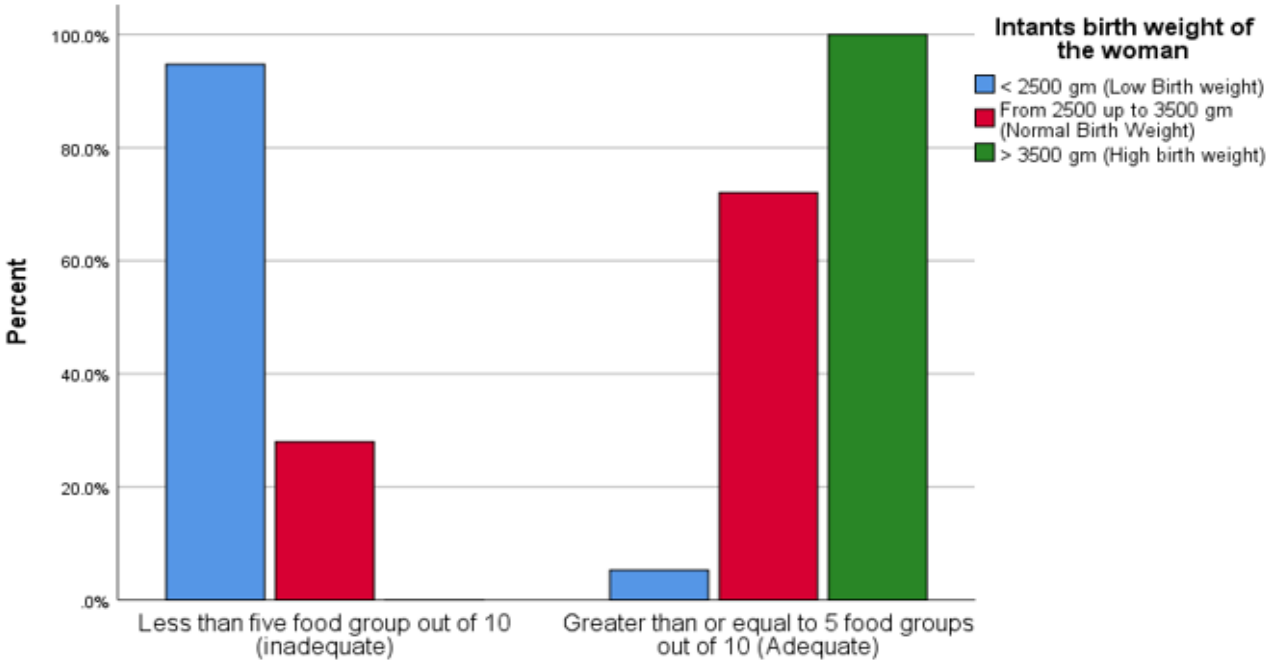

Figure 4: Minimum dietary diversity score for pregnant woman versus birth weight of infants in Addisalem hospital Bahir Dar (n=238), 2024 GC.

4.3 Birth weight of infants

The research findings revealed that the majority of the study participants, specifically 211 participants comprising 88.7% of the total sample, had given birth to infants with normal birth weights. In contrast, a smaller proportion of participants, consisting of 19 individuals (8.0%), delivered infants with low birth weights, while an even smaller subset of 8 participants (3.4%) gave birth to infants with high birth weights. These results highlight the distribution of birth weight outcomes among the study participants, with a significant number delivering infants within the normal range, while a minority experienced low or high birth weight outcomes.

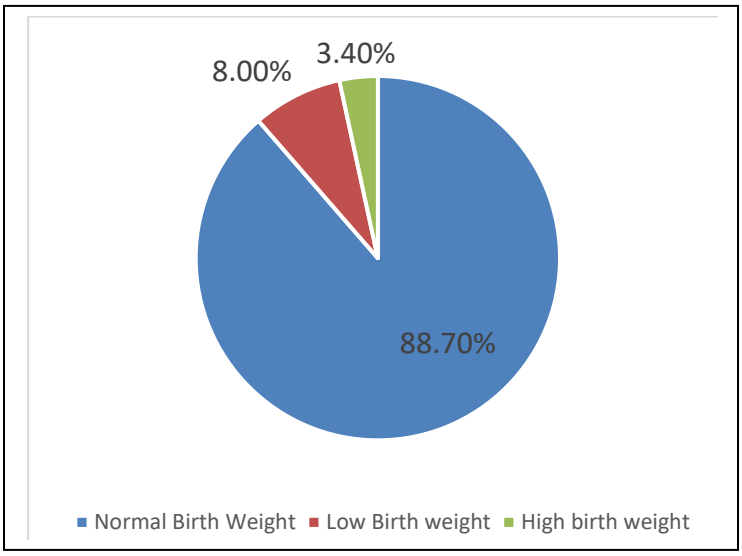

Figure 5: Birth weight of Infants obtained among pregnant women in Addisalem hospital Bahir Dar, 2024.

4.1 Association of MDD-W with infants' birth weight

The key findings from the crosstab analysis suggest that adequate maternal dietary diversity, younger maternal age (20-30 years), urban residence, and higher maternal education levels are associated with higher rates of normal infant birth weight in the study population. These insights can inform interventions to promote maternal and child health in the study area.

Similarly, the key findings from the binary logistic regression analysis indicates inadequate maternal dietary diversity was very strongly associated with increased odds of low infant birth weight, with infants born to mothers with inadequate dietary diversity having 15.7 times higher crude odds of low birth weight compared to infants born to mothers with adequate dietary diversity (COR=15.700, 95% CI: 5.181-17.579, $p<0.001$). Urban maternal residence was associated with significantly lower odds of low infant birth weight, with infants born to urban residents having 63.3% lower crude odds compared to rural residents (COR=0.367, 95% CI: 0.158-0.855, $p=0.020$). Higher maternal education levels (≥9 years of schooling) showed a potentially protective effect, with a 61.1% lower crude odds of low birth weight, though the result was not quite statistically significant (COR=0.389, 95% CI: 0.148-1.027, $p=0.057$). Maternal age did not demonstrate a statistically significant association with infant birth weight in this analysis.

However, the multiple logistic regression analysis revealed that, after adjusting for other maternal factors, inadequate maternal dietary diversity remained a very strong and statistically significant independent risk factor for low infant birth weight (AOR =9.794, 95% CI: 5.956-15.776, $p<0.001$). In contrast, the other maternal variables examined - including maternal education, maternal residence, maternal age, and adequate maternal dietary diversity (MDD-W) - did not demonstrate statistically significant independent associations with infant birth weight in the fully-adjusted model (Table 5).

