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St. Paul's Hospital Millennium Medical College

Graduate Study Program

School of Public Health

Magnitude of undernutrition and Associated Factors among Pregnant Women
Attending Antenatal Care in Public Health Centers of Guna District, Arsi Zone,
Oromia, Ethiopia

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Arsi Zone, Oromia, Ethiopia

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Table of Contents

AcknowledgementsI

Table of ContentsII

List of TablesV

List of FiguresVI

Acronyms and AbbreviationsVII

AbstractVIII

1. Introduction1

1.1. Background1

1.2. Statement of the Problem2

1.3. Rationale of the study4

2. Literature Review5

2.1. Magnitude of undernutrition5

2.2. Factors associated with undernutrition among pregnant women.6

2.2.1. Socio-demographic characteristics and Economic factors6

2.2.2. Dietary intake factors6

2.2.3. Health care and Environmental factors8

2.2.4. Reproductive and other factors8

2.3. Conceptual Framework9

3. Objectives11

3.1. General objective11

3.2. Specific objectives11

4. Methods and Materials12

4.1. Study area12

4.2. Study design and period12

4.3. Population12

4.3.1. Source population12

4.3.2. Study population12

4.4. Inclusion and Exclusion Criteria13

4.4.1. Inclusion criteria:13

4.4.2. Exclusion criteria:13

4.5. Sample Size Determination	13
4.5.2. Sampling procedure	14
4.6. Study variables	14
4.6.1. Dependent variable	14
4. 6.2. Independent variables	14
4.7. Operational definitions	15
4.8. Data collection procedures	15
4.9. Data quality assurance and management	16
4.10. Data processing and analysis	17
4.11. Ethical consideration	18
4.12. Results Dissemination plan	18
5. Results	19
5.1. Socio-Demographic Characteristics and Economic Status of Pregnant Women	19
5.2. Reproductive, Health care and Environmental factors	19
5.3. Dietary Diversity	20
5.4. Household food insecurity	21
5.5. Magnitude of Undernutrition	21
5.6. Factors associated with undernutrition among pregnant women	22
6. Discussion	24
Limitations of the Study	26
Conclusion	26
Recommendations	26
References	28
Annexes	34
Annex I: participant information sheet and informed consent form (English version)	34
Annex II: English Version Questionnaire	35
Annex III: Data collection tools	36
Annex IV: Waraqaa odeeffannoo hirmaattotaa fi uunka hayyamaa odeeffannoo irratti hundaa’e	41
Annex V: Gaaffii (Afaan Oromoo Version questionnaire)	42

List of Tables

Table 1 : Sample size determination for the second objectives of the study participants in Guna district, Arsi zone, Oromia, Ethiopia 2025¹³

Table 2 : Socio-demographic characteristics of pregnant women attended ANC in public health centers of Guna district, 2025 (n=430)¹⁹

Table 3 : Reproductive, Health care and Environmental characteristics of the pregnant women in public health centers of Guna district, Arsi zone, Oromia, Ethiopia, 2025(n=430)²⁰

Table 4 : Dietary characteristics (user) of pregnant women in public health centers of Guna district, Arsi zone, Oromia, Ethiopia, 2025(n=430).²⁰

Table 5 : Results of bivariable and multivariable analysis of factors associated with undernutrition among pregnant women in public health centers of Guna district, Arsi zone, Oromia, Ethiopia, 2025 (n=430).²²

List of Figures

Figure 1 : Conceptual framework on the magnitude of undernutrition and associated factors of undernutrition among pregnant women attending antenatal care in public health centers of Guna district, Arsi zone, Oromia region, Ethiopia, 2025(18, 73). 10

Figure 2 : Map of Guna District, Oromia region, Ethiopia, 202512

Figure 3 : Sampling procedure of the study participants in Guna district, Arsi zone, Oromia, Ethiopia, 2025.14

Figure 4 : Distribution of household food security status of pregnant women in public health centers of Guna district, Arsi zone, Oromia, Ethiopia, 2025(n=430).21

Figure 5 : Magnitude of undernutrition among pregnant women in public health centers of Guna district, 2025.21

Acronyms and Abbreviations

ANC	Antenatal Care
AOR	Adjusted Odd Ratio
CI	Confidence Interval
COR	Crude Odd Ratio
DDS	Dietary Diversity Score
HFIAS	Household Food Insecurity Access Scale
IRB	Institutional Review Board
MUAC	Measurement of Upper Arm Circumference
NGO	Non-governmental Organization
SPHMMC	Saint Paul's Hospital Millennium Medical College
SPSS	Statistical Package for the Social Science
VIF	Variance Inflation Factors

Abstract

Background: Undernutrition during pregnancy remains a leading contributor to poor maternal and neonatal outcomes, especially in resource-limited settings. Undernourished mothers face a higher risk of low-birth-weight infants, increasing susceptibility to infectious diseases and perpetuating intergenerational malnutrition. In Guna District, where local data are scarce, the extent and drivers of undernutrition among pregnant women attending public health centers remain poorly documented.

Objective: To assess the magnitude of undernutrition and associated factors among pregnant women attending antenatal care in public health centers in Guna district.

Methods: A cross-sectional study was conducted in Guna district from February 27 to April 12, 2025 among 438 pregnant women who attended antenatal care. Data were collected through face-to-face interviews using a structured questionnaire, translated into Afan Oromo and pre-tested on 22 pregnant women. Data collection was conducted using Kobo Toolbox version 2.4, and data cleaning and statistical analysis were performed with Statistical Package for the Social Science version 25. Variables with a p-value less than 0.25 in bivariable logistic regression were included in the multivariable model. In the final analysis, variables with p-values below 0.05 were considered statistically significant. The results were summarized by tables and graphs.

Results: Out of 438 pregnant women, 430 voluntarily participated, yielding a response rate of 98%. The magnitude of undernutrition was [20%; 95% CI (16%, 23%)]. In multivariable logistic regression, consuming additional meals [(AOR=0.21, 95% CI: (0.05-0.99)) , P=0.049), family size greater than five [(AOR=2.96, 95% CI: (1.37-6.38)], P=0.006), household monthly income less than 2000 Ethiopian birr[(AOR=5.64, 95% CI: (2.98-10.68)], P<0.001), skipping meals [(AOR=6.31, 95% CI: (3.23-12.29)], P<0.001), and food avoidance [(AOR=9.73, 95% CI: (4.66-20.32)], P<0.001) were identified as significant factors associated with undernutrition.

Conclusion: The magnitude of undernutrition was found to be 20%, indicating that one in five pregnant women is affected, which signifies a high public health problem. This study found that consuming additional meals was protective against undernutrition, while household monthly income, family size, skipping meals, and avoiding food were risk factors. Health workers are encouraged to counsel pregnant women to eat regularly, with more than three additional meals per day, and avoiding unnecessary food restrictions.

Keywords: Maternal, undernutrition, pregnant women, Arsi, Ethiopia

1. Introduction

1.1. Background

Maternal undernutrition is a leading cause of morbidity and mortality among pregnant women. It is a significant global developmental challenge, affecting nearly half of the world's population and responsible for the deaths of 3.5 million mothers and children annually(1). Maternal undernutrition is a key contributor to poor fetal growth, low birth weight, and increased infant morbidity and mortality. Globally, 15% to 20% of all births are low birth weight, accounting for more than 20 million births each year(2). Approximately 795 million people are undernourished, predominantly in low- and middle-income countries, with the problem being most critical during pregnancy(3).

Maternal undernutrition has been strongly linked to functional consequences such as an increased risk of adverse pregnancy outcomes, poor infant survival, and a higher risk of chronic diseases later in life(4). Malnutrition resulting from inadequate dietary intake is associated with growth failure and development of protein-energy malnutrition, especially during the gestation(5). It was recognized that poor growth results not only from a deficiency of protein and energy but also from inadequate intake of micro-nutrients that are vital during pregnancy(6).

Maternal undernutrition can lead to poor health outcomes, including infections, pre-eclampsia, preterm birth, and intrauterine growth retardation(7). Early detection of malnutrition can improve these outcomes, as inadequate nutrition increases the risks of gestational anemia, hypertension, miscarriages, preterm delivery, and maternal mortality, ultimately resulting in low birth weight and long-term developmental challenges for newborns. Adequate maternal nutrition is vital for fetal growth and positive birth outcomes(8).

Pregnancy is the most nutritionally demanding stage in a woman's life. The heightened need for nutrients to support new tissue formation, promote the growth of maternal tissues like the breast and uterus, and fulfill increased energy requirements makes pregnant women more vulnerable to malnutrition(9). The nutritional status of expectant mothers is critical for pregnancy outcomes; good maternal nutrition is vital for women's health and the development of their children(10).

The first 1,000 days, from conception until a child's second birthday, are vital for lifelong health and well-being. Adequate nutrition and healthcare during this time play a significant role in brain development, immunity, and growth. A mother's health and nutrition directly affect her baby's outcomes, with undernutrition during pregnancy being a major contributor to stunting (chronic malnutrition). Promoting good health in these early days lays the groundwork for cognitive and physical development, yielding benefits that extend into adulthood and positively influence society(11).

Undernutrition during pregnancy is further influenced by dietary habits, cultural beliefs, and existing health conditions. Meal skipping, a lack of dietary diversity, and culturally significant food avoidance's or taboos can all reduce the intake of important nutrients(12). Despite efforts to solve the issue, very little progress has been made in the past ten years, and undernutrition continues a major public health concern in developing nations, including Ethiopia(13). This study aims to assess the prevalence and associated factors of undernutrition among pregnant women attending antenatal care in public health centers of Guna district.

1.2. Statement of the Problem

Malnutrition among pregnant women poses a significant public health challenge, contributing to illness and death. The global prevalence of maternal undernutrition was 9.9%, and 21% in Africa(14). In Ethiopia, a 2024 systematic review and meta-analysis estimated the national prevalence among pregnant women to be 32%(15) and 30.4% in Oromia(16). East Shoa zone reports 13.9%(17), while East Borena's Liban District reaches 44.9%(18).

As of 2021, approximately 20.1 million people, or 17% of the population, were estimated to be acutely food insecure(19). In 2023, maternal undernutrition affected 10% of women globally, with 28.9% of the population facing severe food insecurity, including 58% in Africa(14). Poverty, food insecurity, and lack of access to healthcare services exacerbate undernutrition among pregnant women, hindering efforts to improve maternal and child health(20, 21).

Pregnant women in Somalia face significant nutritional challenges, with over half being unaware of the importance of a diverse diet and avoiding certain foods due to personal preferences and cultural beliefs. Despite most consuming three meals daily, many experience health issues, such as anemia and illness in early pregnancy(22). In the East Wollega zone, nearly half of pregnant

women avoid nutritious foods like vegetables and meat due to fears of complications during childbirth, which negatively affects their overall health and diet(23).

Undernutrition results from various factors and is not solely a medical issue. Pregnant women are particularly at risk due to increased dietary needs, making both mother and child vulnerable to deficiencies. Most undernourished pregnant women live in developing countries like Bangladesh, the Democratic Republic of the Congo, Ethiopia, Indonesia, and Pakistan, with over 40% in China and India, indicating the widespread nature of malnutrition among pregnant women(24).

A major problem in developing countries is that pregnant women start to attend antenatal clinics in a late stage of pregnancy. Late antenatal care can increase the risk of complications during pregnancy and childbirth, including preterm birth, stillbirth, and postpartum hemorrhage(25). This poses significant health risks for both mothers and their unborn children, leading to adverse outcomes such as low birth weight and developmental delays(26).

Ethiopians continue to be concerned with undernutrition for a variety of reasons, including socio-demographic status, political unrest, and financial damage. Nearly one in four pregnant women is malnourished, and approximately 22.2% are more likely to be malnourished(27). The burden of undernutrition can be associated with socio-demographic and economic characteristics, obstetric and health-related characteristics, dietary characteristics, and environmental factors(28, 29).

