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Assessment of Nutritional Status of Pregnant Women Attending Antenatal Care at Public Hospitals in Gambella Region, Ethiopia: Institution-Based Cross-Sectional Study

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Abstract

Nutrition is a fundamental pillar of health, particularly for pregnant women whose increased nutritional needs make them vulnerable to deficiencies. This study aims to assess the nutritional status, dietary diversity score (DDS), and associated risk factors among pregnant women attending antenatal care in Gambella Region, South West Ethiopia. An institution-based cross-sectional study was conducted from March to April 2023, involving 237 pregnant women selected through consecutive sampling. Data were collected using structured questionnaires, 24-hour dietary recall, mid-upper arm circumference (MUAC) measurements, and haemoglobin testing. Bivariate and multivariate logistic regression analyses were employed to identify factors associated with undernutrition, dietary diversity, and anaemia. The prevalence of undernutrition was 37.1%, while 48.9% of the participants had inadequate dietary diversity. Anaemia prevalence was found to be 22.8%. Significant determinants of undernutrition included marital status [adjusted odds ratio = 0.10, 95% CI: 0.01-0.81], STIs during pregnancy (AOR = 1.97, 95% CI: 1.01-3.85), and family planning use (AOR = 0.49, 95% CI: 0.25-0.94). Inadequate dietary diversity was significantly associated with age (AOR = 4.24, 95% CI: 1.01-17.84), household income (AOR = 3.00, 95% CI: 1.14-7.88), and family planning use (AOR = 3.62, 95% CI: 1.86-6.94). Housewives were more likely to be anaemic compared to private employees (AOR = 0.14, 95% CI: 0.03-0.78). The study highlights a high prevalence of undernutrition and anemia among pregnant women in the Gambella Region, with significant associations with socioeconomic and health factors. Integrating nutrition education with reproductive health services and promoting economic empowerment are crucial for improving maternal nutrition.

Keywords: *Anemia, Dietary Diversity, Ethiopia, Malnutrition, Pregnant Women, Undernutrition.*

Introduction

Background of the Study

Nutrition is a fundamental pillar of human life, health and development across the entire life span, from the earliest stages of fetal development, at birth, through infancy, childhood, adolescence, and into adulthood and old age. Proper food and good nutrition are essential for survival, physical growth, mental development, performance and productivity, health and well-being. It is an essential foundation of human and national development [1,2]. For this reason, everybody is expected to get adequate nutrition, especially women of childbearing age [3]. Women and young children bear the brunt of the disease burden associated with malnutrition. In Africa and South Asia, 27−51% of women of reproductive age are underweight [4]. Pregnant women are most vulnerable due to their increased nutrient needs. Because these needs are unmet (inadequate nutrient intake) among pregnant

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women, iron deficiency anaemia, undernutrition, and other nutritional deficiencies have remained prevalent in developing countries [5].

In Ethiopia, the analysis of Ethiopian Demographic and Health Surveys (EDHS) 2011 revealed that chronic energy deficiency among non-pregnant and non-post-partum women is 27% [6, 7]. The prevalence of undernutrition among pregnant women according to other studies is 9.2% in the Wondo Genet district [8], and 19.1% in the Haramaya district [7]. Therefore, maternal nutrition is an important issue, because adequate nutrition intake is required during pregnancy to meet the nutrition requirements of the mother and the fetus at the same time [3]. Nutritional problem during pregnancy not only affects the health of the mother, but it affects the well-being of the birth outcome and the nation as a whole [5]. For these reasons, adequate dietary intake during pregnancy is needed to ensure satisfactory birth outcomes and good health for the mother [3]. However, to ensure nutrient adequacy for pregnant women a variety of food is mandatory, indicating a positive relationship between individual dietary diversity and nutrient adequacy of the diet [9]. In other words, there is no single food group that contains all the essential nutrients (except breast milk for infants less than six months) that are required for the nutritional needs of an individual.

Anaemia is defined as a condition in which there is less than the normal haemoglobin [10] level in the body as a result of long-term negative iron balance in the body due to different factors [11,12]. Nutritional iron deficiency is the most common cause of anaemia during pregnancy [13]. Anaemia in pregnancy, defined as having a haemoglobin level of less than 11g/dL, is one of the many adverse health conditions that affect women in both developed and developing countries.

According to World Health Organization [2] World Health Statistics 2005, globally, anaemia affects 1.62 billion people, which corresponds to 24.8% of the population. The highest prevalence is in preschool-age children 47.4%, and the lowest prevalence is in men 12.7%. However, the population group with the greatest number of individuals affected is non-pregnant women 468.4 million. The WHO regional estimates generated for preschool-age children and pregnant and non-pregnant women indicate that the highest proportion of individuals affected are in Africa (47.5–67.6%), while the greatest number affected are in South-East Asia where 315 million individuals in these three population groups are affected. Anaemia affects half a billion women of reproductive age worldwide. In 2005, 30.2 % (468.4 million) of non-pregnant women and 41.8% (56.4 million) of pregnant women aged 15-49 years were anaemic. The prevalence of anemia among pregnant women is highest in South Asia and Africa which is 48.2% and 57.1%, respectively which is almost double in Europe and America (25.1% and 24.1%), respectively [14].

In Ethiopia, according to the EDHS 2016 report the prevalence of anemia among women aged 14-49 years is 23% [15]. Based on other studies in Ethiopia, the prevalence of anaemia in pregnant women based on the WHO criterion for the diagnosis of anaemia in pregnancy, i.e. haemoglobin <11.0 g/dl (PCV <33%) is 53.9% at Gilgel Gibe dam area, South West Ethiopia, 19.7% at Mekelle town, and 39.94% at Wolayita Sodo town, Southern Ethiopia [16-18].

Statement of the Problem

Maternal undernutrition affects both the health of mothers and children and, as a result, has broad impacts on economic and social development [19]. Undernourished pregnant women have higher reproductive risks, including death during or following childbirth. Many women suffer from a combination of chronic energy deficiency, poor weight gain in pregnancy, anaemia and other micronutrient

deficiencies. These along with inadequate obstetric care, contribute to high rates of maternal mortality and poor birth outcomes [20,21].