Table 5: Association of maternal dietary diversity during pregnancy and birth weight of the infant in Addisalem Hospital, Bahir Dar, North west Ethiopia (n=238), 2024 GC

Variables		**Infant birth weight**		COR	95% CI	p-value	AOR	95% CI	p-value
		< 2500 gm.	**≥2500 gm.**						
MDD-W	In adequate	14(73.7%)	8(3.8%)	15.700	5.181-17.579	<0.001	**9.794**	**5.956-15.776**	**<0.001**
	Adequate	5(26.3%)	211(96.2%)		1			1	
Age	< 20	5(19.2%)	13(6.1%)		1			1	
	20-30	10(38.5%)	118(55.7%)	0.353	0.105-1.182	0.091	0.187	0.038-0.917	0.039
	> 30	11(42.3%)	81(38.2%)	1.602	0.650-3.949	0.305	1.023	0.352-2.972	0.967
Resident	Urban	15(57.7%)	167(78.8%)	0.367	0.158-0.855	0.020	2.300	0.597-8.863	0.226
	Rural	11(42.3%)	45(21.2%)		1			1	
Educational status	Illiterate or read and write	7(26.9%)	60(28.3%)		1			1	
	1-8 school	11(42.3%)	53(25%)	0.693	.239-2.007	0.499	0.584	0.150-2.268	0.437
	≥ 9 school	8(30.8%)	99(46.7%)	0.389	0.148-1.027	0.057	0.373	0.091-1.527	0.170

Chapter 5. DISCUSSIONS

This study was conducted to assess the association between maternal dietary diversity during pregnancy and infant birth weight at Addisalem Hospital, Bahir Dar City. The mean dietary diversity score (DDS) of the pregnant women in this study was consistent with the findings from a previous study in Tanzania, where the mean DDS for pregnant women was 3 (Madzorera I. *et al.*, 2020). Similar results were also reported in two studies from Bangladesh, where the mean WDDS for participants of reproductive age was 4.3 and 3.8, respectively (Harris-Fry *et al.*, 2015; Arsenault JE. *et al.*, 2012). The consistency of the current findings with previous studies in Tanzania and Bangladesh suggests that the mean DDS of pregnant women in this study setting is comparable to other low- and middle-income country contexts.

However, the mean DDS observed in the current study is notably lower than the finding from a study conducted in Iran, which reported a mean WDDS of 5.23 *(*Tahereh *K. et al., 2022).* This discrepancy may be attributed to cultural, economic, and health literacy differences between the Ethiopian and Iranian populations. The lower mean DDS compared to the Iranian study highlights the potential for improving maternal dietary diversity in the study population, which may have implications for infant birth weight outcomes.

The dietary intake analysis in this study showed that pregnant women with higher dietary diversity scores (DDS) also had higher intake across the main food groups comprising the DDS, including cereals, meats, dairy, vegetables, and fruits. These findings are consistent with a previous study conducted in Iran. That study found that women with the highest total WDDS scores also had higher intakes of dairy, animal-source foods, and vitamin A-rich fruits and vegetables, compared to those with lower total WDDS *(*Tahereh *K. et al., 2022).*.

Similarly, the current study found that a significant proportion of the pregnant women had adequate dietary diversity, while a smaller subset demonstrated inadequate dietary diversity levels. This aligns with a previous study from Iran, which reported that adequate dietary diversity during pregnancy and greater consumption of dairy, fruits, vegetables, and animal-source foods like meat and eggs were associated with a lower risk of low birth weight (LBW) (Zerfu TA. *et al.*, 2016).

However, the findings from this study contrast with results from studies in Iran and Ghana, which found an inverse relationship between individual dietary diversity score (IDDS) and the incidence of LBW

(Saaka M. *et al*., 2013). Additionally, a randomized controlled trial in India did not find that increased intake of dairy products, fruits, and vegetables before and during pregnancy affected birth weight (Potdar et al., 2014).

These discrepancies in findings highlight the need for further research to elucidate the complex relationships between maternal dietary diversity, dietary intake, and birth weight outcomes. Contextual factors, such as cultural, economic, and health literacy differences, may contribute to the varying results across different study settings.

The dietary intake analysis in this study found that pregnant women with higher scores on the Dietary Diversity (DDS) also had higher intakes across all the main food groups, including cereals, meats, dairy, vegetables, and fruits. This aligns with the findings from a previous study conducted in Iran. That study reported that women with the highest total WDDS scores had higher intakes of dairy, animal-source foods, and vitamin A-rich fruits and vegetables, compared to those with lower total WDDS scores (Tahereh K. et al., 2022).

Further analysis of the dietary habits across different birth weight categories revealed some potentially important distinctions. Consumption of grain, white root vegetables, tubers, and plantains did not exceed 50% of the overall dietary intake, regardless of birth weight status. In contrast, the intake of meat, poultry, fish, eggs, and various vegetables was higher among women who delivered high-birth-weight infants. This suggests a possible link between these food groups and increased birth weight. Interestingly, pulses and dark green leafy vegetables were consumed at relatively equal levels across all birth weight categories. This indicates that these food items are commonly included in the diets of women, irrespective of their infant's birth weight. These mixed findings underscore the complexity of the relationship between maternal diet and birth weight outcomes. Additional research will be important to further elucidate the underlying mechanisms and implications of these dietary patterns (Bhutta ZA. et al., 2013).

Similarly, the current study observed that a significant proportion of the pregnant women fell into the category of having adequate dietary diversity, while a smaller subset demonstrated inadequate dietary diversity levels. This finding is consistent with a previous study from Iran, which found that adequate dietary diversity during pregnancy and greater consumption of dairy, fruits, vegetables, and animal-source foods like meat and eggs were associated with a lower risk of LBW (Zerfu TA. et al., 2016).

However, the findings from this study appear to contrast with previous research conducted in Iran and Ghana. Those earlier studies found that higher Individual Dietary Diversity Scores (IDDS) were

significantly associated with a lower incidence of low birth weight (LBW) infants. Nevertheless, the current results are more aligned with a randomized controlled trial in India. That study showed that providing pregnant women with a specially formulated snack containing more dairy products, fruits, and vegetables did not significantly affect birth weight outcomes (Potdar RD. et al., 2014).

The study findings underscore the robust and statistically significant association between inadequate maternal dietary diversity and low infant birth weight, even after adjusting for other maternal factors. Notably, maternal urban residence and higher maternal education (≥9 years of schooling) exhibited potential protective effects on infant birth weight, although these associations did not reach statistical significance. These results highlight the critical need for targeted nutritional interventions and policy initiatives aimed at enhancing dietary diversity among pregnant women. Such efforts represent a promising strategy to promote healthy birth weights and alleviate the burden of low birth weight.