Factors such as maternal illiteracy, low income, unplanned pregnancies, insufficient meal frequency, poor dietary diversity, and a lack of antenatal care and iron supplementation significantly contribute to maternal malnutrition by limiting access to information, resources, and essential nutrients needed for a healthy pregnancy. These interconnected issues pose serious challenges to maternal and child health, resulting in harmful outcomes for both mothers and their children(16).

To combat malnutrition, global strategies include improving girls' education, enhancing healthcare access, increasing economic opportunities, promoting family planning, and encouraging dietary diversity(30). In Ethiopia, the government and NGOs are working to improve nutrition among pregnant women through community-level antenatal care(31) and health extension programs that train local workers to identify undernutrition and educate mothers

on nutrition and hygiene(32). However, undernutrition among pregnant women remains an unresolved issue in developing countries, where many women continue to face significant challenges during pregnancy(27). While studies on undernutrition among pregnant women in Ethiopia exist, they often fail to address key factors such as household food security, meal frequency, and dietary diversity.

Although undernutrition among pregnant women has been studied in various regions of Ethiopia, specific evidence for Guna District remains insufficient. Despite several programs aimed at reducing maternal malnutrition, the number of cases of undernutrition continues to rise each year. The four-hour journey to health centers for antenatal care, along with poor road accessibility, further complicates access to essential maternal health services. Currently, no studies have explored undernutrition and its associated factors among pregnant women in this district. These challenges have sparked my interest in understanding the contributing factors to undernutrition. Therefore, assessing the prevalence of undernutrition and its contributing factors is crucial for addressing information gaps and improving maternal nutrition service delivery.

1.3. Rationale of the study

Pregnancy-related undernutrition is a persistent and serious public health concern in Ethiopia, particularly in rural and underserved areas. Improving maternal nutrition during pregnancy must be prioritized, given its direct impact on fetal growth, birth outcomes, and long-term child health. Well-nourished mothers are more likely to deliver babies with healthy birth weights reducing susceptibility to infectious diseases and helping to break the cycle of intergenerational malnutrition.

While several studies have investigated maternal undernutrition in Ethiopia, many fail to comprehensively address context-specific factors such as household food security, meal frequency, and dietary diversity particularly at the district level. In Guna District, where local data are scarce, the extent and drivers of undernutrition among pregnant women attending public health centers remain poorly documented. This study seeks to address this critical gap by estimating the prevalence of undernutrition and identifying its associated factors among pregnant women in Guna District. The findings will provide baseline evidence to inform local health programming, guide nutrition-sensitive antenatal care services, and support researchers, policymakers, and planners in designing effective and contextually relevant interventions.

2. Literature Review

2.1. Magnitude of undernutrition

In 2020, globally, undernutrition was responsible for approximately 3.5 million maternal and child deaths per year(10). In 2023, global malnutrition prevalence was 9.1% and 20.4% in Africa(14). In Pakistan, the prevalence of malnutrition was 46% according to MUAC (<21 cm) (33) and 18.1% in Thailand(34). A meta-analysis shows a high prevalence of undernutrition among pregnant women in Bangladesh, with a 2024 review reporting a pooled prevalence of 32% and a 2022 study finding 44.9%(35).

In the western part of Nepal, 24% of pregnant mothers had acute malnutrition (MUAC <23 cm), 67% had inadequate gestational weight gain, and 12% were anemic(36). In Bangladesh and South India, the magnitude of undernutrition among pregnant mothers was 23.5% and 51%, respectively(37, 38). Evidence suggests that 48% of pregnant mothers in the Kamrup district of Assam, India, are malnourished, with a prevalence of iron deficiency anemia of 62%(39). In the Ardal district of Iran, the prevalence of malnutrition among pregnant mothers is 51.3%(40). Additionally, in Rafsanjan, Iran, 9.7% of underweight women gave birth to low birth weight babies(41).

The prevalence of undernutrition among pregnant women attending antenatal care in rural Senegal was found to be 32%(42) and in Nigeria 20%(43). Similarly, a study conducted in Kenya showed that the magnitude of undernutrition among pregnant mothers was 31.7%(44). In Zimbabwe, a significant number of respondents (76%) had a mid-upper arm circumference (MUAC) equal to or greater than 22 cm, while only 24% had a MUAC less than 22 cm(45). Additionally, 12.5% of pregnant women in Khartoum were undernourished(46).

In Ethiopia, 38% of pregnant women experienced undernutrition(4). In Oromia region, 30.4% of pregnant women experienced undernutrition(16). In 2022, the prevalence of undernutrition among pregnant women was 41.7% in the Sidama region(47), 15.3% in the West Arsi zone(48) and 48.6% in Ziway Dugda district (49).

2.2. Factors associated with undernutrition among pregnant women.

2.2.1. Socio-demographic characteristics and Economic factors

Maternal malnutrition in South Asia is prevalent due to poverty, food insecurity, inadequate healthcare access, and gender inequality(50). In Bangladesh, young maternal age, low education levels, and poverty significantly correlate with undernutrition. Economic factors like household income, employment status, and food security also critically influence maternal nutritional status(51).

The study conducted in Romania indicated that pregnant women facing significant social risks such as low education, high birth rates, and low socioeconomic status are predominantly from rural areas and of Romanian origin, with higher prevalence in economically disadvantaged regions(52). Another study conducted in Brazil household monthly income had showed positive statistical association with women's nutritional status(53). A 2022 cross-sectional study conducted in Kenya found that single mothers and self-employments were 4.27 times more likely to be undernourished compared to married women(54).

A 2024 cross-sectional study in North Shewa, Ethiopia found that less educated people were 1.24 times more likely to face undernutrition than those with more education(27). A 2019 community-based cross-sectional study conducted in Ilu Aba Bor Zone, Southwest Ethiopia, revealed that undernutrition among pregnant women was significantly associated with: family size greater than five (3.0 times higher risk), lower educational status (3.4 times higher risk), household food insecurity (1.6 times higher risk), and poor nutrition knowledge (1.7 times higher risk). All of these factors were associated with increased likelihood of undernutrition(55).

A 2022 community-based cross-sectional study conducted in the Liban District found that low household monthly income was associated with an 8.72-fold higher risk of undernutrition(18). Similarly, a study conducted at Miesso Health Center focusing on pregnant and lactating women revealed that those earning less than 1,000 ETB per month were 2.1 times more likely to experience undernutrition, while women under 20 years of age had a 2.2-fold increased risk(56).

2.2.2. Dietary intake factors

The sub-Saharan Africa and South Asia together stand for almost three-fourth of the world's stunted children; whereby, the former contributing for more than 40% and 10% of stunted and

wasted children, respectively. Sub Saharan Africa is home to 98% of the 2.6 million annual third trimester still births(57, 58). The study conducted in Islamabad, Pakistan, found that 89% of pregnant women had medium dietary diversity, while only 5% exhibited low or high dietary diversity. The risk factors were associated with socio-demographic and socioeconomic status(59).

According to the study conducted in Southern part of Ethiopia, pregnant mother with Minimum Dietary Diversity for Women (MDDW) fewer than five food groups were 76% less likely to develop undernutrition. Similarly, another study in Ethiopia reported the same findings(60). A 2024 systematic review and meta-analysis conducted in Ethiopia highlighted key predictors of undernutrition among pregnant women: illiteracy (3.6 times higher risk), rural residence (2.6 times), inadequate dietary counseling (2.6 times), food insecurity (2.5 times), and low dietary diversity (3.7 times). These findings demonstrate how socioeconomic and nutritional factors jointly contribute to maternal undernutrition (26).

A 2024 study in North Ethiopia found that 22.2% of pregnant women were undernourished, linked to low household income, limited education, negative nutritional attitudes, and inadequate dietary diversity(27). A 2023 cross-sectional study in Western Ethiopia revealed that household food insecurity and low dietary diversity were associated with undernutrition in pregnant women(61). A 2023 study in Sidama found that lower dietary diversity scores, low hemoglobin levels, and the lack of meat, beans, peas, and other fruits contributed to undernutrition among pregnant women(6).

At Nigest Ellieni Mohammed General Hospital, dietary factors were found to significantly contribute to undernutrition: a dietary diversity score of less than five (12.4 times higher risk) and consuming fewer than three meals per day (2.6 times higher risk)(62). A cross-sectional study in Wondo Genet District found that not consuming cereal foods was a risk factor for undernutrition in pregnant women(63).

A similar study in Bale Zone, 2019 revealed that around 55.2% of pregnant women had insufficient dietary diversity, as assessed by a 24-hour recall. Important factors that enhanced dietary diversity included access to radio information, safe water sources, latrines, home gardens, urban living, and mobile phone availability(64).

2.2.3. Health care and Environmental factors

In Pakistan, maternal undernutrition is a critical issue, marked by undernutrition, micronutrient deficiencies, and obesity. Access to antenatal care (ANC) is vital, but many women miss visits due to long distances, inconsistent incomes, and costs, especially in rural areas. ANC quality is often poor, lacking adequate nutrition counseling. Climate change exacerbates food insecurity and dietary diversity, with the 2022 floods displacing millions and increasing the risk of stunting and inadequate prenatal nutrition(65). A 2022 cross-sectional study in rural Rwanda Northwest found that greater distances from health facilities are associated with poorer nutritional outcomes for pregnant women, particularly in remote areas with limited access to antenatal care (ANC) and nutritional support(66).

In Burkina Faso, undernutrition among pregnant women is a major public health issue, with high anemia rates. Access to quality healthcare remains inconsistent, and food insecurity is common in semi-urban areas. Many women experience low dietary diversity, with inadequate food intake, high childhood morbidity, poor hygiene, and limited access to clean water contributing to acute malnutrition(67).

Study conducted in Gumay District, Jimma Zone, Southwest Ethiopia showed that Pregnant mother who had not practiced frequent hand washing habits were 6.55 times more likely to have acute under-nutrition compared to their counterparts(68). A 2022 cross-sectional study conducted in Liban district revealed that a total of 375 (95.7%) pregnant women had health care. Pregnant women walking for less than an hour in the second and third trimesters of pregnancy, 143 (79%) women received iron-folic acid tablets. Of the pregnant women, 219 (55.9%) regularly cleaned their hands and used latrines(18).

2.2.4. Reproductive and other factors

South Asia has a high prevalence of maternal malnutrition due to poverty, food insecurity, inadequate healthcare access, and gender inequality. Women from low-income households, limited education, and rural areas are particularly affected.(50). In Bangladesh, young maternal age, low education, and poverty are strongly linked to undernutrition. Economic factors like household income and food security also play a critical role.(69).

A 2023 study in rural Ethiopia revealed that pregnant women with undernutrition were more likely to avoid food, lack counseling, have experienced multiple pregnancies, and have a history of miscarriage(4). A 2021 study in Kacha Bira District found that those with a history of peptic ulcer disease were 1.97 times more likely to be undernourished and 1.73 times more likely to have intestinal parasite infections. They were also 0.34 times less likely to reach optimal gestational age in the second trimester(70).

A 2021 cross-sectional study in Kersa and Haramaya districts found that early marriage increased the likelihood of undernutrition in pregnant women by 2.63 times, while lack of antenatal care raised the risk by 1.73 times, and an inadequately diversified diet increased it by 2.48 times(71). A 2022 cross-sectional study in East Borena Zone, Liben Districts found that pregnant women were 8.72 times more likely to face undernutrition due to low family income, 2.62 times more likely if they skipped meals, and 2.01 times more likely with food insecurity. Additionally, lack of prenatal dietary advice increased the risk by 2.73 times, while the absence of a household latrine raised it by 9.23 times(18).

A 2022 cross-sectional study in Afar showed that pregnant women who did not consume extra meals 24 hours prior were three times more likely to be undernourished. Women with chronic medical conditions faced seven times the risk, while illiterate women had three times the risk compared to those with secondary education. Additionally, rural women had twice the odds of undernutrition, and those lacking dietary counseling during antenatal care were 75% more likely to be undernourished(72).

