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# Food Consumption, Dietary Diversity and Associated Factors in Pregnant Women Receiving Ante-Natal Care in East Gojjam Zone, Amhara, Ethiopia

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**Abstract:** *Introduction*: Dietary Diversity Score (DDS) and Food Consumption Score (FCS) are indices developed to indicate micronutrient deficiency and food inadequacy. This study assessed the association between socio-economic-demographic, environmental, anthropometric and risky behavioral factors with DDS and FCS. Although these indices are significantly applicable in low-income countries set up, limited studies have been conducted on the effect of these factors on DDS and FCS. *Materials and Methods*: An institutional-based cross-sectional study was conducted on 423 pregnant women of<17 weeks gestation from randomly selected health institutions in five Woredas that are located in the local administration of Amhara Regional State from June 2019 to October 2019. Weekly and daily nutritional reports were collected using food frequency questionnaires. In addition, the Mid Upper Arm Circumference (MUAC) of each participant was also recorded using a "MUAC tape". Moreover, Wealth Index (WI) was developed and categorized using principal component analysis. Bivariate and multivariable logistic regression were calculated between DDS and/or FCS and their associated factors. *Results and Discussion*: The prevalence of low DDS and FCS were 53.2 and 19.7%, respectively. Attainment of education up to junior school level (AOR of 0.260 (0.096, 0.709); P<0.009), low FCG (0.008 (0.001, 0.058); P<0.0001), alcohol (0.307 (0.145, 0.651); P<0.002) and frequent coffee consumption (0.393 (0.177, 0.874); P<0.022) were found to be significant risks for low DDS. Whereas, sharing toilets with other households and low DDS were associated with low FCS with AOR of=0.396 (0.174, 0.901); P<0.027 and 0.008 (0.001, 0.06) P<0.0001, respectively. In addition, the poorest WI quintile reduced the probability of the DDS by 53.9% while an increased MUAC will put the participant in the adequate or high DDS group by 11%. *Conclusion and Recommendation*: Low level of education, low FCS, poorest WI, low MUAC, alcohol and frequent coffee consumption were found to contribute to the reduction in DDS. A low FCS was associated with the use of a shared toilet between households as well as low DDS. Therefore, aggressive promotion of women's education, provision of health education about the use of diversified or fortified food and supplementation of micronutrients, ceasing alcohol and coffee consumption is recommended. Moreover, policies on fostering plant and animal food production and consumption would be of high priority. In addition, the fortification of food with essential amino acids and micronutrients, and supplementation of MMN should be encouraged until sufficient production and diversification of the consumed food are attained.

**Keywords:** DDS, FCS, Associated Factors, MUAC, Micronutrients

# 1. Introduction

During pregnancy, there is an increase in the demand for macronutrients, caloric requirements and supplementation of micronutrients, minerals and vitamins, (iron, folate, iodine, calcium and vitamin D) to ensure optimal quality and quantity of diet for the mother and the fetus. Dietary diversity scores (DDS) represent the variety of food consumed over the previous 24 hours from the proposed ten food groups by the Food and Agriculture Organization (FAO) while the food consumption score (FCS) is an index indicating the frequency and weighted quality of diet consumed over a week proposed by WFP [1, 2]. These indices are positively related to increased mean micronutrient adequacy of foods, food security and dietary quality [3, 4].

Micronutrients (MNs) are deficient both in developing and developed countries owing to malnutrition and inappropriate dietary habits. Therefore to mitigate the adverse effects of these deficiencies on pregnant women and the progeny, either dietary diversity, food fortification or supplementation of MNs should be promoted [4]. As micronutrient plasma measurements are very demanding, indices such as DDS and FCS are used to evaluate the MN status and adverse health outcomes associated with their deficiencies. DDS and FCS are affected by dietary habits and knowledge, obstetric, anthropometric, risky behaviors, frequency of ante-natal clinic (ANC) follow-up visits, water, sanitation, hygiene, socio-economic and demographic factors [1, 3–5] This study examined the contributing factors to low DDS and FCS in pregnant women receiving ANC in East Gojjam Zone, Amhara, Ethiopia. This is the first study conducted in the Zone to identify the contributing factors to low FCS.