In a systematic review including sixty-two studies published from 1989 to 2011, Lee et al reported that a large majority of pregnant women from Africa and Asia had taken lower energy and macronutrients than are recommended by the Food and Agriculture Organization (FAO). Lee et al. conclude that the problems of unbalanced macronutrient profiles and multiple micronutrient deficiencies are common among pregnant women in developing countries across regions of the world [22].

Maternal malnutrition both in the form of chronic energy and micronutrient deficiencies causes intrauterine growth restriction, low birth weight, pre-maturity, neonatal and infant mortality, abortion, stillbirth, reduced physical activity, and poor cognitive development of the baby leading to poor educational capability and performance [23]. Undernutrition's most damaging effect occurs during pregnancy and in the first two years of life, and the effects of this early damage on health, brain development, intelligence, education, and productivity are largely irreversible [24].

The toll of maternal undernutrition during pregnancy was not limited to the above consequences. It has a life-cycle (or intergenerational) element as well. Undernourished girls have a greater likelihood of becoming undernourished mothers who in turn have a greater chance of giving birth to low-birth-weight babies, perpetuating an intergenerational cycle. This cycle can be compounded further in young mothers, especially adolescent girls who begin childbearing before attaining adequate growth and development [25].

The WHO cites malnutrition as the single most important threat to global health, particularly as it relates to pregnant women who form the most vulnerable group of the population to malnutrition. Therefore, improving prenatal nutrition is widely regarded as one of the most effective means of improving women's health and pregnancy outcomes [26,27]. In Ethiopia, 29% of women aged 15-49 years are thin, that is, they fall below the cut-off of 18.5 for the body mass index (BMI), of whom 9 per cent are moderately or severely thin [27]. Only 6 per cent of women are overweight or obese (BMI $\geq$25 kg/m^2).

Anaemia in pregnant women is a major problem that has severe consequences on health, social, and economic development and birth outcomes [28]. Anaemic pregnant women will be at risk of low physical activity and increased maternal morbidity and mortality, especially those with severe anaemia. In addition, both pregnant women and their neonates encounter negative consequences including fetal anaemia, low birth weight, preterm delivery, intrauterine growth restriction and prenatal Mortality [29].

Even if the EDHS reports show that the prevalence of anemia among Ethiopian women aged 15 – 49 years has declined from 27% in 2005 to 17% in 2011 and 23% in 2016 different studies in different areas of the country and time show there is still a high prevalence of anemia among pregnant women [6, 7]. Based on the EDHS 2016, there is also an increase in anaemia prevalence in women aged 14-49 years from 17% in 2011 to 23% in 2016 [6,15]. As different studies show, the prevalence of anemia among pregnant women in Ethiopia is a severe problem [11,17,30]. According to the studies the major factors for the high prevalence of anaemia in Ethiopia are diarrhoea and previous history of malaria, [30], plasmodium malaria and soil-transmitted helminths infections [16], parity, meal frequency, dietary diversity and meat consumption [17].

To overcome the nutritional problems, food-based strategies such as dietary diversification have been recommended and

appear in most countries' dietary guidelines. To identify, prioritize and avert the devastating risk of malnutrition the government of Ethiopia has also designed the National Nutrition strategy of which maternal nutrition during pregnancy is one of the priority areas. The government used different task force groups such as The Health Extension Program (HEP) and Agriculture Extension Program Women Development Army to address the problem. Even though these efforts are there, the prevalence of malnutrition, anaemia and other micronutrient deficiencies is high in the country [11, 16, 30]. In most developing countries dietary diversity among the vulnerable groups has received little attention and therefore augments the need for further research [5]. Consistent evidence about Ethiopian's pregnant women dietary practices is lacking. It will be informative to investigate and identify the dietary practice that occurs among Ethiopian pregnant women and the reasons associated with the dietary practice, to provide sufficient data for policymakers and planners in advising pregnant women on dietary practices and food intake.

In Ethiopia, malnutrition is a significant public health concern, with high rates of maternal and child undernutrition and micronutrient deficiencies [15]. The 2016 EDHS indicated that only 19% of pregnant women meet the minimum dietary diversity requirements. Moreover, the Gambella region of South West Ethiopia, with a predominantly rural population and limited access to healthcare services, has been identified as an area with a high burden of malnutrition [8].

Therefore, this institution-based cross-sectional study aims to assess the dietary diversity and nutritional status of pregnant women attending antenatal care [31] at public hospitals in the Gambella Region. The study will provide valuable information on the dietary practices of pregnant women in this region and their association with maternal and fetal outcomes. The findings of this study may inform the development of targeted interventions to improve maternal nutrition and reduce the burden of malnutrition in Gambella.

Methods and Materials

Study Area and Period

The study was conducted from March 1 to April 30, 2023, at public hospitals in the Gambella Region. Gambella town, the capital city of Gambella Regional State of Ethiopia, is located 777 km Southwest of Addis Ababa, the capital city of Ethiopia. The town is founded on the banks of the Baro River, Ethiopia's widest & only navigable river. Geographically, the portion of Gambella land is situated in what is known as the western lowlands. The town has a latitude and longitude of 8°15′N 34°35′E and has an elevation of 526 meters above sea level having hot climatic conditions. Gambella region harbours different Indigenous ethnic groups; the majority are Nuer and Anywaa. However, there are also other ethnic groups of Majang, Komo and Opo including settlers from the highland parts of the country. The region has five hospitals: namely, Gambela General Hospital, Gambela Primary Hospital, Pinyudo Primary Hospital, Nyininiyang Primary Hospital and Kumi Primary Hospital. Moreover, the region has various private clinics, as well as public health centres and health posts. The hospitals serve as referral centres for patients referred from health centres and private clinics in the region.

Study Design

A cross-sectional study was conducted among pregnant women attending ANC at public hospitals in Gambella Region, South West Ethiopia.