2.3. Conceptual Framework

Socio-demographic status can influence and be influenced by dietary diversity (e.g., education level affects food choices, while chronic nutritional challenges may impact economic productivity). Health-care access might shape health-related behaviors, while frequent ANC visits can improve nutritional knowledge and better health status may increase engagement with health services. Pregnant women's health-related factors, like anemia or infections, may influence their dietary choices, while their diet may also affect these health conditions.

Bidirectional arrows among independent variables (e.g., dietary diversity ↔ socio-demographics) are fine to show interconnected or overlapping influences, but these should be interpreted as co-occurring associations, not cause-and-effect. Arrows pointing from independent

variables to undernutrition should be presented as predictive or correlational pathways not as causal links. Arrows indicate hypothesized associations based on literature and plausible mechanisms. Directionality does not imply causality due to cross-sectional design limitations (figure 1).

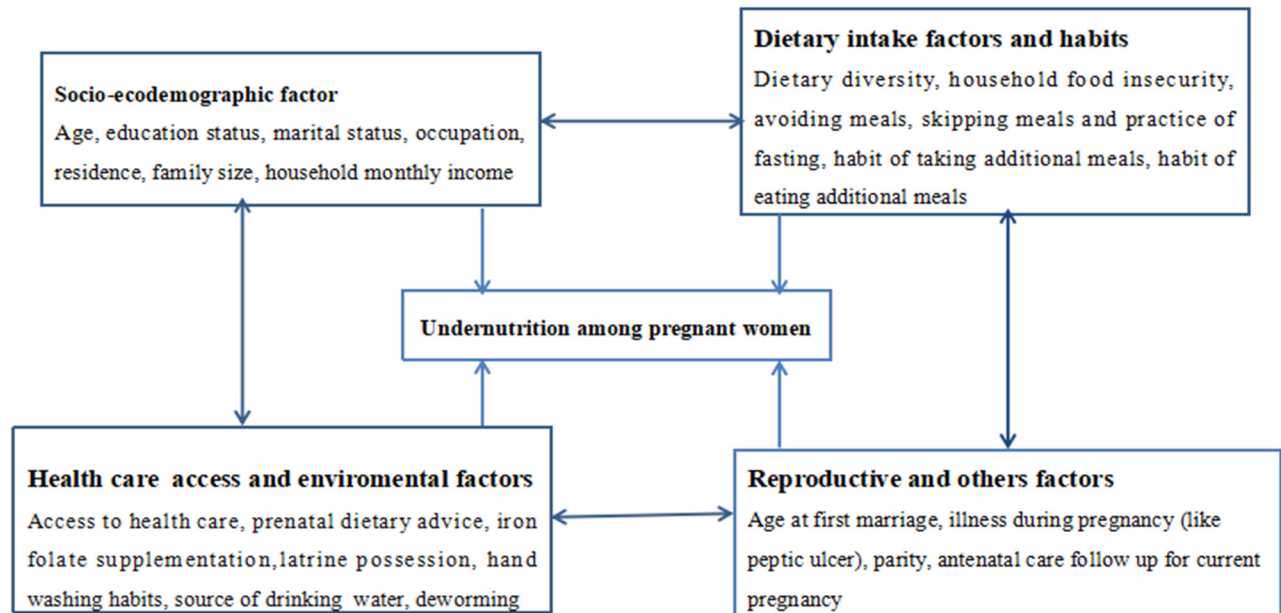


Figure 1: Conceptual framework on the magnitude of undernutrition and associated factors of undernutrition among pregnant women attending antenatal care in public health centers of Guna district, Arsi zone, Oromia region, Ethiopia, 2025(18, 73).

3. Objectives

3.1. General objective

- To assess the magnitude of undernutrition and associated factors among pregnant women attending ANC in Public health centers in Guna district, Arsi zone, Oromia region, Ethiopia.

3.2. Specific objectives

- To assess the magnitude of undernutrition among pregnant women attending ANC in Public health centers in Guna district.
- To identify factors associated with undernutrition among pregnant women attending ANC in Public health centers in Guna district.

4. Methods and Materials

4.1. Study area

The study was conducted in Guna district, Arsi zone, Oromia region, Ethiopia. The district is located 258 kilometers from Addis Ababa and 148 kilometers from the zone's capital, Asela. The district is bordered in the South by Chole and Sude, in the West Jaju and in the North by Marti and in the East by Gololcha districts. The district had a total of 19 kebeles (rural 16, urban 3), three health centers, and 16 health posts. According to the population projection of Ethiopia from the 2007 census, the district currently had a total population of 125,000 (50.5% (63,125) males, of which 86% (107,500) were rural residents. The district had an estimated 4,338 pregnant women.

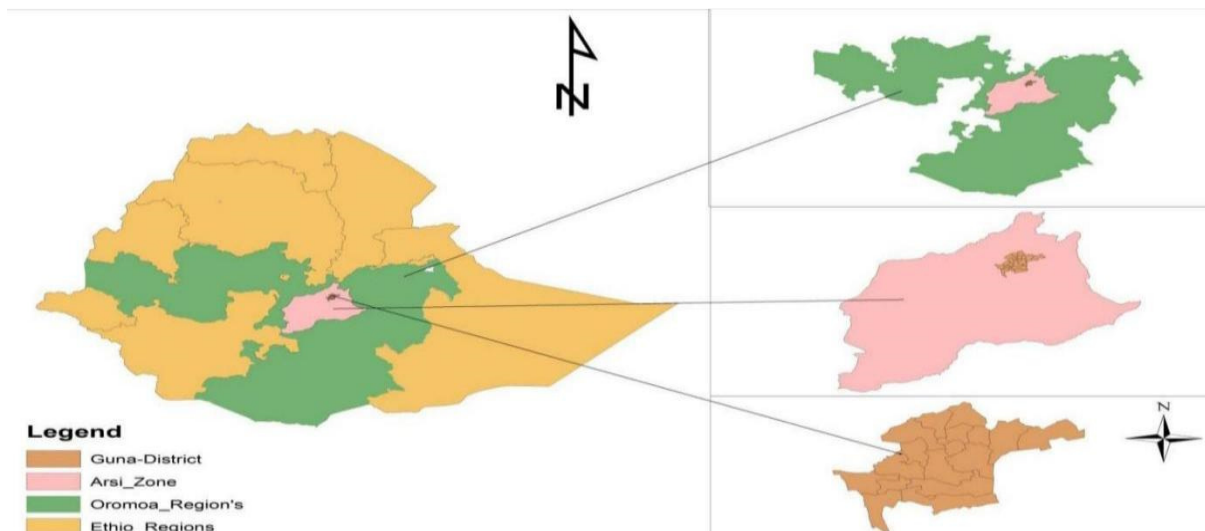


Figure 2: Map of Guna District, Oromia region, Ethiopia, 2025

4.2. Study design and period

Facility-based cross-sectional study design was conducted from February 27 to April 12, 2025.

4.3. Population

4.3.1. Source population

All pregnant women who visited public health centers in Guna district for antenatal care from February 27 to April 12, 2025.

4.3.2. Study population

All consecutively selected pregnant women who visited public health centers for antenatal care and met the inclusion criteria from February 27 to April 12, 2025.

4.4. Inclusion and Exclusion Criteria

4.4.1. Inclusion criteria: All pregnant women who visited health centers during the study period and had lived in the district for at least six months were included.

4.4.2. Exclusion criteria: Pregnant women with physical deformities of upper extremities, critically ill and unwilling to participate were excluded.

4.5. Sample Size Determination

Sample size was estimated for two specific objectives, and finally the highest sample size was selected. The sample size for the first objective was determined using a single population proportion formula, Where $p=22.2\%$ (the prevalence of undernutrition among pregnant women) from a previous study in Minjar Shenkora district, North Shewa, in 2024(27). The margin of error d was set 5% , with a 95% confidence level ($Z_{\alpha/2}=1.96$) and a design effect $g=1.5$ (A design effect of 1.5 was used to increase the sample size, reducing false precision and achieving a broader confidence interval, thus enhancing the reliability and representativeness of the study results).

$$n = \frac{(Z_{\alpha/2})^2 \times p(1-p) \times g}{d^2} = (1.96)^2 (0.222) (0.778) \times 1.5 / (0.05)^2 = 398.$$

The non-response rate calculated at 10% . $398 \times 10\% = 40$. By adding non-response rates, the sample size was $398 + 40 = 438$ for the first objectives. The sample size for the second objective (factors associated with undernutrition) was calculated by using STAT CALC application of EPI-INFO version 7.2.5 software for most significant variables from previous studies by using the assumptions of a 95% confidence level, 80% power and a design effect 1.5 .

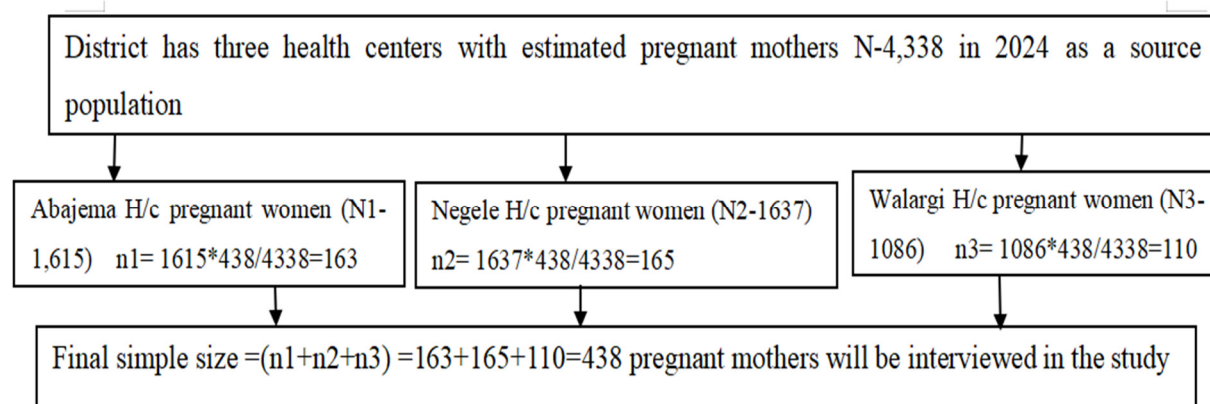
Table 1: Sample size determination for the second objectives of the study participants in Guna district, Arsi zone, Oromia, Ethiopia 2025

Factors			Assumption									Ref
			Ratio	Power	Confidence level	Odd Ratio	Design effect	Non-responder rate	Proportion of outcome		Sample size	
									Exposed	Non-exposed		
No habit of eating snack			1:1	80%	95%	2.16	1.5	10%	48.4	30.3	409	(61)
History of chronic illness		of	1:1	80%	95%	2.41	1.5	10%	60	38.4	304	(61)
Household monthly income <2,000			1:1	80%	95%	3.91	1.5	10%	64.5	31.7	197	(27)

From the calculated sample size, the first objective (prevalence of undernutrition) gave the highest sample size, and the final sample size was 438.

4.5.2. Sampling procedure

All three public health centers in the district were included in the study, with the sample size allocated proportionally to each center. During the study period, eligible pregnant women were consecutively recruited at health centers during antenatal visits to ensure efficient and practical recruitment until the required sample size was achieved. Care was taken to avoid bias during data collection, ensuring a representative sample from each health center.



N=number of pregnant, n=Samples proportionally allocated from each health centers

Figure 3: Sampling procedure of the study participants in Guna district, Arsi zone, Oromia, Ethiopia, 2025.

4.6. Study variables

4.6.1. Dependent variable

Undernutrition among pregnant women

4.6.2. Independent variables

1. The socio-demographic characteristics (age, marital status, educational status, occupation, residence, family size and household monthly income).
2. Dietary intake factors (dietary diversity, household food insecurity, skipping meals, practice of fasting and food avoidance/restriction during pregnancy).
3. Health care and Environmental factors (waiting time to antenatal care, deworming, nutritional and other counselling service availability, iron folate supplementation).
4. Reproductive health and other factors (age at first marriage, ANC, illness during pregnancy (peptic ulcer disease)).