# 2. Materials and Methods

An institutional based cross-sectional study was conducted on 423 eligible consenting pregnant women (GA<17weeks) in randomly selected health institutions in five Woredas namely, Debre Markos, Dejen, Machakel, Hulet Ej Enese and Awabel that are located in East Gojjam Zone, Amhara, Ethiopia from June to October 2019. The sample size was determined using a formula for a single population proportion with a previous low DDS prevalence of 55% in the study area [3], calculated to be $n=(Z_{1-\alpha/2})^2P(1-P)/d^2$; =1.96*1.96*0.55*0.44/0.052=381 and upon addition of 11% non-response rate, the total sample size was 423. The data (questionnaires, MUAC) was collected by trained midwives working in the corresponding health institutions' ANC units using standard and structured questionnaires which were contextualized to the dietary items and practices (Table 1) in the study area [2, 6, 7]. Moreover, the tool was pretested with 5% of the respondents who were not included in the study data. The MUAC measurement was taken halfway between the acromion and olecranon processes on the left arm of the participant while her elbows were flexed at 90° using a flexible and non-stretchable measuring tape. The pregnant women were considered undernourished when the measurement obtained as MUAC value was≤21cm [8]

To analyze associated factors of dietary diversity and food consumption frequency and composition, two indices the dietary diversity score (DDS) and food consumption score (FCS), were developed from the food frequency questionnaires that were adapted from the FIGO Nutrition Checklist for pre-pregnant/early pregnant women [9]; the International Federation of Gynecology and Obstetrics (FIGO) recommendations on adolescent, preconception, and maternal nutrition: "Think Nutrition First" [6] and Minimum Dietary Diversity for Women: A Guide to Measurement[2] as indicated on table 1 below.

***Table 1.*** *A list of diversified diets for women of reproductive ages and pregnant women developed from FAO and FIGO recommendations and contextualized to the study area.*

| SN | Food groups consumed (Food items within the group) with references (*) |
|---|---|
| 1. | Pulses (beans, peas or lentils) |
| 2. | Special diet (mixed dishes: fasting food, vegetarian) |
| 3. | Egg (chicken eggs) |
| 4. | Meat (sheep, cow, goat or ox origin and chicken) |
| 5. | Vegetables (cabbage, spinach, cucumber, carrot, broccoli, tomato, green pepper, chili) |
| 6. | Fruits (bananas, papaya, mango, watermelon, pineapple) |
| 7. | Fish (fresh or canned) |
| 8. | Dairies (liquid and solid dairy products from a cow: milk, cheese, and yogurt) |
| 9. | Whole grain carbohydrates: white roots, 'teff injera, bread, pasta, rice, porridges of maize, sorghum |
| 10. | Packaged snacks: (drinks chips, puffs, candy, cakes, biscuits, cookies, pastries, sweetened fruit and beverages) |

Adapted from: FIGO nutrition checklist for pre-pregnant/early pregnant women (FIGO, 2015) [9]; The International Federation of Gynecology and Obstetrics (FIGO) recommendations on adolescent, preconception and maternal nutrition: "Think Nutrition First" [6]; Minimum Dietary Diversity for Women: A Guide to Measurement [2]. (*=FAO, 2016; Pages 10-12, 15-19, 53-57 FIGO, 2015; pages 1 [6]; Pages 227-235.