The relationship between maternal dietary patterns and birth weight is further complicated by the mixed findings from various prospective cohort studies (Ali F. *et al.*, 2014; Mekonnen S. *et al.*, 2015; Taddese A. *et al.*, 2016). Some have reported that healthier dietary patterns during pregnancy are associated with higher birth weights. Yet, other studies using similar methodologies found no such associations (Gemeda D. *et al.*, 2013; Abel A. *et al.*, 2014; Amanuel N. *et al.*, 2018). Notably, a meta-analysis of 7 studies involving over 70,000 participants did find that higher maternal adherence to a healthy diet during pregnancy was associated with 28% lower odds of having an LBW infant (Emond J., et al., 2018).

These findings underscore the critical role that maternal nutritional status, as reflected by dietary diversity, plays in determining birth weight outcomes. The data highlights the need for targeted interventions to promote diverse and nutrient-rich diets for pregnant women in order to optimize fetal growth and development and reduce the burden of low birth weight.

Chapter 6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The majority of participants had normal birth weight infants, while 8% delivered low birth weight infants and 3.4% had high birth weight infants. The analysis revealed that inadequate maternal dietary diversity was a very strong, independent risk factor for low infant birth weight. In contrast, maternal education, residence, age, and adequate dietary diversity were not significantly associated with birth weight in the fully-adjusted model. These findings underscore the critical importance of promoting diverse, nutrient-rich maternal diets during pregnancy to support healthy infant birth outcomes, as maternal dietary diversity appears to be a key determinant above other socio-demographic factors.

6.2 Recommendation

The findings of this study indicate that mothers who had adequate dietary diversity during pregnancy had lower odds of delivering an infant with low birth weight (LBW). Given these observations, the authors recommend that there is a need to counsel and educate mothers on the most appropriate nutritional practices and food intakes during pregnancy, in order to help prevent or reduce the prevalence of LBW in the study area.

Importantly, the authors also highlight the need for further investigation on the association between maternal dietary diversity scores during pregnancy and the rate of low birth weight, including fetal death.

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Chapter 8. APPENDIX

1. MDD-W Food Groups

The Food and Agriculture Organization (FAO) and the United States Agency of International Development (USAID) both recommend the use of the MDD-W when a categorical indicator of individual dietary diversity for women is needed. These organizations also recommend using the 10-food group dietary diversity indicator if a continuous variable is desired.

Table1. MDD-W Food Groups

S/no	Food groups	Example
1.	Grains, roots, and tubers	Barley product, maize and maize product, emmer product, wheat and wheat product, sorghum white and sorghum red product, Teff product, wheat and wheat product, Sweet potato, potato Irish.
2.	Pulses	Broad beans, kidney beans, chick peas, fenugreek, lentils, peas, vetch,
3.	Nuts and seeds	Nut, nut oil, liquid nut, pumpkin seed, sunflower seed.
4.	Dairy	Fresh whole, low-fat and skim milk when drunk/consumed as such, Reconstituted powdered or evaporated milk or ultra-high temperature (UHT) (boxed) milk consumed as such, Hard cheese (e.g. cheddar, mozzarella, Swiss, parmesan),Soft cheese (e.g. ricotta, cottage, paneer),Kefir Yoghurt/curd.
5.	Meat, poultry, and fish	Beef meat, tongue beef, chicken, goat meat sheep meat Fresh, frozen or dried fish, large or small, all species.
6.	Eggs	Chicken eggs, (egg, whole, boiled and egg whole, fried).
7.	Dark leafy greens and vegetables	Chili greens, Pumpkin greens, Spinach, Sweet potato leaves, Ethiopian kale, Swiss chard, lettuce.
8.	Other Vitamin A-rich fruits and vegetables	Carrot, Pumpkin, Sweet potato (orange- or dark yellow-fleshed only), Mango (ripe, fresh and dried), Papaya (ripe, fresh and dried), Red palm fruit, red palm pulp, Tree tomato, citron, grapes, guava, lemon, tangerine, mustard greens, pepper(chili),
9.	Other vegetables	Cabbage (common and red varieties), Corn (fresh, not dried/flour/meal) (green maize), Mushroom, Onion, Tomato,
10.	Other fruits	Apple, Avocado, Banana, Cherries (cornelian), Coconut flesh, Dates (fresh and dried), Grapes, Lemon, Mandarin orange, Orange, , Pineapple, Strawberry, Watermelon,

(FAO & FHI, 2016).

Food group descriptions

Note that the food groups described here generally follow culinary, rather than botanical, definitions and classifications for such items. For example, tomatoes and peppers are classified as vegetables rather than fruits, and the "Nuts and seeds" group includes only certain types of seeds that are typically described as such in one or many cuisines (e.g. sesame seeds or pumpkin/squash seeds).

Group 1 – grains, white roots and tubers, and plantains

This group is sometimes also called "starchy staples". These foods provide energy, varying amounts of micronutrients (e.g. certain B vitamins provided by grains) and varying amounts of anti-nutrients. Note that white-fleshed plantains (a fruit) are included in this group because they share a similar nutrient profile to some roots and tubers and play the same role in diets as a "starchy staple" food. Common examples from this group include all types of breads and flatbreads, stiff porridges of maize, sorghum, millet or cassava (manioc), pasta, potatoes, white-fleshed sweet potatoes.

Group 2 – pulses (beans, peas and lentils)

This group includes members of the plant family *Fabaceae* (alternate name *Leguminoseae*), such as beans, peas and lentils. The seeds are harvested at maturity and dried and used as food or processed into a variety of food products. This group does not include the same plants harvested green or immature and eaten fresh in the pod – these are included in the "Other vegetables" group. It also does not include groundnut (peanut) because while groundnut is in the *Fabaceae* family, both its high fat content and most common culinary uses are different from other legumes and similar to those of tree nuts. The pulses group does include mature seeds (beans) and processed products, such as tofu, tempeh and other soy products. The group is high in protein and B vitamins, although the protein is not "complete" and certain amino acids must be supplied by other foods. Pulses represent a very important protein source in plant-based diets and among populations where animal-source foods are largely unaffordable. Fat content of pulses is generally low, with the exception of soybean. Pulses contain varying amounts of anti-nutrients that inhibit absorption of certain nutrients. Common examples from this group include common bean (black, kidney, pinto), broad bean (fava, field bean), chickpea (garbanzo), pigeon pea, cowpea, lentil and soybean/soybean products or other legume products.