4.7. Operational definitions

Antenatal Care: Antenatal care is a medical care that is provided to pregnant woman during pregnancy by skilled health service provider based on local situation (by nurse, midwife...)(18).

Nutrition: is the selection of foods items and preparation of foods and consumption to be used by the body(18).

Undernutrition: Pregnant women whose MUAC measurement is less than 23cm(74), a MUAC of less than 23 cm was considered indicative of undernutrition(4, 75, 76). It categorizes pregnant women based on their MUAC results as undernutrition and normal nutritional status(72).

Dietary diversity refers to the variety of foods and drinks consumed over a specific period, assessed by the number of distinct food groups in a diet. It is measured using a Dietary Diversity Score (DDS), which involves data collection methods like 24-hour dietary recall. Each consumed food group scores 1 point, while non-consumed groups score 0. Based on the Minimum Dietary Diversity for Women indicator, which utilizes a ten-food group classification, the dietary diversity of pregnant women was assessed (77, 78).

Household food insecurity (HFIA): This measurement evaluates household food insecurity over the past 30 days using nine occurrence and nine frequency questions. Responses to occurrence questions coded as 'no' received a score of 0, while 'yes' responses were scored as follows: 1. rarely, 2. sometimes, and 3. often. Households were categorized using the Household Food Insecurity Access Scale (HFIAS) based on these scores. The outcomes were classified as: 1 = food secure (HFIA category = 1 if [(Q1a=0 or Q1a=1) and Q2=0 and Q3=0 and Q4=0 and Q5=0 and Q6=0 and Q7=0 and Q8=0 and Q9=0]), 2 = mild food insecurity (HFIA category = 2 if [(Q1a=2 or Q1a=3 or Q2a=1 or Q2a=2 or Q2a=3 or Q3a=1 or Q4a=1) and Q5=0 and Q6=0 and Q7=0 and Q8=0 and Q9=0]), 3 = moderate food insecurity (HFIA category = 3 if [(Q3a=2 or Q3a=3 or Q4a=2 or Q4a=3 or Q5a=1 or Q5a=2 or Q6a=1 or Q6a=2) and Q7=0 and Q8=0 and Q9=0]), and 4 = severe food insecurity (HFIA category = 4 if [Q5a=3 or Q6a=3 or Q7a=1 or Q7a=2 or Q7a=3 or Q8a=1 or Q8a=2 or Q8a=3 or Q9a=1 or Q9a=2 or Q9a=3]) (79).

4.8. Data collection procedures

Data were collected using a structured questionnaire administered through face-to-face interviews. Dietary data were collected using a face-to-face interview list-based approach to obtain a 24-hour dietary recall. Anthropometric measurements (MUAC) were taken after they received their routine ANC services, based on a review of previous literature(26, 63, 80). The

questionnaire covered socio-demographic factors, healthcare and environmental factors, dietary intake and habits, and reproductive health. Participants were informed of the study's objectives and confidentiality. Data were gathered and recorded using the Kobo Collect application on Android devices, allowed data collectors to submit information to a central server and save it during connection interruptions. Measurements were taken on the bare left upper arm at the midpoint between the shoulder and elbow using a standard MUAC tape, recorded to the nearest 1mm.

4.9. Data quality assurance and management

To ensure data quality, the English questionnaire was translated into Afaan Oromo and then back-translated to check for consistency. A pretest was conducted on 5% (22 pregnant women) of the total sample at Moye health center's antenatal care unit to assess clarity, length, and completeness. Corrections were made to skip patterns, and difficult questions were rephrased. This pre-testing helped identify errors, estimate required time, and enhance the questionnaire's quality before actual data collection began.

Three midwifery data collectors and three public health professional supervisors participated in the data collection, and three days of training were provided to them. Close supervision was maintained during the data collection period, with the principal investigator checked questionnaires daily for completeness, clarity, and consistency. Any missed or unfilled data was corrected immediately during the data collection period. A comprehensive standardization process is essential prior to MUAC data collection. It begins with a rigorous equipment check to ensure MUAC tapes are undamaged and their color codes are legible, thus validating the tool's accuracy. This is followed by personnel standardization, where data collectors undergo intensive training and reliability testing to ensure consistent technique in locating the measurement site and applying the tape, thereby minimizing bias and ensuring data integrity.

The respondents were interviewed after they received their routine ANC services in a separate room. MUAC measurements were taken twice on the bare left arm at the midpoint between the shoulder and elbow, using a standard non-stretchable tape to the nearest 1mm, ensuring accuracy in assessing nutritional status. The left arm was used as it showed undernutrition, while the right arm, which is frequently used, showed muscle mass as a result of work. The principal investigator monitored the data collection process of the data collectors and, based on the

findings, provided constructive feedback to them in addition to the nearby assigned supervisors. Lastly, the data was checked during coding and data entry and was cross-checked before analysis.

4.10. Data processing and analysis

Individual records were captured electronically on the Kobo Toolbox version 2.4 platform by trained data collectors. Daily backups and consistency checks, including duplicate-entry verification, were performed, and data cleaning, coding, and handling of missing data were conducted before exporting the dataset to SPSS version 25. For analysis, undernutrition was coded as 1(Yes) (MUAC < 23 cm) and normal nutritional status as 0(No) (MUAC $\geq$ 23 cm).

Categorical variables (socio-demographics, MUAC category) were summarized using frequencies and percentages. Continuous variables (e.g., age) were assessed for normality and described using means ($\pm$ SD) as appropriate. Group comparisons between undernourished and adequately nourished pregnant women were conducted using chi-square tests for categorical factors and independent-samples t-tests or Mann–Whitney U tests for continuous factors.

Prior to multivariable modeling, Multicollinearity was assessed by computing variance inflation factors (VIF) for all candidate predictors. Variables with a VIF ≥ 10 were considered collinear and excluded from further analysis; however, none were eliminated, as all VIF values were below two and satisfied the established criteria. Bivariable logistic regression was first run for each factor against the dependent outcome (undernutrition). Factors with a p-value <0.25 in univariable analysis were retained for multivariable modeling. The Hosmer–Lemeshow goodness-of-fit test was used to assess model adequacy, with a p-value of 0.7 (a non-significant p-value indicates a good fit). Residual diagnostics and the link test were examined to rule out specification errors. A stepwise backward elimination approach was employed in SPSS version 25 to build the final logistic model(18). Adjusted odds ratio along with 95 % confidence interval was estimated to measure the strength of the association and the level of statistical significance was declared at a p-value < 0.05 in final model. Findings were organized into tables, including descriptive statistics, variance inflation factor (VIF) values, and multivariable regression results. Additionally, graphs such as bar charts for categorical distributions and box plots for continuous variables were generated in SPSS and enhanced in Excel for publication quality.

4.11. Ethical consideration

Ethical clearance was obtained from St. Paul's Hospital Millennium Medical College Institutional Review Board (Ref. No. Pm23/476, approved 3 February 2025). All study procedures adhered to the Declaration of Helsinki and national research ethics guidelines. A formal permission letter from SPHMMC was submitted to the Oromia Regional Health Bureau (Ref. BFO/HQ/162/2017) on 13 February 2025. The Regional Health Bureau granted clearance and forwarded it to the Arsi Zonal Health Office (Ref. W/F/G/A/072), on 15 February 2025. The Zonal Health Office authorized data collection in Guna District and informed the District Health Office (Ref. W/F/A/G/341/211), on 25 February 2025. Separate letters of permission were obtained from the directors of the three public health centers.

Before data collection, antenatal care providers at each facility introduced the study to eligible women. Trained data collectors then explained the research objectives, procedures, potential risks, and benefits in the local language. Written informed consent was obtained from each participant; for mothers under 18, assent was obtained along with guardian consent. To maintain confidentiality, questionnaires bore unique code numbers instead of names. All paper records were secured in locked cabinets at SPHMMC, and electronic files were stored on password-protected, encrypted drives accessible only to the core research team.

4.12. Results Dissemination plan

The result will be submitted to SPHMMC School of Public health department of Epidemiology. It will be submitted to Ministry of Health, Oromia Regional Health Bureau Arsi zonal health department and Guna district health office. The principal investigator will work on the report in an effort to publish the results in a peer-reviewed journal and will present them at scientific conferences.

5. Results

5.1. Socio-Demographic Characteristics and Economic Status of Pregnant Women

Out of 438 pregnant women, 430 voluntarily participated in the study, yielding a response rate of 98%. The mean age of respondents was 27.04 ± 3.98 (SD) years. A total of 264 women (61.40%) were between 26 and 34 years of age. Majority of study participants 407 (94.65%) were married and 201 (46.74%) had no formal education. More than half of the women, 247 (57.44%), resided in rural areas. Additionally, 388 (90.23%) were housewives, 295 (68.60%) had a family size of more than five members, and 330 (76.74%) reported a monthly income of less than 2,000 ETB (Table 2).

Table 2: Socio-demographic characteristics of pregnant women attended ANC in public health centers of Guna district, 2025 (n=430)

Variables	categories	Frequency	Percentage
Age categories	15-25	140	32.56
	26-34	264	61.40
	≥ 35	26	6.04
Marital status	Single	11	2.56
	Married	407	94.65
	Divorced	5	1.16
	Widowed	7	1.63
Educational status	No formal education	201	46.74
	Primary (1-8)	193	44.89
	Secondary and above	36	8.37
Residence area	Rural	247	57.44
	Urban	183	42.56
Occupation	Government employs	10	2.33
	Housewife	388	90.23
	Merchants	25	5.81
	Student	7	1.63
family size	<5	135	31.40
	≥ 5	295	68.60
Household monthly income	<2000	330	76.74
	≥ 2000	100	23.26

5.2. Reproductive, Health care and Environmental factors

Of the pregnant women, 110 (25.59%) married at teenage years. The majority, 366 (85.12%) taking iron and folate supplements and 302 (70.23%) dewormed. Nearly all participants, 410 (95.35%), waited less than one hour for ANC services, although nearly three-fourths, 314 (73.02%), traveled more than five kilometers to reach health facilities. Additionally, 417

(96.98%) consumed extra meals daily, 72 (16.74%) practiced fasting during pregnancy, and 89 (20.70%) skipped meals (Table 3).

Table 3: Reproductive, Health care and Environmental characteristics of the pregnant women in public health centers of Guna district, Arsi zone, Oromia, Ethiopia, 2025(n=430)

Variables	Categories	Frequency	Percentage
Age at first marriage	< 18 years	110	25.59
	≥ 18 years	320	74.41
Taking iron and folate supplements	No	64	14.88
	Yes	366	85.12
Dewormed during pregnancy	No	128	29.77
	Yes	302	70.23
Waiting time for ANC services	<60 minutes	410	95.35
	≥ 60 minutes	20	4.65
Distance to health facilities	≤ 5 Km	116	26.98
	> 5 Km	314	73.02
Consumed additional meals	No	13	3.02
	Yes	417	96.98
Skipped meals	No	341	79.30
	Yes	89	20.70
Food avoidance during pregnancy	No	371	86.28
	Yes	59	13.72
Practice fasting during pregnancy	No	358	83.26
	Yes	72	16.74
Using iodized salt	No	28	6.51
	Yes	402	93.49

5.3. Dietary Diversity

The mean ($\pm$ SD) DDS of participants was 6.57($\pm$ 2.71). The majority of participants, 424 (98.60%), consumed cereals, while 389 (90.47%) consumed legumes. More than nine-tenth 397 (92.33%) were consumed oil and fat. Among the ten food groups, fresh meat and other fruits had the lowest consumption, with 164 (38.14%) and 200 (46.51%) respectively.

Table 4: Dietary characteristics (user) of pregnant women in public health centers of Guna district, Arsi zone, Oromia, Ethiopia, 2025(n=430).

Dietary characteristics	Frequency	Percent
Cereal foods	424	98.6
Legumes	389	90.47
Dark green leaf	302	70.23
Vit A carrot, pumpkin	241	56.05
Other fruits apple, avocado, banana	200	46.51
Fresh meats	164	38.14
Milk	241	56.05
Eggs	213	49.53

Oils	397	92.33
Sweets	249	57.91

5.4. Household food insecurity

Among the study participants, 355 (82.56%) were food secure, while 28(6.51%) experienced severe food insecurity.