The dietary diversity score (DDS) and food consumption score (FCS) were categorized into a dietary diversity group (DDSg) and a food consumption group (FCG) as low and adequate or high. The tool for DDS contained ten food groups namely, special vegetable diets, grains, pulses, meat and chicken, eggs, fish, vegetables, fruits, dairies, sugar and oil-rich snacks. The DDS was calculated as the sum of the number of foods consumed from each group during the previous 24 hours. Food intake was considered adequate or high in those women who ate at least five food groups out of ten (high DDSg) while women who ate four or fewer food groups were considered to have low diversified food intake and classified as low DDSg [2] The pregnant women were interviewed to obtain all the food items that were eaten inside or outside the home, irrespective of where they were prepared in the previous 24 hours. Moreover, the FCS was calculated as recommended by the WFP [1]. The aim was to evaluate the weighted food items consumed frequently in the study area in the previous week which indicated micronutrient adequacy and food security. In this case, the weekly food groups frequency was multiplied by the weight of each food group. The weight of the food groups was estimated based on the quality of the diet or diet density based on the proportion of the variety of micro-and macronutrients available (where those food groups containing fat, energy, MN and amino acids considered to have the highest weight). A weighted score of 0.5 was given for sugary snacks and oils, 1 for vegetables and fruits, 2 for grains, 3 for pulses, and 4 for meat, chicken, egg, dairy products and fish. The FCS was categorized into three food consumption groups (FCG): low FCS≤35; adequate FCG=35.5-42 and high FCG≥43. Thereafter, the three FCGs were dichotomized into low (FCG≤35) and adequate or high FCG (FCG≥35.5) for analysis and discussion purposes. The cutoff points were developed by WFP and modified based on the study area context (by assuming weekly consumption of pulses and grains only as low FCS=7*2 (for grains) + 7*3 (for pulses)=35; and this value excluded consumption of other nutrients including fruits, vegetables and animal products) [1]. The wealth index was calculated by using principal component analysis from the multiple responses on asset possession of the pregnant women, continuous variables were developed, categorized into quintiles as recommended by WFP [10]. EpiData was used to enter the data and exported to IBM SPSS version 20 for analysis.

### *2.1. Variables*

The DDS and FCS were the outcome variables while the level of education, WI, MUAC, dietary knowledge and habits, sharing toilets with other households, frequent coffee and alcohol consumption were the predictor variables.

### *2.2. Data Analysis*

The collected data were coded and entered into Epi-Data Version 3.1 and cleaned. The cleaned data set was exported to IBM SPSS version 20 software and used for data analysis. A logistic regression model was used to identify the factors contributing to low DDS and FCS. Frequency distribution for categorical variables, and mean (with standard deviation) for continuous variables were computed. The analysis was executed in two stages for both DDS and FCS. Firstly, bivariate logistic regression analysis was done between each outcome and predictor variables. These predictor variables who were associated with outcomes (DDS and FCS) significantly (95% CI of the crud odds ratio, p<0.05) were included in the multivariable logistic regression and their association with DDS and FCS were determined with 95% CI of the adjusted odds ratio and P<0.05. Model fitness was checked using Hosmer and Lemeshow statistic test at p>0.05 [1].

### *2.3. Inclusion and Exclusion Criteria*

All consenting pregnant women (<17weeks gestation starting from day one of their last menstrual period (LMP)) who presented for antenatal care and planned to deliver in the selected hospitals or health centers within the study period were included. Whereas, women with chronic hypertension, or previous history of pre-eclampsia, severe anemia, chronic renal, liver and gastrointestinal diseases and HIV/AIDS [11] are likely to affect micronutrient status as well as diabetes mellitus and poor obstetric histories (like hyper emesis during the first trimester) were excluded.

## 3. Results

In the socio-economic-demographic characteristic parameters, a total of 421 study participants were included in the study making a response rate of 99.5%. More than three-fourth (83.1%) of the study participants lived in the urban area. Most of the pregnant women were married (96%), of Amhara ethnicity (99%), in the 20-29 age group (73.3%), and were Orthodox Christian in religion (95.5%). Less than a quarter of the group had health insurance (24.4%). Most of the participants (85.5%) attended school varying from primary to a higher level of education. Moreover, a larger proportion of the participants could read and write (87.1%), with a little more than a quarter of the participants (26.1%) holding a Diploma and above. Regarding decision-making within the household, both husband and wife did on most occasions (56.9%). Among the study participants, 9.8% and 47.3% were job seekers and housewives, respectively. In addition, the majority (96.6%) of the participants (below the age of thirty) were primigravidae. One out of every five participants (19.4%) were pregnant teenagers (13-19yrs). The mean age of the participants was 26.3±4.8 years. The BMI of the majority (74.95%) of the participants was between 18.5 and 25 while the prevalence of low MUAC was 6.6% as depicted in Table 2.