Source and Study Population

Source Population

The source population was pregnant women aged 15-49 years attending ANC at public hospitals in the Gambella Region.

Study Population

The study population was pregnant women aged 15-49 years attending ANC at public hospitals in the Gambella Region from April to May 2023.

Eligibility Criteria

Inclusion Criteria

Pregnant women aged 15-49 years, who were willing to participate in the study and who had been residents of the Gambella Region at least for six months before the study were included.

Exclusion Criteria

Pregnant women whose antenatal follow-up institution is somewhere else and presented for other medical consultations will be excluded from the study.

Sample Size Determination and Sampling Technique

Sample Size

The sample size was calculated using a single population proportion by considering the prevalence of anemia among pregnant women at 22% [6], 5% margin of error and 95% confidence interval.

$$n = \frac{z^2 \times p \times (1-p)}{w^2} = \frac{1.96^2 \times 0.22 \times (1-0.22)}{0.05^2} \approx 264$$

Where: n= sample size, z= z-score corresponding to 95% CI= 1.96, p= proportion of anaemic and/or thin pregnant women, and d= margin of error.

Since the number of pregnant women in the region was small (N=1662), i.e., <10,000, finite population correction was used to calculate the final sample size [32] by using the following formula:

$$n_f = \frac{n}{1 + \frac{n-1}{N}} = \frac{264}{1 + \frac{264-1}{1662}} = 228$$

Hence, after considering a 5% non-response rate, the final sample size became 239.

Sampling Techniques

Using a list of pregnant women attending ANC at each public hospital in the Gambella Region as a sampling frame, a simple random sampling method was used to select 239 participants. The sample size was proportionally allocated to each hospital (Figure 1).

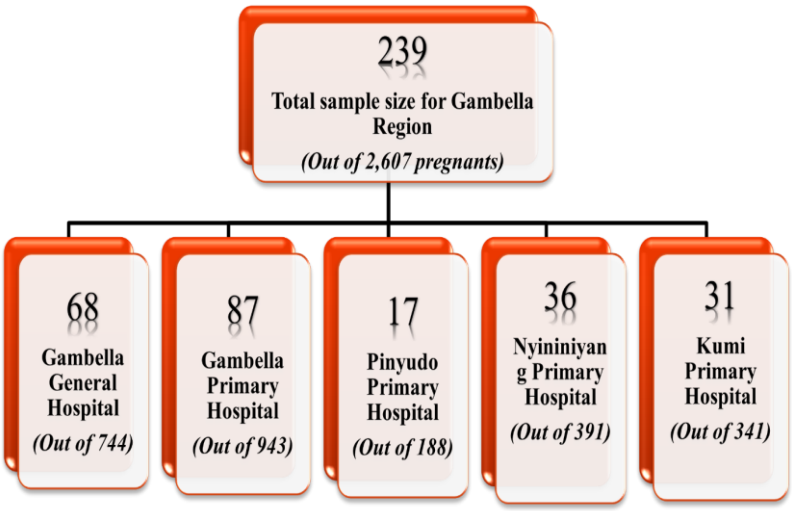

Figure 1. Random **S**ampling Method used with a Proportional Sample Size Allocation for Selecting Study Participants

Study Variables

Dependent Variables/ Outcome Variables

1. Nutritional status of pregnant women (assessed by DDS, haemoglobin level and MUAC).

Independent Variables

1. **Socio demographic factors:** Age, religion, marital status, educational status, occupation husband's educational status and occupation.
2. **Socioeconomic factors:** Household income and family size.
3. **Socio-cultural factors: e**arly marriage, history of teenage pregnancy, living in polygamy, and intra-household food distribution.
4. **Individual and behaviour factors:** Knowledge about nutrition, dietary practice, birth interval, and ANC visit.
5. **Physiological and morbidity factors:** Gestational age, parity, gravidity, history of malaria infection, and history of sexually transmitted infections (STIs).

Operational Definitions

1. **Nutritional status:** A measurement of the extent to which an individual's physiological needs for nutrients are being met and measured by MUAC and haemoglobin test.
2. **Undernutrition:** A pregnant woman was declared to have undernutrition when her MUAC is below 23cm.
3. **Anemia:** Pregnant women with haemoglobin levels <11.0 mmol/l were considered anaemic while those with haemoglobin levels <7.0 mmol/l are considered to have severe anaemia; therefore, these cut-offs will used in this study [14].
4. **Inadequate dietary diversity score:** A woman who has consumed less than five of the following 10 food groups, 24 hours before the data collection, was classified as having inadequate diet diversity consumed: Grains, roots and tubers; pulses; nuts and seeds; milk and milk products; meat, poultry, and fish; eggs; dark leafy greens and vegetables; other Vitamin A-rich fruits and vegetables; other vegetables; and other fruits [33].
5. **Nutritional knowledge:** If a pregnant woman correctly answers more than 50% of knowledge questions about appropriate nutrition during pregnancy, then she is announced to have good nutritional knowledge.

Data Collection Instruments and Procedures

Data Collection Instruments

An individual DDS questionnaire recommended by FAO was adapted to collect data on DDS [33]. Socio-demographic and other factors influencing DDS and anthropometric and anaemia status of the pregnant mothers were assessed by a structured questionnaire adapted from EDHS [6]. The questionnaire was divided into 6 sections: sociodemographic information and socio-economic characteristics, Socio-cultural determinants; individual knowledge and behaviour factors; physiological and morbidity characteristics; 24-hour recall for DDS; and MUAC for anthropometry measurement and haemoglobin levels to determine the anaemia status of the pregnant.

Data Collection Procedures

Data were collected daily during the five working days i.e., Monday to Friday by the use of pre-tested questionnaires. Kobo toolbox mobile application was used to collect the data. The respondents were interviewed after they had received their routine ANC services in a private room. A 24-hour dietary recall questions were asked to assess DDS. The 24-hour dietary recall questions involved asking the respondents to recall all the drinks and food eaten in the previous day in chronological order starting with the food eaten in the

morning through the day up to the time the respondents went to sleep. Probing was done to ensure no foods or drinks were omitted.