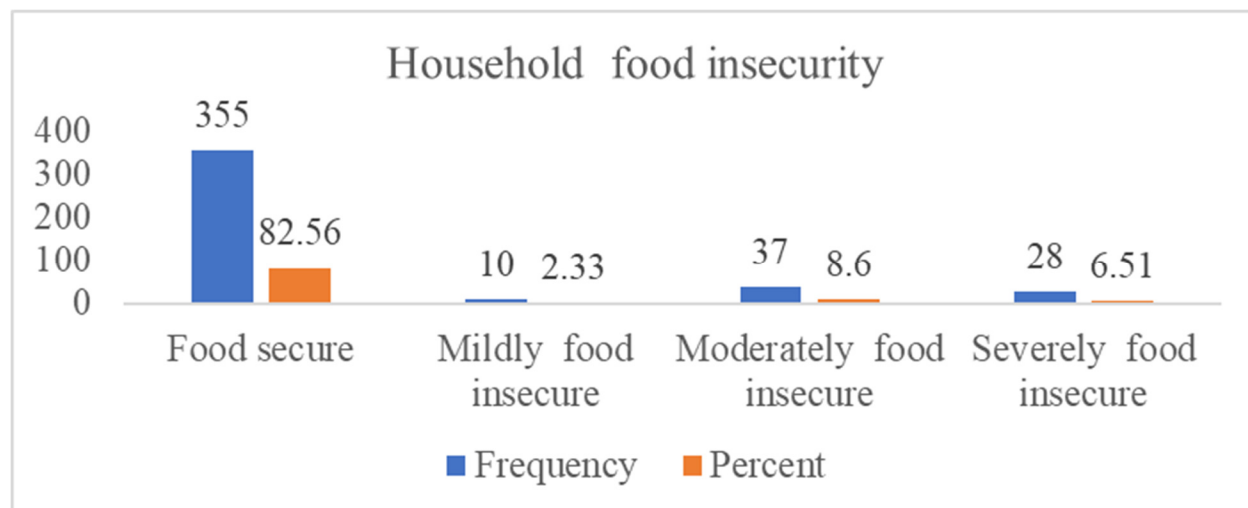


Figure 4: Distribution of household food security status of pregnant women in public health centers of Guna district, Arsi zone, Oromia, Ethiopia, 2025(n=430).

5.5. Magnitude of Undernutrition

The overall magnitude of undernutrition among pregnant women in Guna district was 84 [(20%), 95% CI (16%, 23%)].

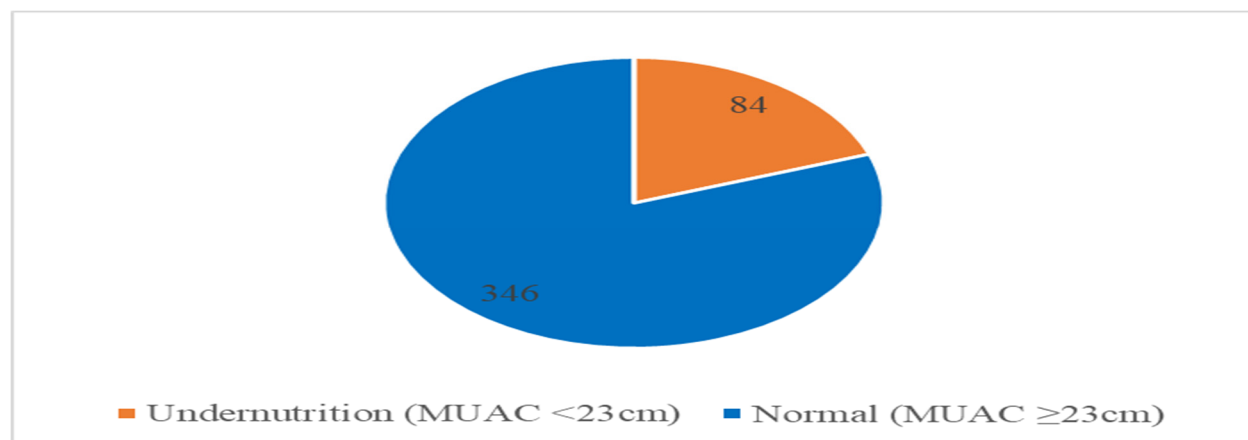


Figure 5: Magnitude of undernutrition among pregnant women in public health centers of Guna district, 2025.

5.6. Factors associated with undernutrition among pregnant women

In the first stage of analysis, we employed bivariable logistic regression to screen a comprehensive set of demographics, socioeconomic, health-service, and dietary factors for their unadjusted association with undernutrition (MUAC < 23 cm). Variables reaching a liberal significance threshold ($P < 0.25$) including age categories, educational level, residence address, family size, household monthly income, ANC waiting time, deworming, consumed additional meals, meal skipping, food avoidance, fasting practices, and using iodized salt were advanced into the multivariable model. Model diagnostics confirmed no problematic collinearity (all VIF < 2) and demonstrated adequate calibration (Hosmer–Lemeshow $\chi^2 = 2.21$, $P = 0.70$) with moderate explanatory power (Nagelkerke $R^2 = 0.44$).

After adjustment, several factors remained independently associated with undernutrition. Pregnant women from larger households (> 5 members) had 2.96 times higher odds of undernutrition (AOR=2.96, 95% CI: 1.37-6.38, $P=0.006$) compared to smaller families, and those earning less than 2,000 ETB per month were 5.64 times more likely to be undernourished (AOR=5.64, 95% CI: 2.98-10.68, $p < 0.001$). Dietary behaviors exhibited the strongest effects: skipping meals during pregnancy increased the odds nearly sixfold (AOR=6.31, 95% CI: 3.23-12.29, $p < 0.001$), and avoiding certain foods raised the odds by 9.73-fold (AOR=9.73, 95% CI: 4.66-20.32, $p < 0.001$). Conversely, consuming additional meals daily conferred a protective benefit, reducing the risk of undernutrition by approximately 79% (AOR=0.21, 95% CI: 0.05-0.99, $P=0.049$).

Table 5: Results of bivariable and multivariable analysis of factors associated with undernutrition among pregnant women in public health centers of Guna district, Arsi zone, Oromia, Ethiopia, 2025 (n=430).

Variables	Categories	Undernutrition		P. value	COR (95%CI)	AOR (95%CI)	P. value
		Yes (n=84)	No (n=346)				
Age categories	15-25	26(18.57%)	114(81.43%)	0.01	0.31(0.12-0.75)		
	26-34	47(17.80%)	217(82.20%)	0.004	0.29(0.12-0.68)		
	≥35	11(42.31%)	15(57.69%)	1			
Education al status	No formal education	47(23.38%)	154(76.62%)	0.053	3.36(0.98-11.44)		
	Primary (1-8)	34(17.62%)	159(82.38%)	0.176	2.35(0.68-8.11)		
	Secondary and above	3(8.33%)	33(91.67%)	1			

Residence	Urban	30(16.39%)	153(83.61%)	1				
	Rural	54(21.86%)	193(78.14%)	0.159	0.70(0.42-1.15)			
Family size	<5	16(11.85%)	119(88.15%)	1				
	≥ 5	68(23.05%)	227(76.95%)	0.008	0.45(0.25-0.81)	2.96(1.37-6.38)	0.006*	
Monthly income	<2000	37(11.21%)	293(88.79%)	0.000	0.14(0.09-0.24)	5.64(2.98-10.69)	0.000*	
	≥2000	47(47.00%)	53(53.00%)	1				
Waiting time	<60 min	73(17.80%)	337(82.20%)	1				
	≥ 60 min	11(55.00%)	9(45.00%)	0.000	0.18(0.07-0.44)			
Dewormed during pregnancy	No	30(23.44%)	98(76.56%)	0.185	1.41(0.85-2.33)			
	Yes	54(17.88%)	248(82.12%)	1				
Consume additional	No	7(53.85%)	6(46.15%)	0.004	5.15(1.68-15.76)	0.21(0.05-0.99)	0.049*	
	Yes	77(18.45%)	340(81.53%)	1				
Skipped meals	No	47(13.78%)	294(86.22%)	1				
	Yes	37(41.57%)	52(58.43%)	0.000	0.22(0.13-0.38)	6.31(3.23-12.29)	0.000*	
Avoidance of food	No	47(12.67%)	324(87.33%)	1				
	Yes	37(62.72%)	22(37.28%)	0.000	0.09(0.05-0.16)	9.73(4.66-20.32)	0.000*	
Practice fasting	No	62(17.32%)	296(82.68%)	1				
	Yes	22(30.56%)	50(69.44%)	0.011	0.48(0.27-0.84)			
Using iodized salt	No	3(10.71%)	25(89.29%)	0.233	0.48(0.14-1.61)			
	Yes	81(20.15%)	321(79.85%)	1				

* Indicate P-value less than 0.05 statistically significant, 1= indicate reference

6. Discussion

The magnitude of undernutrition among pregnant women was 20%. Factors significantly associated with undernutrition include consumed additional meals, which serve as a protective factor. In contrast, family size greater than five, household monthly income below two thousand Ethiopian birr, skipping meals, and food avoidance were identified as risk factors. These findings underscore the pivotal role of household resources and maternal dietary practices in shaping nutritional status during pregnancy.

The study found a 20% (95% CI: 16–23%) prevalence of undernutrition (MUAC < 23 cm) among pregnant women, which is consistent with previous research but notably lower than rates reported in Konso district (43.1%)(75), Bench Sheko Kaffa Zone (42.4%)(76), rural Southern Ethiopia (41.2%)(81), and East Borena Zone's Liben District (44.9%)(18). This may be due to socioeconomic variations like income and education affecting food, healthcare access, health interventions, and dietary practices. This implies that improving access to food, healthcare, and socioeconomic support can significantly enhance nutritional outcomes in vulnerable populations.

The study indicated that households with more than five members faced a 2.96-fold increased risk of undernutrition. This finding was consistent with regional studies that reported varying risk levels: 2.5-fold in Gedio Zone(82), 3-fold in Ilu Aba Bora Zone(55), 6.98-fold in Chinaksen District(83), 1.19-fold in Haramaya District(84), 8.2-fold at Metu Karl Referral Hospital(85), and 2.06-fold at Mieso Health Center(56). Larger households struggle to feed all members, particularly children and pregnant women, with risks worsening when most are dependent children. Food-insecure large families often cannot meet nutritional needs, leading to child/prenatal malnutrition and increased under-five mortality. This may be due to pregnant women's dual vulnerability from greater household burdens and food shortages exacerbated by family members competing for resources and the stress of pregnant women in large families. It implies that large families (5+ members) face higher undernutrition risks and should be prioritized in food and health programs to protect children and pregnant women.

The study found that pregnant women in households earning less than 2,000 ETB per month had a 5.64 times higher risk of undernutrition. These results were consistent with findings from Mieso District (5.63 times higher risk)(56) and Gumay District (8.72 times higher risk)(86).

This confirmed that lower household income significantly increased malnutrition risk during pregnancy. As household income decreases, family members may decrease the quality and quantity of food consumption and eat only a limited variety of food items due to the unaffordability of purchasing or producing sufficient, safe and nutritious food. This implies that prioritizing pregnant women in low-income households is essential for improving access to nutritious food, healthcare services, and affordable nutritious food support, which will enhance maternal and child nutrition outcomes.

This study found that women who skipped meals had a 6.31 times higher risk of undernutrition. While these results were consistent with findings from Liben district (2.6 times higher risk)(18) and Metu Karl Referral Hospital (3.8 times higher risk)(85), the elevated risk in our study suggests more severe consequences. This difference may reflect poorer food availability or lower diet quality among participants, potentially due to food insecurity, cultural practices (such as religious fasting), or economic barriers to regular meal consumption. It implies that pregnant women urgently need antenatal nutrition education, dietary counseling, and social support to ensure adequate and consistent food intake.