***Table 2.*** *Socio-economic-demographic (SED) factors, BMI, MUAC and WI Values.*

| SED factors | Category of variables | Frequency | % | Cum. % |
|---|---|---|---|---|
| Place of residence | Rural | 71 | 16.9 | 16.9 |
| | Urban | 350 | 83.1 | 100.0 |
| Marital status | Married | 403 | 96.0 | 96.0 |
| | Single | 17 | 4.0 | 100.0 |
| Ever attended school? | Yes | 360 | 85.5 | 85.5 |
| | No | 61 | 14.5 | 100.0 |
| level of education | cannot read and write | 54 | 12.9 | 12.9 |
| | can read and write | 24 | 5.7 | 18.7 |
| | Primary education 1-5 | 36 | 8.6 | 27.3 |
| | Junior secondary 6-8 | 46 | 11.0 | 38.3 |
| | Senior secondary 9-12 | 113 | 27.0 | 65.3 |
| | TVET | 36 | 8.6 | 73.9 |
| | Diploma and above | 109 | 26.1 | 100.0 |
| Head of the household | Husband | 158 | 38.4 | 38.4 |
| | Wife | 19 | 4.6 | 43.1 |
| | Husband and wife | 234 | 56.9 | 100.0 |
| Ethnicity | Amhara | 417 | 99.0 | 99.0 |
| | Oromo | 4 | 1.0 | 100.0 |
| Age during first pregnancy | 13-19 | 80 | 19.4 | 19.4 |
| | 19.9-24 | 205 | 49.8 | 69.2 |
| | 25-29 | 113 | 27.4 | 96.6 |
| | ≥30 | 14 | 3.4 | 100.0 |
| Age group | ≤19 | 17 | 4.0 | 4.0 |
| | 20-29 | 308 | 73.3 | 77.4 |
| | ≥30 | 95 | 22.6 | 100.0 |
| Occupation | Housewife and job seeker | 193 | 57.1 | 57.1 |
| | Farmer, civil servant, and alcohol seller | 145 | 42.9 | 100 |
| Do you have health insurance? | Yes | 100 | 24.4 | 24.4 |
| | No | 309 | 75.6 | 100.0 |
| Religion | Orthodox | 402 | 95.5 | 95.5 |
| | Muslim | 16 | 3.8 | 99.3 |
| | Protestant | 3 | .7 | 100.0 |
| BMI group | 15-18.4 | 44 | 12.5 | 12.5 |
| | 18.5-25 | 263 | 74.9 | 87.5 |
| | ≥25.1 | 44 | 12.5 | 100.0 |
| MUAC in cm | ≤21 | 27 | 6.6 | 6.6 |
| | ≥22 | 381 | 93.4 | 100.0 |
| Toilet facility | Shared by other house holds | 229 | 54.2% | 54.2% |
| Wealth Index | Poorest | 67 | 18.9 | 18.9 |
| | Poorer | 71 | 20 | 38.9 |
| | Poor | 71 | 20 | 58.9 |
| | Rich | 75 | 21.1 | 80 |
| | Richest | 71 | 20 | 100 |

***Table 3.*** *Food Consumption and DDS.*

| Score Categories | | Frequency | % |
|---|---|---|---|
| FCS | Poor FCG (≤35) | 83 | 19.7 |
| | High FCGs (≥35.5) | 338 | 80.3 |
| DDS | Low DDS (<5) | 224 | 53.2 |
| | adequate/High (≥5) | 197 | 46.8 |

In the food consumption and DDS parameters, more than half (53.2%) of the participants had a low DDS. Only 197 (46.8%) of the pregnant women had adequate and high DDS. The percentage of poor FCS was 19.7% while an adequate or high FCS was 80.3% as indicated in table 3 above. The most commonly consumed food groups were pulses (95.7%) and cereals (90.3) while the least ones are fish (4.8%) and special fasting diets (2.6%).

In the study parameters for the risky behaviors (habits) and ANC reported urinary tract infections (UTI), the majority (97.6%) of them did not chew khat or smoke actively or passively. However, 40.3% of the participants took alcoholic drinks two to four times per week while 43.8% drank coffee at least once a week as depicted in table 4 below. In addition, the complaint about UTI were 25.5% during ANC follow-up visits.