After the face-to-face interview, MUAC was measured to the nearest 0.1cm by using non-stretchable standard MUAC tape on the non-dominant arm of the women at the midpoint between the tips of the shoulder and elbow. The MUAC measurement was taken with no clothing on the arm and it was done twice for each respondent to ensure accuracy.

Finally, a qualified laboratory technician did the haemoglobin test in the same room where the interview was done. HemoCue Hemoglobin analyzer was used to determine the haemoglobin levels of pregnant women to assess their anaemia status. Capillary whole blood from a finger prick of each pregnant woman was drawn for the measurement of haemoglobin level. The haemoglobin level of each respondent was recorded immediately on the questionnaire by the data collectors. During the measurement of haemoglobin level; for quality results and preventing the respondents and data collector's safety standard operating procedures were followed.

Two trained diploma nurse data collectors and one BSc. Holder health professional supervisor was employed for data collection. The responsibilities of data collectors are measuring the MUAC of the respondents and filling the questionnaires; the supervisor provided all items necessary for the data collection on each data collection day and checked the filled questionnaire for completeness.

Data Quality Control

To maintain the quality of the data structure and standardized questionnaire was used. The questionnaire was originally prepared in English and translated into Amharic, Anywaa and Nuer languages. To check for its consistency and conceptual equivalence, the questionnaire was also translated back to English from Amharic, Anywaa and Nuer languages.

Three-day training was given to the data collectors and supervisors by the principal investigator. They were trained theoretically for two days; and on the third day, they practised interviewing and MUAC measurement. The participants were trained on the study objective, data collection techniques, how to administrate the structured questionnaire, how to take the anthropometric measurement (MUAC), and how to adhere to ethical considerations including how to keep confidentiality.

A pretest (5%) was conducted in Bonga Health Center at Gambella Zuria Woreda 10 days before actual data collection. Consequently, the total time required for one questionnaire was known and some modifications were made to fit the study objectives. The supervisors checked the collected data daily for completeness and consistency both during and after data collection. Double data entry was used to ensure data quality.

Data Management

The data collected through the Kobo toolbox was daily uploaded to a central server, from which downloaded as a Microsoft Excel file. After cross-checking for inconsistencies and cleaning, the data were exported to Statistical Package for Social Science (SPSS) version 26.0 software packages for analysis.

Data Analysis and Presentation

The data were analyzed using SPSS. Initially, univariate analysis was conducted to explore frequency distribution, central tendency, variability and shape of the overall distribution of independent variables. Then bivariate analysis was done, using binomial logistic regression, to identify independent variables associated with outcome variables such as low DDS, wasting and anaemia. To identify the predictors of dependent variables,

first, a bivariate logistic regression model was fitted. Independent variables that show association at a p-value less than 0.2 in the bivariate analysis were entered into the multivariable logistic model using the backward stepwise method. In multivariable analysis, p-values of less than 0.05 were considered statistically significant.

Ethical Considerations

Ethical clearance was obtained from Gambella Regional Health Bureau for their collaboration. An official letter along with the ethical clearance from Gambella Regional Health Bureau was submitted to all hospitals. Before data collection, the participants were informed about the purpose, risks and benefits of the study, with their full right to participate in the study. They were also told that their non-participation decision by no means affects any of their right to health provisions intended in the ANC clinic for pregnant women. To ensure privacy, names and other identifiers were not used during the data collection. Confidentiality was ensured by keeping all the information obtained in strict confidence and by using it only for the study. Verbal consent was obtained from each participant to confirm willingness. For this purpose, a consent form was attached to each questionnaire. Those participants who had low MUAC (< 23 cm) and low haemoglobin levels (<11.0 mg/dl) were referred for treatment.

Results

Socio-Demographic Characteristics

The socio-demographic characteristics of the participants are presented in Table 1. The study assessed 237 pregnant women attending ANC at Gambella Hospital, yielding a response rate of 99.2% (237/239). The mean± standard deviation of the age of participants was 26.2± 5.4 years. The majority of the participants were Protestant (51.9%), followed by Orthodox (30.8%), Muslim (9.3%), and Catholic (8%). In terms of education, 30.8% had no formal education, 14.8% completed primary school, 28.7% completed secondary school, and 25.7% had a college diploma or above.

Table 1. Sociodemographic Characteristics of Pregnant Women Attending ANC at Public Hospitals in Gambella Region, South West Ethiopia, 2024 (n = 237)

Variables	**Category**	**Frequency**	
		Number (n)	**Percent (%)**
Age in years	16-24	96	40.5
	25-34	125	52.7
	>34	16	6.8
Religion	Catholic	19	8.0
	Muslim	22	9.3
	Orthodox	73	30.8
	Protestant	123	51.9
Ethnicity	Amhara	36	15.2
	Anyway	30	12.7
	Nuer	74	31.2
	Oromo	48	20.3
	Others*	49	20.7
Educational level	No formal education	73	30.8

	Primary school	35	14.8
	Secondary school	68	28.7
	College diploma and above	61	25.7
Occupation	Housewife	105	44.3
	Private employee	52	21.9
	Government employee	43	18.1
	Unemployed	35	14.8
	Others	2	0.8
Marital status	Married	218	92.0
	Unmarried	19	2.5
Having a husband with another wife	Yes	52	21.9
	No	171	72.2
The educational level of the husband	No formal education	41	17.3
	Primary school	16	6.8
	Secondary school	45	19.0
	College diploma and above	121	51.1
Occupation of husband	Unemployed	15	6.3
	Government employee	104	43.9
	Private employee	101	42.6
	Others	3	1.3
Family size	1-5	180	75.9
	>5	57	24.1

*Kemebata (6.8%), Majang (4.2%), Tigre (8.9%) and others (0.8%)

Regarding occupation, most participants were housewives (44.3%), followed by private employees (21.9%) and government employees (18.1%). A significant number of the respondents were married (92%). Most women's households (29.1%) earned monthly between 4001-6000 Ethiopian Birr (Figure 2).