The study showed that consuming additional meals during pregnancy reduced the risk of undernutrition by 79% compared to those who did not consume additional meals. In contrast, not taking extra meals increased the risk by three times among pregnant women in Afar Regional State(72) and at Metu Karl Referral Hospital(85). This may be due to the increased nutritional demands during pregnancy that require more frequent meal intake to support both maternal and fetal health. This implies promoting frequent, nutritious meals during pregnancy is an efficient, scalable, and impact full strategy especially in resource limited settings.

This study revealed that pregnant women who avoided food faced a 9.73 times greater risk of undernutrition. While consistent with patterns observed in Eastern Ethiopia (1.9 times higher risk)(87) and Afar (3.7 times higher)(72), the elevated risk in our study population suggests more severe nutritional consequences. This greater risk comes from cultural misunderstandings, especially the belief that eating well makes delivery harder, leading women to avoid food fearing big babies. This may be due to cultural food restrictions during pregnancy, where nutrient-rich foods like meat and eggs are avoided due to misguided fears of birthing complications from larger babies, exacerbating undernutrition. The implication is to enable early, targeted

identification through screening mechanisms, opens pathway for tailored nutritional counseling and intervention and allows for culturally sensitive reintroduction strategies and education to improve diet diversity.

Limitations of the Study

MUAC measurement is highly susceptible to human error in identifying the midpoint, applying tape tension, and reading the value correctly. To minimize human error in MUAC measurement, implement mandatory hands-on training reinforced by routine audits to ensure technique consistency. Facility-based sampling may not reflect the broader pregnant population due to demographic variability (where community-based or multi-site studies would enhance generalizability), and cross-sectional designs cannot establish causality, being susceptible to reverse causation and unmeasured confounders such as seasonal diets and cultural factors (whereas a longitudinal cohort or nested case–control study would help clarify temporal relationships). Self-reported dietary data remain vulnerable to recall bias and social desirability bias. To address these issues, we minimized recall bias through clear questionnaires, face-to-face interviews, and structured dietary lists, while social desirability bias was reduced by ensuring participant confidentiality and clearly explaining the study purpose.

Conclusion

The magnitude of undernutrition was found to be 20%, indicating that one in five pregnant women is affected, which signifies a high public health problem. Key predictors of undernutrition identified in this study were dietary and socioeconomic factors. Specifically, consuming additional meals was protective against undernutrition, while larger family size, low household monthly income, skipping meals, and food avoidance significantly increased the risk. These findings highlight the importance of both household economic capacity and maternal dietary practices in shaping maternal nutritional status during pregnancy.

Recommendations

Nutrition Education and Counselling: Guna district health facilities should strengthen nutrition counselling services during ANC visits, with emphasis on the importance of consuming additional meals, avoiding unnecessary food restrictions, and not skipping meals.

Household Economic Empowerment: Local government and stakeholders should design and implement income-generating activities and social support programs for low-income households to improve food access and dietary diversity for pregnant women.

Community-Based Interventions: Health workers should be actively involved in promoting culturally appropriate and affordable dietary practices, while addressing harmful traditional food taboos and misconceptions.

Targeted Support for Large Families: Families with many dependents should be given priority in food security and nutritional support programs, as they are more vulnerable to undernutrition among pregnant women.

Policy and Program Implications: Regional and district health authorities should integrate maternal nutrition programs into routine maternal and child health services, and ensure multi-sectoral collaboration between health, agriculture, and social affairs sectors to address the root causes of undernutrition.

Further Research: Longitudinal and qualitative studies are recommended to better explore causal pathways and cultural beliefs contributing to meal skipping and food avoidance among pregnant women.

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Annexes

Annex I: participant information sheet and informed consent form (English version)

I. Informed Consent

Title of the study: Magnitude of undernutrition and Associated Factors among Pregnant Women Attending Antenatal Care in Public Health Centers of Guna District, Arsi Zone, Oromia, Ethiopia, 2025

Introduction

My name is I am here on behalf of Zeyede residents of SPHMMC College of health Science. They are conducting research on Prevalence and Associated Factors of Undernutrition among Pregnant Women Attending Antenatal Care in public health centers of Guna district, for the partial fulfillment of master's in Field Epidemiology in SPHMMC. Before you decide whether or not to participate in this study, I would like to explain to you the purpose of the study, procedure, any risks, benefits and what is expected of you. Your participation in this study is entirely of your own free will. You are under no obligation to participate; you may choose to participate or not to participate. If you decide not to participate, no freedoms will be taken away from you. If you agree to participate, you will be asked to sign in the space provided below.

Purpose of the study

The purpose of this study is to assess prevalence and associated factors of undernutrition among pregnant women attending antenatal care.

Procedure

After you have signed the informed consent form, and have a chance to ask questions, you will be requested to answer questions asked by the interviewers.

Risks

No risks are involved apart from the use of your time for answering questions.

Benefits

Agreement to participate will not result any immediate benefits to you. But by taking part in this study, you will be able to provide true information that will help relevant health care providers working in different health facility to give factors-oriented health education, authorities and

policy makers to come up with strategies and policies that will help to increase ANC services utilization and this will in turn benefit mothers, children and the community at large.

Confidentiality

The information that you provide will be confidential to the data collectors only and it will be used for the purpose of this study only.

Informed consent form

I have been well aware of that this research undertaking is for a partial fulfillment of MPH degree which is fully supported and coordinated by the SPHMMC, College of Health Sciences, Department of Public health and the designate principal investigators is Zeyede. I have been fully informed in the language I understand about the purpose of this research. I have been informed that all the information I shall provide to the interviewer will be kept confidential. I understood that the research has no any risk and no composition. I have assured that the right to ask information that is not clear about the research before and or during the research work and also taking part in this study is as purely voluntary. I have read this form/ it has been read for me in the language I know and understood the condition stated above.

So, I am agreed to participate in this study. 1. Yes 2. No

If yes, sign _____ Time started _____ Time finished _____

Person to contact for problems or questions/ at any time for further explanation.

Name of principal investigators: - Zeyede – phone No: +251921369240

Annex II: English Version Questionnaire

Questionnaire to identify factors associated with undernutrition among pregnant mothers.

Questionnaire ID _____ Name of the District _____

Name of Kebele _____ Name health center _____ Date of interview _____

Name of interviewer _____ Signature _____

Result of interview: 1. Completed 2. Respondent not available 3. Refused 4. Partially completed

Checked by: Name of supervisor _____ Signature _____

Annex III: Data collection tools

Data collection tool for undernutrition among pregnant women attending antenatal care in public health centers of Guna district, Arsi zone, Oromia Region, Ethiopia, 2025.

Date: _____, Kebele _____, Woreda _____, Zone _____, Region _____
Interview number: _____

Part 1: Socio- demographic characteristics

1	Age (in years)	_____
2	Marital status	1.Single 2. Married 3. Divorced 4. Widowed
3	Educational level	1. No formal education 2. Primary (1-8) 3. Secondary education (9-12) 4. College and above
4	Residential address	1.Urban 2. Rural
5	Occupation	1.Housewife 2. Farmer 3. Government employs 4. Private employ 5. Others
6	Husbands Occupation	1.Farmer 2. Government employs 3. Private employ 4. Others
7	Family size/members?	1.<5 2. ≥ 5
8	Household monthly Income	1.<2000 ETB 2. ≥2000 ETB

PART 2: Reproductive, Health care and Environmental factors

1	Age at first marriage of respondents	1. <18 years 2. ≥ 18 years
2	Trimesters of pregnancy	1.first trimester 2. Second 3. Third
3	Number of ANC visit	1.1st 2. 2nd 3. 3rd 4. 4th 5. 5th 6. 6th 7.7th 8. 8th
4	What types of services are offered at antenatal clinic? NB. more than one answer is possible	1.Immunization 2. Nutrition counsel/education 3. Treatment of diseases 4. Family planning 5. vitamin A supplementation 6. Iron and folic acid supplements 7. Others (specify)
5	Is it always important to take ANC follow-up?	1.Yes 2. No

6	If yes, why? NB. more than one answer is possible	1. To monitor pregnancy status 2. To take action if there is problem 3. To monitor health of mother 4. To identify whether fetus is healthy or sick 5. Others (specify___)
7	Use of iron and folic acid supplementation	1. Yes 2. No
7	Deworming	1. Yes 2. No
8	What are the benefits of assessing nutrition during ANC follow up? NB. more than one answer is possible	1. Health workers give nutritional counsel/education 2. To monitor the growth of children 3. To take corrective measures in case of growth failure 4. To prevent diseases 5. Other (specify___)
9	What is your Source of information on utilization of nutritional services? NB. more than one answer is possible	1. HEWs 2. HWs 3. Volunteers 4. Neighbors 5. Radio 6. Others specify_____)
10	What has been your waiting time for ANC services today?	1. <60 minutes 2. ≥ 60 minutes
11	What are the reasons for waiting times of 60 minutes or more for ANC services today? Multiple answer is possible	1. Health workers are not always available 2. There is no health worker at the ANC unit/clinic 3. It takes a long time to be served 4. Different ANC services were provided in different units 5. Other specify (_____)
12	Distance to health facilities	1. ≤ 5 Km 2. > 5 Km
13	Did you face any challenges when you go to for follow up?	1. Yes 2. No
14	If yes, what challenges do you faced? NB. more than one answer is possible	1. The health facility is far 2. It takes long to be served 3. Health workers are not always available 4. Road not accessible 5. Lack of transportation 6. Cost of transport is high 7. Other (specify -----)
15	What is the source of your household's drinking water?	1. Piped water 2. Protected well 3. Unprotected well 4. Protected spring 5. Unprotected spring 6. Lake/river 7.

		Other specify (_____)
16	What is the type of toilet facility for household?	1. Shared toilet 2. Flush to pit latrine 3. Ventilated improved pit latrine 4. Pit latrine with slab 5. Pit latrine without slab/open pit 6. No facility/bush/field 7. Other specify_____

Part 3: Health conditions during the current pregnancy

1	History of chronic illness	1.Yes 2. No
2	If yes, which types of disease?	1.Diabetes 2. Cancer 3. kidney disease 4. CVD 5. Others
3	History of peptic ulcer disease	1. Yes 2. No
4	History of nausea or vomiting	1. Yes 2. No
5	Nutritional advice during pregnancy	1. Yes 2. No
6	Do you take/consume additional meals in between?	1. Yes 2. No
7	If yes, how many of meals/ days	1. ≤ 3 2. >3
8	Do you ever skip meals during this pregnancy?	1. Yes 2. No
9	Avoidance/restriction of specific food during pregnancy	1. Yes 2. No
10	If yes, what types of food?	1.eggs 2. butter 3. meat 4. Avocado 5. others
11	Common reasons for food taboos NB. more than one answer are possible	1.Fear to fat baby to delivery 2. Fear of fetal abnormality 3. Fear of miscarriage 4. Others (Specify_____)
12	Habit/practice of fasting	1. Yes 2. No
13	Using iodized salt to cook main meal	1. Yes 2. No
14	If yes, at what time do you use it?	1.Before cooking 2. during cooking 3. After cooking

Part 4: Dietary Diversity Questionnaire (24-hour recall)

	Food items	Response
1	Cereals (bread, pasta, macaroni, biscuits, cookies or any other	0.No 1. Yes

	foods made from millet, sorghum, maize, rice, porridge or other locally available grains)	
2	Legumes, nuts and seed (beans, peas, lentils, nuts, seed or foods made from these)	0.No 1. Yes
3	Dark green leafy vegetables (Spinach, kale, cabbage and lettuce, sweet pepper, dark green/leafy vegetables, locally available vitamin-A rich leaves)	0.No 1. Yes
4	Vitamin A rich vegetables (pumpkin, carrot, red sweet pepper).	0.No 1. Yes
5	Other fruits (apple, avocado, banana, watermelon, mandarin, grapefruit, guava, lemon, orange, pineapple, strawberry, figs, peach, fruit juice and including wild fruits)	0.No 1. Yes
6	Flesh meats (beef, lamb, goat, chicken, fish)	0.No 1. Yes
7	Milk and milk products (milk, cheese, butter, yogurt)	0.No 1. Yes
8	Eggs (Chicken, hen, or any other egg)	0.No 1. Yes
9	Oils and fats (oil, fats or butter added to food or used for cooking)	0.No 1.Yes
10	Sweets (sugar, honey, sugar cane, sweetened soda or sugary foods such as chocolates, sweets or candies)	0.No 1.Yes