***Table 4.*** *Prevalence of risky behaviors and UTI (*=active or passive).*

| Risky habits. and UTI | Categories or intake/week | Cases | % | Cum. % |
|---|---|---|---|---|
| Alcohol intake | >4times | 19 | 4.5 | 4.5 |
| | 2-4 times | 169 | 40.3 | 44.9 |
| | rarely≤1 times | 101 | 24.1 | 69.0 |
| | Never | 130 | 31.0 | 100.0 |
| Coffee intake | >1 times | 183 | 43.8 | 43.8 |
| | <times | 151 | 36.1 | 79.9 |
| | Never | 84 | 20.1 | 100.0 |
| *Smoking / chewing khat | >1imes | 2 | .5 | .5 |
| | <1 times | 8 | 1.9 | 2.4 |
| | Never | 408 | 97.6 | 100.0 |
| UTI | Yes | 97 | 25.5 | 25.5 |

In the binary logistic regression analysis, the odds of the participants to be in the high DDSg were at least 1.109 times more likely when the participants had a formal education (COR of=1.983 (1.118, 3.517); p<0.019); major household decisions were made by the husband alone than by both partners (1.839 (1.223, 2.767); p<0.003); source of fuel was electricity or kerosene (685 (1.562, 4.616); p<0.001); increased in MUAC (1.767 (1.06, 2.948); p<0.029); acquired information and health education about MMN (1.109 (1.011, 1.217); p<0.029); supplemented with vitamin A, D, B12 and Fe (1.532 (1.029, 2.28); P<0.036) and were with normal than high BMI (2.722 (1.246, 5.948); p<0.012). In addition, the predictive probability of the outcome variable to be high DDSg is decreased at least by 47.2% when the predictor variables were low FCG (COR=0.035 (0.019, 0.065); 0.001); poorest WI (0.461 (0.233, 0.912); p<0.026); could not read and write (0.412 (0.21, 0.808); p<0.01); reached junior school (0.332 (0.159, 0.691); p<0.003); consumed alcohol (0.33 (0.19, 0.572); p<0.0001) and attended three or lesser ANC follow up visits (COR=0.528 (0.299, 0.932); p<0.028).

Moreover, the odds of participants to be in the adequate and high FCG was increased by at least 1.28 times when the predictor variables were high gravidity and parity (COR=1.28 (1.024, 1.601); p<0.032); housewives and civil servants than job seekers (COR=2.581 (1.142, 5.834); p<0.023); took folic acid before pregnancy (4.023 (1.688, 9.587); p<0.002); received health education on MMN (1.85 (1.097, 3.121); p<0.021); supplemented with vitamin A, D, B12 and Fe (3.284 (1.271, 8.483); p<0.014) and being in the high DDS (29.69 (12.87, 68.49); p<0.0001). However, there was a decreased predictive probability to be in the adequate or high FCG category by at least 51% in those participants with a smaller BMI (15-18.4) (COR=0.245 (0.077, 0.775); p<0.017) and with a shared of toilet facilities with other households (COR=0.488 (0.284, 0.839); p<0.009).

Finally, in the multivariable analysis, being in the junior school education (AOR=0.260 (0.096, 0.709); p<0.009); low FCG (AOR=0.008 (0.001, 0.058); p<0.0001); alcohol consumption (AOR=0.307 (0.145, 0.651) p<0.002) and frequent coffee consumption (AOR=0.393 (0.177, 0.874); p<0.022) were significant risks for low DDS. Whereas, sharing toilets with other households (AOR of=0.396 (0.174, 0.901); p<0.027) and low DDS (0.008 (0.001, 0.06); p<0.0001) were associated with low FCS as indicated on Table 5.