Group 3 – nuts and seeds

This group comprises mostly tree nuts but also includes groundnut (peanut) and may include certain seeds when consumed in substantial quantities. While seeds are usually recorded in the "Condiments and seasonings" category (below), they are included in the nuts/seeds category if they are a substantial ingredient in local mixed dishes or if they are eaten as a substantial snack or side dish. This group also includes nut and seed "butters", such as pounded groundnut/peanut butter, cashew butter or sesame butter (tahini), when consumed in substantial amounts and not merely added to flavor mixed dishes. Note that oils extracted from nuts and seeds are not included in this group. Nuts and certain seeds are rich in unsaturated fatty acids, vegetable protein, fiber, minerals, tocopherols, phytosterols and phenolic compounds. They may have unique health benefits [54].With the exception of chestnuts, they generally have a very high fat content. Common tropical tree nuts include cashew, macadamia and Brazil nut; common nuts grown in more temperate zones include almond, chestnut, hazelnut, pecan, pistachio and walnut. Peanut/ groundnut cultivars are grown in a wide range of climates. Commonly consumed seeds include sesame, sunflower, pumpkin/squash/gourd and pine nut.

Group 4 – dairy

Dairy foods are easily understood as a group and are important sources of high-quality protein, potassium and calcium, as well as vitamin B12 (available only from animal-source foods) and other micronutrients. This group includes almost all liquid and solid dairy products from cows, goats, buffalo, sheep or camels. Tinned, powdered or ultra-high temperature (UHT) milk, soft and hard cheeses and yoghurt and kefir are also included. However, butter, cream and sour cream, ice cream, sweetened condensed milk and processed/ packaged "yoghurt drinks" are excluded. Butter, cream and sour cream are classified with fats and oils because of their high fat content and most typical culinary uses. Ice cream and sweetened condensed milk are classified with sweets. Commercially processed/packaged "yoghurt drinks" are classified with sweet drinks, because these are usually high in sugar and low in dairy content. While high-quality ice cream and yoghurt drinks can contain substantial amounts of dairy and associated nutrients, cheaper and poorer-quality products do not, and the classification is aimed to avoid false inflation of the proportion of women consuming nutritious dairy products.

Group 5 – meat, poultry and fish

This group is sometimes referred to as "flesh foods". All meats, organ meats, poultry and other birds and fresh and dried fish and seafood/shellfish are included. Wild birds and mammals ("bush meat"), snakes, frogs and other reptiles and amphibians are also included. On the questionnaire, these appear as three subgroups: organ meat, meat and poultry, and fish/seafood. All flesh foods are important sources of high-quality protein and bioavailable micronutrients, notably iron, zinc and vitamin B12 (the last is available only from animal-source foods).There is increasing interest in and concern regarding consumption of red meat and processed meats [54].n some settings, consumption of animal-source foods is very low, while in others it is consumed in excess of needs. For the purposes of the MDD-W indicator, all flesh foods, including red meat and processed meat, are included in this group. However, in settings where there are public health concerns about excessive consumption and/or where processed meats are widely consumed, an additional row could be added to the questionnaire to disaggregate and capture descriptive information about specific types of meat of concern, i.e. to separate red meat and/or processed meat from other items. For global comparability, however, these items should still "count" in MDD-W in the same way as poultry or fish.

Group 6 – eggs

This group includes eggs from any type of bird (domesticated poultry and wild birds) but not fish roe, which are classified with small protein foods. Like other animal-source foods, eggs are a good source of protein, vitamin B12 and a range of bioavailable micronutrients.

Group 7 – dark green leafy vegetables

Essentially all medium-to-dark green leafy vegetables are vitamin A-rich only very light leaves, such as iceberg lettuce, are not. Medium green leaves, such as Chinese cabbage, romaine and Bibb lettuce, along with darker greens, are all vitamin A-rich and are included in this group. In addition to being rich in vitamin A, many green leafy vegetables are rich in folate and several other micro nutrients. Commonly consumed leaves vary widely by country and region, and include many wild and foraged species, as well as the green leaves of other food crops (e.g. cassava leaves, bean leaves, pumpkin leaves, amaranth leaves and others). In the absence of information on nutrient content, wild/foraged leaves that are medium-to-dark green can be assumed to be vitamin A-rich and placed in this group.

Group 8 – other vitamin a-rich fruits

This group includes both vitamin A-rich fruits and a small but diverse group of vitamin A-rich vegetables other than leafy greens. These foods may also be good sources of vitamin C and/or folate and/or other micronutrients. While "Other vitamin A-rich fruits and vegetables" constitutes one of the ten distinct food groups in the indicator, fruits are listed separately from vegetables on the questionnaire, as this may be more intuitive for enumerators. The most common vitamin A-rich fruits are ripe mango and ripe papaya; others include red palm fruit/pulp, passion fruit, apricot and several types of melon. When eaten "green" (unripe), mango and papaya are not rich in vitamin A and if consumed "green" should be classified with "Other fruits". Certain varieties of ripe, deep yellow-fleshed or orange-fleshed bananas are also rich in vitamin A, but white/cream-fleshed bananas are not. Deep yellow-fleshed and orange-fleshed bananas may be classified with vitamin A-rich fruits when their high vitamin A content is known to survey planners and it is considered feasible to distinguish bananas by color during fieldwork. Otherwise, all bananas should be classified with "Other fruits" Other vitamin A-rich vegetables include orange-fleshed sweet potato, carrot, pumpkin and deep yellow- or orange-fleshed squash.

Group 9 – other vegetables

This group includes vegetables not counted above as dark green leafy vegetables or as other vitamin A-rich vegetables. Diets rich in fruits and vegetables are associated with positive health outcomes. This may be due to consumption of a range of bioactive compounds found in fruits and vegetables, including phenolic, flavonoids and fiber, and not just to their commonly recognized role as sources of micronutrients [63].This group includes legumes when the fresh/green pod is consumed (as in fresh peas, snow peas, snap peas or green beans). In general, the "Other vegetables" group follows the culinary definition of a vegetable, not the botanical definition. It includes stems, fruits and flowers of plants when generally consumed in savory dishes and considered as vegetables in culinary systems. So, for example, cucumber, tomato and okra (all fruits in botanical terms) are included as "Other vegetables". However, this group excludes high-carbohydrate "starchy" roots and tubers, such as white potatoes, white yams, cassava and cocoyam, because their nutrient contributions differ, even though they are considered vegetables in some culinary definitions. Exclusion of roots and tubers is consistent with how WHO documents define which vegetables count towards the recommended consumption of fruits and vegetable. As with dark green leafy vegetables, commonly consumed vegetables vary widely with geography and can include foraged as well as cultivated foods.

Group 10 – other fruits

This group includes most fruits, excluding vitamin A-rich fruits. Health effects of diets rich in fruits and vegetables were noted above. As with "Other vegetables", this group follows the culinary definition of fruits and so does not include tomatoes, etc., as explained above. Fruits are usually easily recognized and classified as such. Note that plantains are classified with starchy staples, but sweet white bananas are classified with fruit. As with vegetables, commonly consumed fruits vary widely with geography and can include foraged as well as cultivated fruits.