Part 5: Household Food Insecurity Access Scale (HFIAS) Measurement Tool

[Rarely (once or twice times in the past four weeks), Sometimes (three to ten times in the past four weeks), Often (more than ten times in the past four weeks)]

S / N	Question	Response	If each question is yes, how often did this happen? If No skip to next question
1	In the past one month, did you worry that your household would not have enough food?	0.No 1.Yes	1.Rarely 2.Sometimes 3. Often
2	In the past one month, were you or any household member not able to eat the kinds of foods you	0.No 1.Yes	1.Rarely 2.Sometimes

	preferred because of a lack of resources?		3. Often
3	In the past one month, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0.No 1.Yes	1.Rarely 2.Sometimes 3. Often
4	In the past one month, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	0.No 1.Yes	1.Rarely 2.Sometimes 3. Often
5	In the past one month, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0.No 1.Yes	1.Rarely 2.Sometimes 3. Often
6	In the past one month, did you or any household member have to eat fewer meals in a day because there was not enough food?	0.No 1.Yes	1.Rarely 2.Sometimes 3. Often
7	In the past one month, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0.No 1.Yes	1.Rarely 2.Sometimes 3. Often
8	In the past one month, did you or any household member go to sleep at night hungry because there was not enough food?	0.No 1.Yes	1.Rarely 2.Sometimes 3. Often
9	In the past one month, did you or any household member go a whole day and night without eating anything because there was not enough food?	0.No 1.Yes	1.Rarely 2.Sometimes 3. Often

Part 6: Anthropometric measurements of the participants

1	Current MUAC (cm)= __
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Annex IV: Waraqaa odeeffannoo hirmaattotaa fi uunka hayyamaa odeeffannoo irratti hundaa’e

I. Hayyama Odeeffannoo irritate hunda’ee

Mata duree qorannichaa : Tajaajila fi sakkata’insaa hanqinaa nyaataa hadhollee ulfaa fi sababoota kanaaf gumaachaan kan Aanaa Gunaa, Godina Arsii, Oromiyaa, Ethiopia 2025.

Seensa

Akkam Bultan/oltan. Maqaan koo_____jedhama. Ani Aanaa Gunaatti Tajaajila sakkata’insa hanqina nyaata hadhollee ulfa fi sababoota kanaaf gumaachaan irraatti qorannoo gaggeessaa jira, kutaa saayinsii fayyaa hawaasaa yuunivarsiitii Kiduus pawuloos keessatti barnoota Field Epidemiology digrii lammaffaa barachaa kan jiruudha. Qorannoo kana irratti hirmaachuu fi dhiisuu kee murteessuun kee dura kaayyoo qorannichaa, hojimaata, miidhaa kamiyyuu, faayidaa fi maaltu sirraa akka eegamu siif ibsuun barbaada. Qo’annoo kana irratti hirmaachuun kee guutummaatti fedhii keetiin kan murtaa’udha. Hirmaachuuf dirqama tokkollee hin qabdu; hirmaachuu ykn hirmaachuu dhiisuu filachuu dandeessa. Yoo hirmaachuu dhiisuuf murteeffatte bilisummaan sirraa hin fudhatamu. Yoo hirmaachuuf walii galtan bakka armaan gaditti kenname irratti akka mallatteessitan isin gaafatama.

Kaayyoo qorannichaa

Kaayyoon qorannoo kanaa tajaajila sakkatainsa hanqina nyaata hadhollee ulfa fi sababoota kanaaf gumaachaan aanaa keessan keessatti safaruudha.

Adeemsa

Unka hayyama beekumsa qabu erga mallatteessitee booda, fi carraa gaaffii gaafachuu erga argatte booda, gaaffii gaafattoonni gaafatan akka deebistu si gaafatama.

Miidha

Yeroo kee gaaffii deebisuuf fayyadamuu irraa kan hafe miidha tokkollee hin jiru.

Faayidaalee

Hirmaachuuf walii galteen faayidaa battalaa tokkollee siif hin argamsiisu. Garuu qorannoo kana irratti hirmaachuudhaan, odeeffannoo dhugaa kan kennitoonni eegumsa fayyaa dhimmi ilaallatu dhaabbilee fayyaa adda addaa keessatti hojjetan barnoota fayyaa , abbootii taayitaa fi imaammata baastonni tooftaa fi imaammata gargaaran akka baasan gargaaru kennuu ni dandeessu itti fayyadama tajaajila guddisuuf kan hojjetamu yoo ta’u kunis dabaree isaatiin hadholee fi hawaasa waliigalaa ni fayyada.

Iccitii eeguu

Odeeffannoon isin kennitan namoota odeeffannoo walitti qaban qofaaf iccitii kan ta'u yoo ta'u, kaayyoo qorannoo kanaa qofaaf kan oolu ta'a.

Unka hayyama odeeffannoo irratti hundaa'e

Qorannoo kun barataa digrii lammaaffaa Yuniversitii Kiduus pawuloos muummee saayinsii hawaasaa kan ta'e Zayyada Warquu akka qoratamuu fi Yuunivarsiitii Kiduus pawuloos kolleejjii saayinsii fayyaa kutaa fayyaa hawaasaa guutummaatti deeggaramee fi qindoominaan akka ta'e sirriitti beeka ture. Kaayyoo qorannoo kanaa afaan naaf galuun odeeffannoo guutuu argadheera. Odeeffannoon ani nama gaaffii fi deebii godhuuf kennu hundi iccitii akka ta'u naaf himameera. Qorannoon kun balaa tokkollee akka hin qabnee fi faayida battalaa akka hin qabne hubadheera. Mirgi hojii qorannoo duraa fi ykn yeroo qorannoo sanaa odeeffannoo ifa hin taane gaafachuu fi akkasumas qorannoo kana irratti hirmaachuu akkuma tola ooltummaa qulqulluu ta'uu isaa mirkaneesseen jira. Unka kana dubbiseera/ afaan ani beekun naaf dubbifamee haala armaan olitti ibsame hubadheera.

Kanaafuu, qorannoo kana irratti akkan hirmaadhu walii galeera.

☐ Eeyyee ☐ Lakki

Yoo eeyyee ta'e, Mallattoo_____ Yeroon jalqabe _____Yeroon xumurame_____ .

Nama rakkoo ykn gaaffii/ yeroo kamiyyuu ibsa dabalataaf .

Maqaa qorataa muummee: Zayyada Warquu

Lakk bilbila harkaa: +251921369240/+251962036368

Imeelii: zeyedeworku00@gmail.com irratti ergaa

Annex V: Gaaffii (Afaan Oromoo Version questionnaire)

Gaaffii haadholii ulfa tajaajila sakkatainsa hanqina nyaata hadhollee ulfa fi sababoota kanaaf gumaachaan kanaan walqabatan adda baasuuf.

ID Gaaffii _____ Maqaa Aanaa_____ .

Maqaa Gandaa _____Guyyaa gaaffii fi deebii_____ .

Maqaa gaafataa_____ Mallattoo _____ .

Bu'aa af-gaaffii:1. Guutumatti xumurame 2. Deebii kennaan hin jiru 3. Af-gaaffii didee 4.

Gartokkoon xumurame

Kan sakatta'ame: Maqaa supparvaayizaraa _____ Mallattoo _____ .

I. Amaloota hawaas-dimoogiraaffii hirmaattota qorannoo Aanaa Gunaa, Godina Arsii, Mootummaa Naannoo Oromiyaa, Itoophiyaa, 2025.

T	Jijjiiramaa/gaaffii	Deebii ta'uu danda'u
1	Umrii (waggaadhaan)	
2	Haala gaa'ilaa keessaan akkami?	1.Kan hin herumnee 2.Kan herumtee 3.Kan wal hiikan 4.Kan abbaan manaa irraa du'e
3	Sadarkaa barnoota kee maali (kutaa meeqa xummurtee)?	1.Barnoota idilee hin qabu 2.Sadarkaa tokkoffaa(1-8) 3.Barnoota sadarkaa lammaffaa (9-12) 4.Kolleejjii fi isaa ol
4	Iddoon jireenya kessaan essaa?	1.Magaalaa 2. Baadiyyaa
5	Hojiin keessan maali?	1.Hadhaa waraa 2. Hojjattuu mootummaa 3.Dhabbataa dhuunfaa biraatti qaxaramee hojjattuu 4.Daldaltuu 5. Barattuu 6.Kan biroo
6	Hojiin Abbaa waraa keessanii maali?	1.Qonnaan bulaa 2.Hojjataa mootummaa 3.Dhabbataa dhuunfaa biraatti qaxaramee hojjattuu 4.Daldalaa 5. Kan biroo
7	Baay'ina maatii mana keessan keessa jiran meeqa?	
8	Galiin keessan ji'an meeqa?	

II. Seenaa dahumsaa fi wantoota ykn sababaa Naannoo

T.I	Jijjiiramaa/gaaffii	Deebii ta'uu danda'u
1	Umrii meeqaatti herumtan?	1.<18 2. ≥ 18
2	Ulfi keessan ji'a meeqaa gahee? (Tilmaamamaan ji'aa)	
3	Hordoffii kununsaa dahumsaa duraa yeroo meeqaa gottan?	1.1ffaa 2. 2ffaa 3. 3ffaa 4. 4ffaa 5. 5ffaa 6. 6ffaa 7. 7ffaa 8. 8ffaa
4	Yeroo hunda hordoffii ulfaa irratti argamuun barbaachisaa dha jettanii amantuu?	1. Eeyyee 2.Lakki

5	Eeyyeen, yoo ta'ee, maaliif?	1. Fayyaa haadholii hordofuuf 2. Rakkon yoo umamee tarkaanfii sirreeffama fudhachuuf 3. ulfi rakkoo fayyaa qabachuu fi dhabuu addaa basuuf 4. kan biroo
6.	Kininii Ayireenii fi foolikii asiidii fayyadamaa jirtu?	1. Eeyyee 2. Lakki
7	Kininii raammoo balleessuu fudhatee jirta?	1. Eeyyee 2. Lakki
8	Hordoffii sirnaa nyaataa/soorataa yeroo hordoffii ulfaa faayidaa maal fa'aa qabaa jettani amantuu? Hub. deebii tokkoo ol ta'uu ni danda'ama	1. Fayyaa haadholii hordofuuf 2. Guddina daa'immanii hordofuuf 3. Guddinni da'imaani yoo gadi'anaa ta'e tarkaanfii sirreeffamaa fudhachuuf 4. Dhukkuboota/hanqina soorataa ittisuuf 5. Yeroo ulfaa rakkoolee mudatan hiri'suuf 6. kan biroo
9	Odeeffannoo tajaajila soorataa/sirnaa nyaataa adda durummaan eenyuu irraa argattu? (Hub. deebii tokkoo ol ni danda'ama)	1. Hojattoota eksteeshinii fayyaa 2. Oggeessotaa fayyaa 3. Tola oltota 4. Ollaa 5. Raadiyoo 6. Kan biroo
10	Tajaajila dahumsaa duraa har'a sa'aati meeqa isin tursisee?	1. daqiqaa 60 gadii 2. daqiqaa 60 fi isaa ol
11	Tajaajila kununsaa dahumsaa duraattif daqiqaa 60 ol maalif turtee? Multiple answer is possible	1. Oggeessi waan hin jireef 2. Tajaajilii kununsaa dahumsaa duraa bakka garagaraatti waan kennamuf 3. Tajaajilaa argachuuf sa'aati dheeraa waan tursisuuf 4. kan biroo (_____)
12	Fageenya dhaabbilee fayyaa irraa hangam fagaattuu?	1. ≤5 Km 2. >5 Km
13	Hordoffii ulfaadhaaf wantii gufuu/rakkoo sinittii ta'ee jiraa?	1. Eeyyee 2. Lakki
14	Eeyyeen, yoo ta'ee, wantii rakkoo /gufuu isinitti ta'ee maaliidhaa?	1. Fageenyaa dhaabbilee fayyaa 2. Turtii tajaajilaa fayyaa 3. Oggeessotni fayyaa

		dhabbilee fayyaa gahaa ta'uu dhabuu 4. Haali geejibaa mijataa ta'uu dhabuu 5. geejibaa dhabuu 6. gatii geejibaa dabaluu 7. kan biroo
15	Maddi bishaan dhugaatii mana keessanii maali? Hub. deebii tokkoo ol ta'uu ni danda'ama	1.Bishaan tuuboo 2. Boolla bishaanii kan dallaa qabu 3. Boolla bishaanii kan dallaa hin qabne 4.Burqaa kan dallaa qabu 5.Burqaa kan dallaa hin qabne 6. Haroo/laga 7.Kan biroo
16	Gosti mana fincaanii manaa keessanii kamii?	1.Mana fincaanii waliinii 2.Mana fincaanii boolla keessaatti dhangala'u 3.Mana fincaanii boolla fooyya'aa qilleensa qabu 4.Mana fincaanii boollaa kan simintoon/dhagaan hojjatame 5.Mana fincaanii boollaa kan simintoon/dhagaan hin hojjatamne 6.Mana fincaanii hin qabu/bosona/dirree irrattiin fayyadama 7.Kan biroo