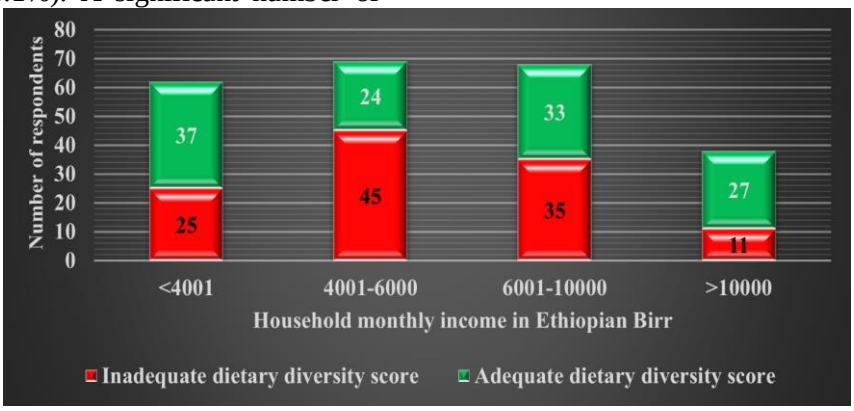

Figure 2. Monthly Household Income of Participants (in Ethiopian Birr) by DDS

Obstetric and Health-Related Characteristics

The mean age of the pregnant women at first marriage was 20.1 years with a standard deviation of 2.5 years, while the mean± standard deviation age at first pregnancy was 21.0± 2.8 years. Most women (60.8%) had 2-4 pregnancies, and 54.4% had less than 2 children. Usage of family planning methods was reported by 63.7%. The study also noted high incidences of malaria (79.3%) and STIs (67.1%) during pregnancy (Table 2).

Table 2. Obstetric and Health-Related Characteristics of Pregnant Women Attending ANC at Public Hospitals in Gambella Region, South West Ethiopia, 2024 (n = 237)

Variables	Category	Frequency	
		Number (n)	Percent (%)
Age at first marriage in years	<18	24	10.1
	18-24	192	81.0
	>24	16	6.8
Age at first pregnancy in years	<18	22	9.3
	18-24	189	79.7
	>24	26	11.0
Interval of ANC contact during current pregnancy in weeks	1-4	221	93.2
	>4	16	6.8
Total number of pregnancies	1	67	28.3
	2-4	144	60.8
	>4	26	11.0
Total number of children	<2	129	54.4
	2-4	93	39.2
	>4	15	6.3
The gap between previous and current pregnancy in years	1-2	86	36.3
	>2	84	35.4
Ever used family planning	Yes	151	63.7
	No	86	36.3
Had malaria infection during the current pregnancy	Yes	188	79.3
	No	49	20.7
Had STI during the current pregnancy	Yes	159	67.1
	No	78	32.9

Nutrition Related Characteristics

Table 3 outlines the nutrition-related characteristics. Due to culture, one-fifth (21.9%) of the participants reported omitting some foods during pregnancy. The majority of participants (73%) ate more than two meals per day, and 75.1% were currently taking micro-nutrient supplements. A significant portion (81.9%) had poor nutritional knowledge.

Table 3. Nutrition-Related Characteristics of Pregnant Women Attending ANC at Public Hospitals in Gambella Region, South West Ethiopia, 2024 (n = 239)

Variables	Category	Frequency	
		Number (n)	Percent (%)
Culturally omitting some foods during	Yes	52	21.9

pregnancy	No	185	78.1
Number of meals per day	1-2	64	27.0
	>2	173	73.0
Eating more foods during pregnancy than non-pregnancy period	Yes	114	48.1
	No	123	51.9
Currently taking micro-nutrient supplements	Yes	178	75.1
	No	59	24.9
Nutritional knowledge	Poor	194	81.9
	Good	43	18.1

Prevalence of Undernutrition and Associated Factors

The prevalence of undernutrition among pregnant women attending ANC at Gambella Hospital was 37.1% (95% CI: 31.6-43.5). During bivariate logistic regression, marital status, occupation, catching STI during current pregnancy and ever using family planning were factors associated with undernutrition among the women. Upon multivariate logistic regression, marital status, contracting STI during current pregnancy and ever using family planning were found to be predictors of undernutrition (Table 4).

Table 4. Factors Associated with Undernutrition among Pregnant Women Attending ANC at Public Hospitals in Gambella Region, South West Ethiopia, 2024

Variables	**Undernutrition**		**COR (95% CI)**	**AOR (95% CI)**
	Yes (88)	**No(149)**		
Marital Status				
Married	87	131	1	1
Unmarried	1	18	0.08 (0.01-0.64)*	0.10 (0.01-0.81)*
Occupation				
Housewife	41	64	1	1
Private employee	26	26	1.56 (0.80-3.05)	1.47 (0.72-3.00)
Government employee	15	28	0.84 (0.40-1.75)	0.85 (0 .39-1.85)
Unemployed	6	29	0.32 (0.12-0.85)*	0.37 (0.13-1.01)
Others	0	2	0.00 (-0.01-0.02)	0.00 (-0.01-0.01)
Had STI during current pregnancy				
Yes	70	89	2.62 (1.42-4.84)**	1.97 (1.01-3.85)*
No	18	60	1	1
Ever used family planning				
Yes	69	82	1	1
No	19	67	0.34 (0.19-0.62)**	0.49 (0.25-0.94)*

COR= crude odds ratio; AOR= adjusted odds ratio

*= P value < 0.05; **= P value < 0.01

The study found that unmarried women had a significantly lower risk of undernutrition compared to married women (AOR = 0.10, 95% CI: 0.01-0.81). Having a STI during the current pregnancy increased the odds of undernutrition by double (AOR=1.97, 95% CI:

1.01-3.85). Not using family planning was associated with lower odds of undernutrition (AOR=0.49, 95% CI: 0.25-0.94).