Condiments and seasonings – required

This category includes all minor ingredients in mixed dishes, which primarily provide flavor and would be consumed in very small amounts in any individual serving of the dish. It includes items added at any stage of cooking or when serving food (e.g. garnishes sprinkled on top of a dish to add flavor or visual appeal). This category includes fresh or dried herbs, spices, chili peppers, ginger root, garlic, fish

powder, bean paste, fermented bean paste, tomato paste and seeds added for flavor or to garnish mixed dishes. It also includes bouillon cubes, “Maggi cubes” and similar items, soy sauce, fish sauce and pepper sauce. It includes sugar when sugar is added as a flavoring to mixed dishes or side dishes. Note that many of these items that are added to flavor dishes may be nutritious and could be promoted as nutrient-rich additions to the family meal. But the amounts consumed are typically small and do not contribute substantially to micronutrient adequacy. Several studies have shown that exclusion of foods eaten in very small quantities strengthens the association between food group diversity and micronutrient adequacy [40]. Therefore, these items are placed in the “Condiments and seasonings” category to avoid a false inflation of women’s dietary diversity. The reason for including this category on the questionnaire is primarily to give a place for enumerators to mark these foods to avoid falsely classifying elsewhere.

Other beverages and foods – required

This category includes beverages, such as unsweetened tea, unsweetened coffee, clear broth, herbal infusions and alcohol, and miscellaneous foods, such as pickles and olives. In addition, and optionally, a space can be left where enumerators can write down other recalled foods if they are uncertain where to classify the item on the questionnaire. If it will not be possible for supervisors to review forms with enumerators on an ongoing basis (as in many large-scale surveys), having enumerators write in “other” foods are not advised. In surveys with smaller sample sizes, allowing use of this space can contribute to ongoing enumerator training and data quality control, especially if there is timely review by supervisors and feedback to the enumerator. The reason for including this category on the questionnaire is primarily to give a place for enumerators to mark these foods to avoid falsely classifying elsewhere.

2. Interview questionnaire for maternal diet during pregnant

Information sheet and informed consent

Title of the project: *Association of maternal dietary diversity during pregnancy and birth weight of the infant in Addisalem Hospital, Bahir Dar, North west Ethiopia.*

Name of the organization: Bahir Dar University, Institute of Technology, School of Chemical and Food Engineering.

Introduction: The information sheet and consent form prepared by the investigator with the aim of explaining the research project that you are asked to join by the group of research investigators. The main aim of this research project is to assess the effects of maternal dietary diversity and associated factors during pregnancy on birth weight of the infant. Decision on your involvement will be made by you and only you. The investigator includes 2 data collectors, 1 supervisor and two advisors from Gondar University and Bahir Dar University.

Purpose: to assess the effects of maternal dietary diversity and associated factors during pregnancy on birth weight of the infant and recommend possible interventions based on the finding.

Procedure: To assess the effects of maternal dietary diversity and associated factors during pregnancy on birth weight of the infant, you are invited to participate in the project. If you are willing to participate in this project, you need to understand and sign the agreement form. Then you will be requested to give response to some questions that will take few minutes (about 30 minutes) and then there will be height, weight, measurement if so. All the responses given by you will be kept confidentially by using coding system whereby no one will have access to your response.

Risk: By participating in this study, you may feel that it has some discomfort especially on wasting your time (20-30 mints) to respond questions but this may not be too much as you are one of the members of the communities, your response will help as important input to determine the Effects of maternal dietary diversity and associated factors during pregnancy on birth weight of the infant. However, there is no physical or psychological risk expected being involved in the study.

Benefits: If you participate in this study, you may not gain direct benefit but your participation will help us to assess effects of maternal dietary diversity and associated factors during pregnancy on birth weight of the infant and to take measures based on the finding.

Confidentiality: Information about you will be collected without your name but a cod number assigned to it will be stored in a file and kept locked. Your personal information will only be used for the purpose of the study. Your response will be aggregated to yield summary data, but your individual response will not be reported.

Participation: You have to know that your participation is largely based on your willingness and approval. There are questions to be answered by you. you are expected to answer all of the questions but you have the right to say "no" and not participate in the study (you can choose not to respond to some or all of the questions). You have also a full right to withdrawal from this study at any time you wish without losing any of your right and without any penalty.

Person to contact: This research project will be reviewed and approved by the ethical committee of Bahir Dar University. If you want to know more information and ask any questions at any time you went you can contact with the following address.

Mohammed Dawed Endres, Address: 0918071129; email- famzya@gmail.com

Questionnaire

A. Socio demographic Information of pregnant

No	Questions	Alternative Choices for pregnant	Code
1	Age	1. ‹20 years 2. 20-30 years 3. ›30 years	A1
2	Ethnicity	1 Amhara 2 Oromo 3 Tigre 4 Other	A2
3	Religion	1. Muslim 2. Orthodox 3. Other	A3
4	Marital status	1. Married 2. Separated/Divorced 3. Widowed	A4
5	Education status	1.Illiterate 2.read and write 3.Secondary education 4.High school and above	A5
6	Residence	1. Urban 2. Rural	A6
7	Occupation	1. House wife 2. Government employee 3. private employee 4. daily laborer 5. farmer	A7
8	Household size	1. 1-5 2. 6-10	A8
9	Pica practice	1. no 2. yes	A9
10	Experienced nausea / vomiting	1.no 2.yes	A10
11	Antenatal care	1. first antenatal care visit 2. 2 or 3 ANC visit 3. 4 and above ANC visit	A11

B. Minimum Dietary diversity for woman (MDD-W)
"Was yesterday a celebration or feast day where you ate special foods or where you ate more, or less than usual?

a) Questionnaire for an open recall of food eaten in the last 24 hours

Now I'd like to ask you to describe everything that you ate or drank yesterday during the day or night, whether you ate it at home or anywhere else. Please include all foods and drinks, any snacks or small meals, as well as any main meals. Remember to include all foods you may have eaten while preparing meals or preparing food for others. Please also include food you ate even if it was eaten elsewhere, away from your home. Let's start with the first food or drink consumed yesterday.

Table 12: Open recall of food eaten in the last 24 hours.48

Did you have anything to eat or drink?	When you woke-up? If yes, what?	Later in the morning? If yes, what?	At mid-day? If yes, what?	The afternoon? If yes, what?	In the evening? If yes, what?	In the evening before going to bed? If yes, what?
Anything else?						