III. Haala fayyaa yeroo ulfaa ammaa

T.1	Jijjiiramaa/gaaffii	Deebii
1	Seenaa dhukkuba yeroo dheeraa qabdu?	1.Eeyyee 2.Lakki
2.	Eeyyee yoo ta'ee, dhibee kam qabdan ?	1. Dhibee Sukaara 2. Kansarii 3. Dhibee Kalee 4. dhibee onnee 5. Kan biroo
3	Seenaa dhukkuba madaa garaachaa/ cogaraa	1.Eeyyee 2.Lakki
4	Haqee fi lolocuu qabdaa?	1.Eeyyee 2.Lakki
5	Yeroo hordoffii ulfaa gorsa sirnaa nyaataa fudhattee jirtaa?	1.Eeyyee 2.Lakki
6.	Yeroo ulfaa kanatti nyaata idilee keessan gidduutti nyaata dabalataa ni nyaattu?	1.Eeyyee 2.Lakki
7	Eeyyee yoo ta'ee, guyyaatti yeroo meeqaa?	1. ≤ 3 2. >3

8	Yeroo ulfaa kanatti nyaata darbitee beektaa?	1.Eeyyee 2.Lakki
9	Sababoota ulfaa waan taatteef nyaata duraa nyaatuu irraa fagaattuu/dhorkamtuu jiraa?	1.Eeyyee 2.Lakki
10	Eeyyee yoo ta'ee, nyaata gosaa akkamii?	1.Hanqaaqu 2. Dhadhaa 3. Foon 4. Avookadoo 5. kan biroo
11	Sababaa maaliidhaaf dhorkamee	1.Daa'imni yoo furdade dahumsaa irratti ni rakkisa jedhamee waan yaadamuf 2. Daa'imni qaama midhamaa ta'ee dhalatamaa jedhamee waan yaadamuf 3. Ulfa ni basaa waan jedhamee waan yaadamuf 4. Kan biroo (____)
12	Yeroo ulfaa kanaa ni soomta?	1.Eeyyee 2.Lakki
13	Nyaata yeroo bilcheessituu soogidda ayoodinii fayyadamtaa?	1.Eeyyee 2.Lakki
14	Eeyyee yoo ta'ee, yeroo kam fayyadamtaa?	1.Qopheessu koo duraa 2. Yeroon qopheessu 3. Ergaa qopheeffamee boodaa

IV. Nyaata gosa gara garaa (yaadannoo sa'aatii 24)

T.L	Jijjiiramaa/gaaffii	Deebii
1	Xaafii,garbuu,mishingaa,boqqolloo,qamadii,ruuzii,ajjaa fi nyaata kanneen irraa hojjetaman kanneen akka marqaa, dabboo,buddeen, mokoroonii, paastaa, fi kanneen kan fakkataan nyaatani?	1.Eeyyee 2.Lakki
2.	Midhaan dheedhii (Baaqelaa, ataraa, misira goggogaan fi nyaata isaan irraa hojjetamee) nyaate?	1.Eeyyee 2.Lakki
3	Kuduralee baala magariisa qabaani fi nyaataf oolan (saalaxaa, raafuu maramaa, doobbii, qoosxaa fi kanneen kan fakkataan) nyaate?	1.Eeyyee 2.Lakki
4	Nyaataa vaayitamiinii A badhaadhaan kuduralee fi muduralee biroo (mango, pappaa, yaa, dabaaqula, karoota, maxaxisaa, hundee diimaa, fi cuunfaa nyaatoota kanneen irraa hojjetaman) nyaate?	1.Eeyyee 2.Lakki
5	Muduraalee biroo (Avookadoo, muuzii, loomii, burtukaana, annanasii,cuunfaa kanneen irraa hojjetaman fi kanneen kan fakkatan) nyaate?	1.Eeyyee 2.Lakki

6.	Foon (foon loonii, hoolaa, re'ee, lukkuu,qurxumii) nyaate?	1.Eeyyee 2.Lakki
7	Aannanii fi oomishaalee aannani (aannan, baaduu/aybii, itittuu ykn oomishaalee aannani biroo) nyaate?	1.Eeyyee 2.Lakki
8	Hanqaaquu (Hanqaaquu lukkuu, gogorrii, sololiyaa fi nyaata kanneen irraa hojjeetaman)	1.Eeyyee 2.Lakki
9	Zayitii fi cooma (zayitii, cooma ykn dhadhaa nyaata irratti dabalamee ykn nyaata bilcheessuuf oolu) nyaate?	1.Eeyyee 2.Lakki
10	Mi'eessituu (sukkaara, damma, nyaata sukkaara qabu kan akka chokoleetii, mi'eessituu ykn karamella) nyaate?	1.Eeyyee 2.Lakki

V. Gaaffilee waa'ee haala nyaata mana

T.L	Jijjiiramaa/gaaffii	Deebii	Haalli kun yeroo hangamiif ta'aa?
1	Torbaan afran darbaan kana keessaatti mana kessaan keessaatti rakkoon hanqina nyaata akka hin mudanneef yaddooftee beekta?	1.Eeyyee 2.Lakki	1a.1.Darbee darbee (yeroo tokkoo yookiin lama ji'a tokkoo keessatti 2.Yeroo murasaa (yeroo 3- 10) 3.Yeroo baay'ee (yeroo 10 ol)
2.	Torbaan afran darbaan kana keessaatti atii ykn maatiin kee kamiyyuu sabaaba hanqina nyaatan nyaata barbaadan/ddan nyaachuu dhabdani beektuu?	1.Eeyyee 2.Lakki	2a.1.Darbee darbee (yeroo tokkoo yookiin lama ji'a tokkoo keessatti 2.Yeroo murasaa (yeroo 3- 10) 3.Yeroo baay'ee (yeroo 10 ol)
3	Torbaan afran darbaan kana keessaatti atii ykn maatiin kee kamiyyuu sabaaba hanqina dhiyyeessii nyaatan akaakuu nyaata nyaattanii/tani hira'aate beekaa?	1.Eeyyee 2.Lakki	3a.1.Darbee darbee (yeroo tokkoo yookiin lama ji'a tokkoo keessatti 2.Yeroo murasaa (yeroo 3- 10) 3.Yeroo baay'ee (yeroo 10 ol)
4	Torbaan afran darbaan kana keessaatti atii ykn maatiin kee kamiyyuu sabaaba hanqina dhiyyeessii nyaataan nyaata nyaachuu hin barbaannee nyaatannii/tanii jiru/ttuu?	1.Eeyyee 2.Lakki	4a.1.Darbee darbee (yeroo tokkoo yookiin lama ji'a tokkoo keessatti 2.Yeroo murasaa (yeroo 3- 10) 3.Yeroo baay'ee (yeroo 10 ol)

5	Torbaan afran darbaan kana keessaatti atii ykn miseensi maatii kee kamiyyuu sabaaba nyaanni gahaan hin jirreef hangii nyaachuu qabdaan hir'atee jiraa?	1.Eeyyee 2.Lakki	5a.1.Darbee darbee (yeroo tokkoo yookiin lama ji'a tokkoo keessatti 2.Yeroo murasaa (yeroo 3- 10) 3.Yeroo baay'ee (yeroo 10 ol)
6.	Torbaan afran darbaan kana keessaatti atii ykn miseensi maatii kee kamiyyuu sabaaba hanqina nyaatan guyyaatti yeroon nyaata itti nyaattaan xiqqatee beeka?	1.Eeyyee 2.Lakki	6a.1.Darbee darbee (yeroo tokkoo yookiin lama ji'a tokkoo keessatti 2.Yeroo murasaa (yeroo 3- 10) 3.Yeroo baay'ee (yeroo 10 ol)
7	Torbaan afran darbaan kana keessaatti sabaaba hanqina nyaatan wanti nyaatamuu kamiyyuu mana dhabamee beeka?	1.Eeyyee 2.Lakki	7a.1.Darbee darbee (yeroo tokkoo yookiin lama ji'a tokkoo keessatti 2.Yeroo murasaa (yeroo 3- 10) 3.Yeroo baay'ee (yeroo 10 ol)
8	Torbaan afran darbaan kana keessaatti atii ykn miseensi maatii kee kamiyyuu sabaaba nyaata gahaa waan hin jireef osoo beela'anuu, osoo nyaata hin nyaatin rafaani beekuu?	1.Eeyyee 2.Lakki	8a.1.Darbee darbee (yeroo tokkoo yookiin lama ji'a tokkoo keessatti 2.Yeroo murasaa (yeroo 3- 10) 3.Yeroo baay'ee (yeroo 10 ol)
9	Torbaan afran darbaan kana kessaatti atii ykn miseensi maati kee kamiyyuu nyaata gahaa waan hin jireef guyyaa fi halkaan guutuu osoo nyaata hin nyaatin oolani bulani beekuu?	1.Eeyyee 2.Lakki	9a.1.Darbee darbee (yeroo tokkoo yookiin lama ji'a tokkoo keessatti 2.Yeroo murasaa (yeroo 3- 10) 3.Yeroo baay'ee (yeroo 10 ol)

VI. Safartuu sirna nyaata hadhaa walqabatee

T.1	Jijjiiramaa/gaaffii	Deebii
1	Safartuu naannoo harka gubbaa jiddugaleessaa hadhaa	

Annex VI: Declaration

I, the undersigned, declare that Magnitude of undernutrition and Associated Factors among Pregnant Women Attending Antenatal Care in Public Health Centers of Guna district my own work. In compliance with internationally accepted practices, I have acknowledged and refereed all materials used in this work. I understand that non-adherence to the principles of academic honesty and integrity, misrepresentation/ fabrication of any idea/data/fact/source was constituting sufficient ground for disciplinary action by the college and can also evoke penal action from the sources which have not been properly cited or acknowledged.

Name of the resident: Zeyede Worku

Signature: _____

Date: August 13, 2025

Place: Saint Paul's Hospital Millenium Medical College, Addis Ababa, Ethiopia

This body of work with thesis has been submitted for examination with our approval as Candidate's.

Approval of the Primary Advisor

Name of the primary advisor: Dr. Shimalis Hussein

Signature: 

Date: August 13, 2025

Approval of the Co-Advisor

Name of the Co-advisor: Dr. Shikur Mohamed

Signature: 

Date: August 13, 2025

September 2025
Addis Ababa, Ethiopia