Magnitude of Inadequate DDS and its Determinants

The magnitude of inadequate DDS among the pregnant women was 48.9% (95% CI: 43.0-55.3). Meat, poultry, and fish (82.7%) were the most frequently consumed food group by pregnant women. On the other hand, the least frequently consumed food group was pulses (19%) (Figure 3).

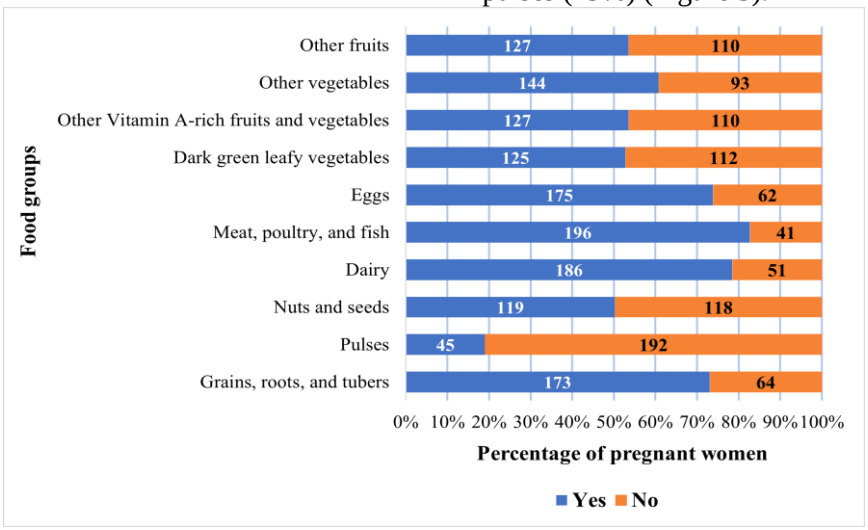

Figure 3. Percentage of Respondents Consuming a Specific Food Group

The study on factors associated with inadequate dietary diversity score (DDS) among pregnant women attending antenatal care at public hospitals in the Gambella region in 2024 revealed several key associations. Age, marital status, income, family size, age at first marriage, age at first pregnancy, family planning usage, eating more foods during pregnancy, currently taking micro-nutrient supplements and nutritional knowledge were factors associated with inadequate DDS through bivariate logistic regression. However, during multivariate logistic regression, only age, income and family planning usage were factors significantly associated with inadequate DDS (Table 5).

Pregnant women aged 16-24 years were four times more likely to have inadequate DDS (AOR 4.24, 95% CI: 1.01-17.84) compared to those pregnant women aged above 34. In contrast to monthly household income above 10000 Ethiopian Birr, earning between 4001-6000 Ethiopian Birr tripled the odds of inadequate DDS (AOR=3.00, 95% CI: 1.14-7.88). Participants who had never used family planning had higher odds of inadequate DDS (AOR 3.62, 95% CI: 1.86-6.94).

Table 5. Factors Associated with Inadequate DDS among Pregnant Women Attending ANC at Public Hospitals in Gambella Region, South West Ethiopia, 2024

Variables	DDS		COR (95% CI)	AOR (95% CI)
	Inadequate (116)	Adequate (121)		
Age in years				
16-24	53	43	5.34 (1.43-19.96)*	4.24 (1.01-17.84)*
25-34	60	65	4.00 (1.09-14.73)*	2.94 (0.72-11.92)
>34	3	13	1	1
Marital status				

Married	103	115	1	1
Unmarried	13	6	2.42 (0.89-6.60)	2.46 (0.55-10.98)
Monthly household income in Ethiopian Birr				
<4001	25	37	1.66 (0.70-3.94)	1.14 (0.42-3.08)
4001-6000	45	24	4.60 (1.95-10.86)**	3.00 (1.14-7.88)*
6001-10000	35	33	2.60 (1.12-6.07)*	1.91 (0.73-4.98)
>10000	11	27	1	1
Family size				
1-5	83	97	1	1
>5	33	24	1.61 (0.88-2.93)	1.65 (0.68-3.98)
Age at first marriage in years				
<18	18	6	3.00 (0.78-11.54)	1.61 (0.33-8.00)
18-24	88	104	0.85 (0.31-2.35)	0.44 (0.13-1.56)
>24	8	8	1	1
Age at first pregnancy in years				
<18	15	7	2.92 (0.89-9.58)	0.00 (-0.01-0.01)
18-24	90	99	1.24 (0.54-2.84)	0.96 (0.21-4.35)
>24	11	15	1	1
Ever used family planning?				
Yes	53	98	1	1
No	63	23	5.07 (2.83-9.07)**	3.62 (1.86-6.94)**
Eating more foods during pregnancy than non-pregnancy period				
Yes	40	74	1	1
No	76	47	2.99 (1.76-5.08)**	1.18 (0.56-2.48)
Currently taking micro-nutrient supplements.				
Yes	80	98	1	1
No	36	23	1.92 (1.05-3.50)*	0.90 (0.42-1.95)
Nutritional knowledge				
Poor	107	87	4.65 (2.11-10.21)**	2.28 (0.97-5.39)
Good	9	34	1	1

*= P value < 0.05; **= P value < 0.01

Burden and Predictors of Anemia

Anaemia was present in 22.8% (95% CI: 17.7-28.3) as shown in Figure 4. And, during bivariate logistic regression, it was associated with marital status, occupation, occupation of husband, having a husband with another wife, family size, income, family planning usage, the gap between previous and current pregnancy, total numbers of children, current taking the micro-nutrient supplement, eating

more foods during pregnancy, number of meals per a day and nutritional knowledge (Table 6).