For each eating episode, after the respondent mentions foods and drinks, probe to ask if she ate or drank anything else. Continue probing until she says "no, nothing else". If the respondent mentions a mixed dish like a soup or stew, ask for all the ingredients in the mixed dish. For mixed dishes where it is possible to pick out ingredients or consume only broth, ask if she herself ate each ingredient or if she only had the broth. Continue to probe about ingredients until she says "nothing else".

b) Questionnaire for detailed description of food groups

INSTRUCTIONS FOR RECORDING INFORMATION

The following text can be provided to enumerators on a job aid or included on the questionnaire form:

As the respondent recalls foods and drinks, mark the corresponding item in the "Description/examples to be adapted" column and mark '1' in the response column for that row on the questionnaire. If more than one item in a row is mentioned, mark each item. If the same food or drink is mentioned more than once, you do not need to mark it again after the first time. *[Optionally: If the food is not listed in any of the rows on the questionnaire, write the food in the bottom row labeled "Other beverages and foods".]* In some surveys, it may be possible for the enumerator to review the foods that have been reported by repeating them to the respondent and making a final probe ("anything else?"), but this will depend on the specific survey context. Immediately after completing the recall, the enumerator should mark "no"16 for rows where the respondent did not report consuming any items.

Table 13(MDD-W) score

No	Food group	Examples	Yes=1 No=0
1	Grains, white roots and tubers, and plantains	Barley product, maize and maize product, emmer product, wheat and wheat product, sorghum white and sorghum red product, Tef product, wheat and wheat product, Sweet potato, potato Irish.	-------
2	Pulses (beans, peas and lentils)	Broad beans, kidney beans, chick peas, fenugreek, lentils, peas, vetch,	-------
3	Nuts and seeds	Nut, nut oil, liquid nut, pumpkin seed, sunflower seed.	-------
4	Dairy	Fresh whole, low-fat and skim milk when drunk/consumed as such, reconstituted powdered or evaporated milk or ultra-high temperature (UHT) (boxed) milk consumed as such, Hard cheese (e.g., cheddar, mozzarella, Swiss, parmesan), Soft cheese (e.g., ricotta, cottage, paneer), Kefir Yoghurt/curd.	-------
5	Meat, poultry and fish	Beef meat, tongue beef, chicken, goat meat sheep meat Fresh, frozen or dried fish, large or small, all species.	-------
6	Eggs	Chicken eggs, (egg, whole, boiled and egg whole, fried).	-------
7	Dark green leafy vegetables	Chili greens, Pumpkin greens, Spinach, Sweet potato leaves, Ethiopian kale, Swiss chard, lettuce.	-------
8	Other vitamin A-rich fruits and vegetables	Carrot, Pumpkin, Sweet potato (orange- or dark yellow-fleshed only), Mango (ripe, fresh and dried), Papaya (ripe, fresh and dried), Red palm fruit, red palm pulp, Tree tomato, citron, grapes, guava, lemon, tangerine, mustard greens, pepper(chili),	-------
9	Other vegetables	Cabbage (common and red varieties), Corn (fresh, not dried/flour/meal) (green maize), Mushroom, Onion, Tomato,	-------
10	Other fruits	Apple, Avocado, Banana, Cherries (cornelian), Coconut flesh, Dates (fresh and dried), Grapes, Lemon, Mandarin orange, Orange, Pineapple, Strawberry, Watermelon,	-------
Others			
11	Condiments and seasonings	Fish powder, Garlic, Ginger root, Herbs, dried and fresh, all types, Lemon or lime or other juice, added to “bring up flavor” of mixed dishes Spices, dried and fresh, all types, Sugar, Tomato paste, any other seasoning or flavoring added during cooking, any garnish added at the end of cooking or when serving (e.g., grated cheese, grated vegetable, seeds or legumes).	-------
12	Other beverages and foods	Alcohol, all types, Coffee, with or without milk, if unsweetened, Herbal beverages/infusions, Olives, Pickled cucumbers, Tea, with or without milk, if unsweetened, any other food or beverage not included in previous groups/categories.	-------
Total sum of MDD-W score			-------

(FAO, 2016; Ethiopian food composition, 2018)

D. Infant characteristics and Minimum dietary diversity for woman (MDD-W) S.

12	Minimum Dietary diversity for Woman (MDD-W) score	1. Inadequate (<5 food groups out of 10) 2. Adequate (≥ 5 food groups out of 10**)**	D5
13	Infants birth weight ----------	1.<2500g (Lowe birth weight) 2.2500---3500g (Normal birth weight) 3.>3500g(high birth weight)	D6

Table 14. Infant characteristics and Minimum dietary diversity for women (MDD-W) S.50

Code number of the pregnant _____

Name of data collector_____ signature _____

Name of Supervisor _____ signature_____ Date of data collection _____/___

Thank you for your participation!

የመረጃና የስምምነት ፎርም

የምርምር ፕሮጀክቱ ርእስ ፡ በአዲስ አለም ሆስፒታል ነፍሰጡር እናቶች ያላቸውን የስነ ምግብ ሁኔታ እና ተያያዥ ነገሮችን በማጥናት በጨቅላ ህጻናት ላይ የሚያመጣውን የክብደት መለያየት መዳሰስ።

የዋናው ተመራማሪ ስም ፡ ሙሃመድ ዳውድ እንድሪስ

የድርጅቱ ስም ፡ በባህር ዳር ዩንቨርስቲ ቴክኖሎጅ ኢንስቲትዉት ኬሚካል እና ምግብ ምህንድስና ትምህርት ቤት::

ወጪውን የሚሸፍነው ፡ በግል

መግቢያ፡ ይህ የመረጃና የውል ስምምነት የተዘጋጀበት አላማ በምርምር ፕሮጀክቱ እርስዎ እንዲሳተፉ በፕሮጀክቱ አባላት በሚጠየቁበት ወቅት ስለ ፕሮጀክቱ መረጃ በማግኘት እንዲብራራሎት ነው ።የፕሮጀክቱ ዋና አላማ በአማራ ብሄራዊ ክልላዊ መንግስት በምእራብ ጎጃም ዞን ባህር ዳር ከተማ በአዲስ አለም ሆስፒታል ነፍሰጡር እናቶች ያላቸውን የስነ ምግብ ሁኔታ እና ተያያዥ ነገሮችን በማጥናት በጨቅላ ህጻናት ላይ የሚያመጣውን የክብደት መለያየት መዳሰስ ሲሆን በጥናቱ የመሳተፍም ሆነ ያለመሳተፍ ውሳኔው በእርሶና በእርሶ ብቻ የሚወሰን ነው።።ይህ አጥኚ ቡድን ሁለት የባህርዳር ዩንቨርሰቲ የጎንደር ዩንቨርስቲ መምህራን በአማካሪነት ያካተተ ነው።

የጥናት ፕሮጀክቱ የሚካሄድበት ምክንያት

የጥናቱ ዋና አላማ፡ በአማራ ብሄራዊ ክልላዊ መንግስት በምእራብ ጎጃም ዞን ባህር ዳር ከተማ በአዲስ አለም ሆስፒታል ነፍሰጡር እናቶች ያላቸውን የስነ ምግብ ሁኔታ እና ተያያዥ ነገሮችን በማጥናት በጨቅላ ህጻናት ላይ የሚያመጣውን የክብደት መለያየት መዳሰስ ሲሆን በሚገኘውም የጥናት ውጤትም ከክብደት በታች የሚወለዱ ጨቅላ ህጻናት ላይ መፍትሄ ለማምጣት የሚያስችሉ መንገዶችን ያመላከታል ተብሎ ይታሰባሉ።

አተገባበር: ነፍሰጡር እናቶች ያላቸውን የስነ ምግብ ሁኔታ እና ተያያዥ ነገሮችን በማጥናት በጨቅላ ህጻናት ላይ የሚያመጣውን የክብደት መለያየት ለማጥናት እርሶዎ በፕሮጀክቱ ተሳታፊ እንዲሆኑ ተጋብዘዋል።በፕሮጀክቱ ለመሳተፍ ፈቃደኛ ከሆኑ ውሉ ሊገባዎትና ሊፈርሙ ይገባል። ከዚያም በመረጃ ሰብሳቢዎች ጥቂት ደቂቃዎች ለሚወስዱ ጥያቄዎች መልስ እንዲሰጡ በአክብሮት ይጠየቃሉ ፣ለእያንዳንዱ ጥያቄ ለሚሰጡት ምላሽ ማንም በማያገኘው መለያ ቁጥር ሚስጥራዊነቱ የተጠበቀ ይሆናል።

ሊገጥም የሚችል ችግር/ አለመመቸት: በዚህ ጥናት በመሳተፍዎ መጠነኛ አለመመቸት ማለትም የደቂቃዎች ብክነት ሊገጥመዎ ይችላል ።

ቢሆንም ግን የህብረተሰቡ አካል እንደመሆነዎ መጠንና የሚሰጡት መረጃ ለነፍሰጡር እናቶች የስነ ምግብ እና ተያያዥ ነገሮችን ለማጥናት እንደግብአት ስለሚጠቅም የሚያጠፉት ጊዜ ብዙ ላይሆን ይችላል።ስለሆነም በጥናተዎ በመካፈለዎ የሚደርሱበት አንዳችም ጉዳት የለም።

ጥቅሞች: ከዚህ ጥናት እርስዎ በቀጥታ ተጠቃሚ ላይሆኑ ይችላሉ። ነገር ግን የእርሶ መሳተፍ ለነፍሰጡር እናቶች የስነ ምግብ እና ተያያዥ ነገሮችን ለማጥናት እና በጥናቱ ውጤት ከክብደት በታች እና ከክብደት በላይ የሚወለዱ ጨቅላ ህጻናት ላይ መፍትሄ ለማምጣት የሚያስችሉ መንገዶችን ያመላክታል ተብሎ ይታሰባል።

ስለ ተሳትፎ: በጥናቱ ለመሳተፍዎ የእርሶ ሙሉ ፍቃደኝነት ወሳኝ ነው ። ለሚጠየቁት ጥያቄዎች ሁሉ ይመልሳሉ ብዬ ተስፋ አደርጋለሁ ። ነገር ግን ከሚጠየቁት ጥያቄዎች ለተወሰኑት አሊያ ለሁሉም መልስ ያለመመለስ መብት አለዎት። እንዲሁም ያለምንም ቅጣትና መብት መጓደል በፈለጉ ሰአት ጥናቱን የማቋረጥ ሙሉ መብት አለዎት።

ረጅ አካላት: ይህ የምርምር ፕሮጀክት በባህር ዳር ዩንቨርስቲ ታርሞና ተከልሶ ይጸድቃል ። ተጨማሪ መረጃ ካስፈለግዎትና ማንኛውንም ጥያቄ በማንኛውም ሰአትና ጊዜ መጠየቅ ከፈለጉ በሚከተሉት አድራሻዎች የፈለጉትን አካል ማነጋገር ይችላሉ።

1. ፕሮፌሰር ታደሰ አወቀ፡ ከጎንደር ዩንቨርስቲ ኢ-ሜ ል taweke7@gmail.com
2. አቶ ደግነት ተፈሪ (ተ/ፕሮፌሰር)፡ ከባህርዳር ዩንቨርስቲ ስልክ 0939633976

ኢ-ሜል degnet2006@gmail.com

በጥናቱ ተሳታፊ ለመሆን ፍቃደኛ ኖት አዎ _____ አዎ ከሆነ ይቀጥሉ

አይደለሁም_____ አመስግነው ወደሚቀጥለው ተሳታፊ ይሂዱ።

ሀ. የማህበራዊና ስነ-ህዝብ ሁኔታዎች

ተ.ቁ	ጥያቄ	አማራጭ መልሰ	ኮድ
1	ዕድሜ	1.< 20 ዓመት 2.ከ20-30 ዓመት 3.>30 ዓመት	U1
2	ብሄር	1.አማራ 2. ኦሮሞ 3. ትግሬ 4. ሌላ	U2
3	ሀይማኖት	1.ሙስሊም 2. ኦርቶዶክስ 3. ሌላ	U3
4	የጋብቻ ሁኔታ	1.ያገባ 2. የተለያየ/የተፋታ 3, የሞተባት	U4
5	የትምህርት ሁኔታ	1.መፃፍ እና ማንበብ የማትችል 2. መፃፍና ማንበብ የምትችል 3.የመጀመሪያ ደረጃ ት.ት የተማረች 4.ሁለተኛ ደረጃ ትምህርት የተማረች 5ከሌጅና ከዚያ በላይ	U5
6	መኖሪያ ቦታ	1.ከተማ 2, ገጠር	U6
7	የስራ ሁኔታ	1.የቤት እመቤት 2. የመንግስት ሰራተኛ 3.የግል ሰራተኛ 4. የቀን ስራ የምትሰራ 5. በግብርና የምትተዳደር	U7
8	የቤተሰብ መጠን	1.ከ1-5 2.ከ6-10 3. ከ10በላይ	U8
9	የአምሮት ሁኔታ	1.አዎ አለ 2. የለም	U9
10	ማስታወክ እና ማሰመለስ	1. አዎ አለ 2. የለም	U10
11	የቅድመ ወሊድ ክትትል	1. ከ 4 ጊዜ በታች ክትትል ያደረገች 2. ከአራት በላይ ክትትል ያደረገች	U11