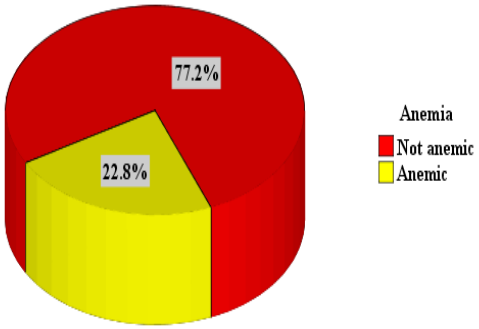

Figure 4. Prevalence of Anemia among Pregnant Women Attending ANC at Public Hospitals in Gambella Region

After imputing those associated factors, during bivariate analysis, in multivariate logistic regression, only occupation emerged as a predictor of anaemia. Pregnant women whose occupation was housewife were more likely to be anaemic compared to private employees (AOR 0.14, 95% CI: 0.03-0.78). Unmarried women had a higher likelihood of anaemia compared to married women, with a crude odds ratio (COR) of 2.72 (95% CI: 1.03-7.15), though the adjusted odds ratio was not significant. The occupation of the husband was another factor; women whose husbands were private employees had an AOR of 1.61 (95% CI: 0.22-12.13), though this was not statistically significant.

Table 6. Factors Associated with Anemia among Pregnant Women Attending ANC at Public Hospitals in Gambella Region, South West Ethiopia, 2024

Variables	**Anemia**		**COR (95% CI)**	**AOR (95% CI)**
	Yes (54)	**No(183)**		
Marital Status				
Married	46	172	1	1
Unmarried	8	11	2.72 (1.03-7.15)*	0.00 (-0.03-0.09)
Occupation				
Housewife	25	80	1	1
Private employee	3	49	0.20 (0.06-0.68)*	0.14 (0.03-0.78)*
Government employee	11	32	1.10 (0.49-2.50)	0.86 (0.27-2.74)
Unemployed	13	22	1.89 (0.83-4.29)	1.07 (0.30-3.78)
Others	2	0	0.00 (-0.01-0.02)	0.00 (-0.01-0.02)
Occupation of husband				
Unemployed	8	7	1	1
Government employee	25	79	0.28 (0.09-0.84)*	1.11 (0.16-7.68)
Private employee	18	83	0.19 (0.06-0.59)**	1.61 (0.22-12.13)
Others	0	3	0.00 (-0.01-0.01)	0.00 (-0.01-0.01)
Having a husband with another wife				
Yes	16	36	1.73 (0.86-3.47)	1.01 (0.29-3.52)
No	35	136	1	1
Family size				
1-5	35	145	1	1

>5	19	38	2.07 (1.07-4.02)*	1.54 (0.47-5.03)
Monthly household income in Ethiopian Birr				
<4001	16	46	2.96 (0.91-9.64)	3.96 (0.57-27.30)
4001-6000	16	53	2.57 (0.79-8.33)	1.02 (0.15-6.99)
6001-10000	18	50	3.06 (0.95-9.84)	2.03 (0.30-13.51)
>10000	4	34	1	1
Ever used family planning?				
Yes	19	132	1	1
No	35	51	4.77 (2.50-9.09)**	2.81 (0.93-8.49)
The gap between previous and current pregnancy in years				
1-2	15	71	1	1
>2	23	61	1.76 (0.86-3.72)	2.54 (0.98-6.64)
Total number of children				
<2	25	104	1	1
2-4	25	68	1.53 (0.81-2.88)	2.65 (0.82-8.59)
>4	4	11	1.51 (0.44-5.15)	1.73 (0.27-10.96
Currently taking micro-nutrient supplements.				
Yes	33	145	1	1
No	21	38	2.43 (1.26-4.68)**	0.89 (0.25-3.15)
Eating more foods during pregnancy than non-pregnancy period				
Yes	16	98	1	1
No	38	85	2.74 (1.43-5.26)**	2.73 (0.83-9.02)
Number of meals per day				
1-2	16	98	3.18 (1.68-6.05)**	0.57 (0.15-2.16)
>2	38	85	1	1
Nutritional knowledge				
Poor	53	141	15.79 (2.12-117.61)*	0.00 (-0.01-0.04)
Good	1	42	1	1

Discussion

The present study aimed to assess the prevalence and predictors of nutritional status and DDS of pregnant women attending ANC at Gambella Hospital, South West Ethiopia. The study revealed that the prevalence of undernutrition, anaemia and inadequate DDS among the women was 37.1%, 22.8% and 48.9%, respectively. Having an STI during the current pregnancy, being married and ever using family planning were determinants of undernutrition, whereas occupation is the sole predictor of anaemia. On the other hand, inadequate DDS was significantly associated with age, income and family planning usage.

The prevalence of undernutrition among pregnant women attending ANC at Gambella Hospital was found to be 37.1%, which is analogous to a 34% magnitude revealed in a study conducted in Shashemene district [34]. However, this finding is higher compared to the 9.2% prevalence reported in the Wondo Genet district [8] and the 19.1% prevalence in the Haramaya district, Ethiopia [7]. The high prevalence in Gambella can be attributed to various socio-economic and cultural factors, including limited access to diverse foods and healthcare services. Moreover, the current prevalence is significantly higher than the national average (27%) reported by the EDHS

2016 [15]. The higher prevalence in Gambella may be attributed to the region's socio-economic and cultural factors, which were not as prevalent in other areas studied.

The study revealed that nearly half (48.9%) of the pregnant women had inadequate DDS; this is concerning, as dietary diversity is crucial for meeting the increased nutritional needs during pregnancy. This result is in line with a study in Gindeberet district, Ethiopia, which reported that 44.6% of pregnant women had inadequate DDS [35]. Nonetheless, the finding is higher than the burden of inadequate DDS (5%) in Islamabad, Pakistan [36]. This discrepancy might be explained by the lower economic status and literacy of participants in the current study area. On the other hand, the inadequate DDS in the current study is lower than the prevalence of 84.4% in the Gurage zone and 73.6% in the Ambo District, Western Ethiopia [37,38]. This difference could be due to the increased availability of fish and other animal food sources in Gambella, as well as geographical variations. Furthermore, it is lower than 55.9% in the Southern Province of Rwanda [39]. The higher burden in the current study may be attributed to differences in the study setting and design.