ለ.**ዝቅተኛ የአመጋገብ አይነት** ለሴቶች (MDD-W)

ሀ) በ 24 ሰዓት ውስጥ ስለተመገቧቸው ምግቦች መጠይቅ

በዚህ ምእራፍ ውስጥ የምጠይቅሽ በትናንትናው እለት ሙሉ ቀን ስለተመገብሻቸው ምግቦች እና መጠጦች ሲሆን ከመደበኛ አመጋገብ ውጭ የተመገብሻቸውን ምግብ እና መጠጥ ያካትታል። ለምሳሌ ከቤት ውስጥ ወይም ከቤት ውጭ የተመገብሻቸው እና የጠጣሻቸው ሊሆን ይችላል፣ ትንሽም ሆነ ብዙ የተመገብሽው ሁሉንም ትነግሪኛለሽ ማለት ነው። አሁን በትናንትናው እለት መጀመሪያ ከተመገብሽው ወይም ከጠጣሽው እንጀምራለን ማለት ነው።

ምን አይነት ምግብና መጠጥ ወስደሻል?	ክእንቅልፍሽ እንደነቃሽ?	ከጡዋት ባለው ሰአት?	ከቀኑ አጋማሽ ላይ (ምሳ)?	ከሰአት?	አመሻሽ ላይ (እራት)?	ከመተኛትሽ በፊት?

ሌላ የተረሳ ካለ?						

ስለምግቦች በዝርዝር የምናይባቸዉ ጥያቄዎች

ተ.ቁ	የምግብ መደብ	የምግብ አይነት ምሳሌዎች	አዎ – 1 አይደለም – 0
1	ጥራጥሬ ነጭ ስር ና ክብ ስር ያላቸው አትክልቶች	ከሁሉም ጥራጥሬወች በቆሎ፣ አጃ፣ ስንዴ፣ ገብስ፣ ዳጉሳ ፣ ጤፍ (እንጀራ፣ ዳቦ፣ሩዝ፣ ፓስታ፣ ማካሮኒ፣ በሶ፣ ፈንዲሻ፣ ቅንጬ፣ ሽሮ፣ ሩዝ፣ስንዴ ቆሎ፣ፓስታ፣ማካሮኒ፣ እንጀራ ፍርፍር፣ ዳቦ ፍርፍር፣ የሃበሻ ድንች፣ ስኬር ድንች፣ ገንፎ፣ ንፍሮ ፣ ፈንድሻ)፡፡	
2	የቅባት እህሎች (ባቄላ አተር ምስር)	ባቄላ(ወጥ፣ንፍሮ፣አሹቅ) አደንዳሬ(ንፍሮ ቦለቄ) ሽንብራ(ወጥ፣ንፍሮ፣አሹቅ) አብሽ(መጠጥ) ምስር(ወጥ፣ ንፍሮ) አተር(ወጥ፣ንፍሮ፣አሹቅ) ጉያ(ወጥ፣ንፍሮ) ቦሎቄ፡፡	
3	ለውዝ ና ዘር	ለውዝ(የለዝ ቅቤ፣የለውዝ ሻይ፣ለውዝ የተቆላ፣) የዱባ ፍሬ የተቆላ፣የሱፍ ፍሬ የተቆላ፡፡	
4	ወተት እና የወተት ተዋፅኦ	ወተት፣ እርጎ፣ አይብ፣ ቅቤ እና ሌሎች	
5	ስጋ እና አሳ	የበሬ ስጋ፣ የበግ ስጋ፣ የፍየል ስጋ፣ የዶሮ ስጋ፣ የአሳ ስጋ(ልብ፣ ጉበት፣ ኩላሊት የሁሉም)፡፡	
6	እንቁላል	የእንቁላል እና የእንቁላል ተዋፅኦ	
7	አረንጉዋዴ ቅጠል ያላቸው አትክልቶች	ሰላጣ፣ ቆስጣ፣ የሃበሻ ጎመን፣	
8	በቪይታሚን A የበለፀጉ ፍራፍሬ እና አትክልቶች	ካሮት፣ዱባ፣ስኳር ድንች፣ማንጎ፣ፓፓያ፣ትርንጎ፣ወይን፣ዘይቱና፣ ሎሚ፣መንደሪን፣ስናፍጭ፡፡	
9	ሌሎች ቅጠላቅጠሎች	ጥቅል ጎመን፣የበቆሎ እሸት፣እንጉዳይ፣ሽንኩርት፡፡	
10	ሌሎች ፍራፍሬዎች	ቱፋ፣አቮካዶ፣ሙዝ፣ኮኮናት(የዘንባባ ገውዝ)፣ተምር፣ወይን፣ሎሚ፣ ብርቱካን፣አናናስ፣እንጆሪ፣ ሽንኩርት፣ ቀይ ስር፣ ተምር፣ ሃብሃብ፣ ፣ቲማቲም፡፡	
	አጠቃላይ ድምር(MDD-W)S		

ሕ)			

ማጠቃለያ			
11	አጠቃላይ ድምር(MDD-W)S	1. ዝቅተኛ አመጋገብ (≤ 4 የምግብ መደብ) 2 ከፍተኛ አመጋገብ **(≥ 5 የምግብ መደብ)**	**ሕ.1**
12	የህፃኑ/ኗ ክብደት(Infants birth weight)	1.<2500g (ዝቅተኛ ክብደት) 2.2500---3500g (መካከልኛ ክብደት) 3.>3500g (ከፍተኛ ክብደት)	**ሕ.2**

የነፍሰጡሯ **መለያ (ኮድ)----------**

የነፍሰጡሯ መለያ(ኮድ)_____

መረጃውን የሰበሰበው ስም_____ፊርማ_____

የሱፐርቫይዘር ስም_____ፊርማ_____

ቀን_____/_____/_____!

ሰለተሳትፎዎ እናመሰግናለን!!!

Chapter 9. BIOGRAPHICAL SKETCH OF THE AUTHOR

The author was born in January 5, 1980 E.C in Bahir dar Amhara regional state. He was in Bahir dar Teyma, Ghion, Tana & Bahir dar preparatory school from elementary and junior school, high school education and preparatory, respectively. After the completion of his high school education joined Bahir Dar University in 1998 E.C, he successfully fulfilled the requirement of Bachelor of Science degree in Industrial chemistry and graduated on July 24, 2002 E.C. After graduation he employed by ANRS education office as technical drawing teacher S/Gondar zone Nefase mewcha preparatory school for two years, and for one year in Samara University worked as graduate assistant. From 2005 up to 2009 in Injibara poly technic collage as sugar and ethanol production instructor. Right now the author is working as vice director in Soma Academy, Bahir Dar, Ethiopia.