Almost one-fourth (22.8%) of respondents in this study had anaemia. This figure is consistent with a study in Tanzania (23%), in Gondar, North Ethiopia (21.6%), in Addis Ababa, Central Ethiopia (21.3%), and national averages reported in the EDHS 2016, which indicated a 22% prevalence of anemia among pregnant women [15,40,41,42]. However, this contrasts with a study in Laikipia County, Kenya where 16.9% of respondents had anaemia [5]. This variation can be attributed to differences in study settings, as well as the high prevalence of malaria diseases in the abundant lowland Gambella. On the other side, the finding is lower than the 61.6% in Boditi and 52% in Nekemte, which could be due to regional health disparities and differences in access to healthcare services [11, 30]. The lower prevalence compared to some regions might also be influenced by better nutritional interventions and iron supplementation programs in Gambella. The prevalence of anaemia was also lower than 62% in Assam, India, and 34.8% in Westmoreland, Jamaica [28,43]. This discrepancy might be explained by differences in study periods and settings, and by socioeconomic variations.

The study found that married women had a higher risk of undernutrition compared to unmarried women. This could be due to the social stressors and economic dependencies often faced by married women, which could contribute to their nutritional deficits. Moreover, the association might be attributed to increased household responsibilities and potential nutritional neglect in larger family settings. In contrast to this finding, a study by Girma et al. reported that unmarried women were more likely to be undernourished than currently married women [44]. This deviation may be because of the study period and design variation.

In the current study, pregnant women who had STIs during their pregnancy were significantly more likely to be undernourished. The link between STIs and undernutrition can be attributed to the additional nutritional demands, health complications, and potential nutrient losses associated with infections, further exacerbating nutritional vulnerabilities [8].

Surprisingly, women who had never used family planning had lower odds of undernutrition. This finding is somewhat counterintuitive [46,47] and may reflect complex socio-behavioural dynamics that warrant further investigation. This association may be due to infrequent side effects of weight loss by some contraceptives [31].

Younger pregnant women (16-24 years) were four times more likely to have inadequate DDS compared to those aged above 34. This finding aligns with other studies reporting that

as the age of a woman increases, the chance of getting a nutritional ailment decreases [43-48]. This might be explained by more knowledge or resources to ensure diverse diets acquired by younger women. However, a study in the Afar region of Ethiopia, revealed that older women have lower dietary diversity practices than younger women [47]. This contrary finding may be attributed to differences in the study area and design, such that the latter study defined inadequate DDS consumption from less than 4 food groups, unlike this study (less than 5 food groups).

The study revealed that pregnant women with lower monthly household incomes were more likely to have inadequate DDS. This association is supported by other studies in Ethiopia, which reported that higher income had a positive relationship with pregnant mothers' dietary practices [3, 50, 49]. The higher odds of inadequate DDS among pregnant women with lower incomes may be attributed to economic barriers that may restrict their ability to purchase diverse and nutrient-rich foods. Hence, low-income households often prioritize quantity over quality, focusing on filling foods that are cheaper but nutritionally inadequate.

Participants who had never used family planning were more than three times more likely to have inadequate DDS compared to those women who ever used family planning. The higher chance of inadequate DDS among family planning nonusers might be explained by their lesser ability to plan and control family size, which may lead to higher family size, that could consequently cause inadequate DDS [51,52,39]. The other reason for this association might be women who utilize family planning services often receive additional nutritional education that can enhance their awareness about the importance of a varied diet during pregnancy. Studies show that pregnant women who have received nutritional information are more likely to have adequate DDS [3,35].

Housewives were more likely to be anaemic compared to private employees. This finding is consistent with a study in the Beed District of Maharashtra state of India, which reported that pregnant women who are non-working housewives have higher odds of anaemia [26]. This association could be due to the economic dependency of housewives on their spouses or families, limiting their access to diverse and iron-rich foods. The lower odds of anaemia among private employees may be attributed to their higher educational attainment and greater exposure to nutritional education, which can lead to better dietary practices and lower anaemia rates.

Unlike most scientific reports, some covariates including educational status, family size, nutritional knowledge, meal frequency, having malaria infection, were not significantly associated with inadequate DDS and nutritional outcomes. This might be due discrepancy in the study design and settings.

The study utilized a combination of dietary recalls, anthropometric measurements, and haemoglobin testing to provide a comprehensive assessment of nutritional status. The other strength of the study was achieving a high response rate of 99.2%, enhancing the reliability of the findings. Moreover, the use of multivariate logistic regression allowed for the control of confounding variables which enhanced the robustness of the findings. However, the study's cross-sectional design limits the ability to establish causal relationships between DDS and nutritional outcomes. Conducting the study in a single hospital in Gambella, which may minimize the generalizability of the findings to other regions, was one of the limitations of the research. Furthermore, data on dietary practices were self-reported, which may be subject to recall bias and social desirability bias. Eventually, we stress the need for more research capable of addressing the limitations of this study.

Conclusion

The prevalence of undernutrition, inadequate DDS, and anemia was high among pregnant women in the Gambella region. Numerous factors, including age, low household income, being married, lack of family planning, and having STI were significantly associated with poor DDS and nutritional outcomes. These results underscore the pressing need for targeted nutritional interventions, and health education on nutrition and contraceptive usage to improve the health of pregnant women in the region.

Based on the results of the study, the following recommendations are forwarded to Gambella Regional Health Bureau, researchers and other stakeholders:

1. Implementing comprehensive nutritional education programs targeting pregnant women, especially focusing on the importance of dietary diversity and nutrient-rich food intake.
2. Providing financial support and food assistance programs to low-income households to ensure access to diverse and nutrient-rich foods.
3. Enhancing access to family planning services and integrating nutritional education into these services to promote better dietary practices.
4. Establishing regular monitoring and assessment of the nutritional status of pregnant women to identify and address deficiencies early.
5. Engaging community health workers to disseminate information and support pregnant women in adopting healthy dietary habits.

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