***Table 5.*** *Multivariable logistic regression results DDS and FCS with associated factors.*

| SN. | Predictor variable | 95% C.I. for Exp(B) (COR), P value | AOR (CI 95%) P value | H&LT |
|---|---|---|---|---|
| 1. | Highest level of education | 0.332 (0.159, 0.691), p<0.003 | 0.260 (0.096, 0.709), p<0.009 | 1 |
| 2. | Alcoholic drinks | 0.33 (0.19, 0.572), p<0.0001 | 0.307 (0.145, 0.651), p<0002 | 1 |
| 3. | Coffee drinking | 0.618 (0.367, 1.041), p<0.07 | 0.393 (0.177, 0.874), p<0.022 | 1 |
| 4. | Low FCG | 0.003 (0.0001, 0.019), p<0.001 | 0.008 (0.001, 0.058), p<0.0001 | 1 |

Predicted Probability is of Membership for high DDSg. (DDS≥5)

| SN. | Predictor variable | 95% C.I. for Exp(B) (COR), p value | AOR (CI 95%), p value | H&LT |
|---|---|---|---|---|
| 1. | Sharing toilet facility with HH | 0.488 (0.284 0.839), p<0.009 | 0.396 (0.174, 0.901), p<0.027 | 0.53 |
| 2. | Low DDSG | 0.009 (0.001, 0.064), p<0.001 | 0.008 (0.001, 0.060), p<0.0001 | 0.42 |

Predicted Probability is of Membership for adequate or high FCG. (FCG≥35.5)

# 4. Discussions

The mean age of the participants was, $26.26 \pm 4.763$ years which was comparable with previous studies in the region [12] but with a higher age at first pregnancy ($22.5 \pm 3.796\, years$) than another previous study which was reported 20 years ago [13]. This could be explained by the higher percentage of urban than rural participants n this study. As the median age at first marriage in Ethiopia is 17.1 years among women [14], the age at first pregnancy was higher than the national average.

Under-nutrition (MUAC≤21 cm) was observed in 27 of 423 pregnant women studied with a prevalence of 6.6%. This mean MUAC value, $24.48 \pm 2.15$cm, was comparable with a previous study, 24.8±2.9cm, yet with a smaller prevalence of (6.6 versus 16.2%) due to the recruitment of pregnant women from all trimesters in the previous studies [15].

The percentage of low FCS was 19.5% while 53.2% had low diversified dietary intake. This indicates a higher deficiency in the variety of the foods consumed by pregnant women, especially food from animal sources, thus predisposing them to food insecurity and micronutrient deficiency. Similar findings of DDS were obtained in previous studies with a low DDS of 55% [3]. In addition, in this study, the low FCG of 19.5% in this study, was recorded due to the frequent use of pulses and grains than fish, meat and chicken. The lower FCG also indicates the presence of food insufficiency in addition to poor micronutrient composition and diversity nearly in one-fifth of the participants. Previous studies in the region had reported a low FCS of 18.5% [16]. The most commonly consumed food groups, in this study, were pulses (95.7%) and cereals (90.3) while the least was fish (4.8%) and special diets (2.6%). Previously, in the study area, the commonly consumed dietary groups were also legumes, nuts, and seeds (85.5%) followed by starchy staples (64.7%) [3]. Another study in the region reported a comparable FCS in a total of 422 pregnant women, 81.5% had acceptable food consumption scores [16]. In addition, another study also indicated that cereals were most commonly (96%) consumed food groups than fish, egg and fruits in Ethiopia [17]. In a study from Nigeria, more than 10% of households had a poor or borderline food consumption score (FCS) in all the states [18] indicating a relatively lower proportion of FCS than this study. Previous studies had reported a strong relationship between DDS and micronutrient intake thus suggesting it as an index of micronutrient deficiency [19, 20]. Low DDS indicated a proportional deficiency of MMN ranging from five to eleven including riboflavin, niacin, folate, vitamin B-12, calcium, and iron as indicated in previous studies [20, 21]. Therefore, dietary interventions such as dietary diversity, consumption of fortified foods and supplementation of micronutrients are appropriate depending on the presence of nutrients in a natural way and accessibility [6].

In this study, ability to read and write, attending formal education, having a diploma and above, the greater role of husbands in decision making, use of kerosene or electricity as a source of fuel, increased MUAC, no alcohol or frequent coffee consumption, knowledge about MMN, health education on MMN, supplementation of participants with Vitamin A, D, B12 and Fe, attendance at the fourth or more ANC follow-up visits and not being in the poorest wealth index decreased the risk of being either in the low DDSg or low FCS. Another study in Ethiopia had also reported that being part of the higher socio-economic strata, literacy, urban residence, male-headed household, larger family size and owning livestock positive association with higher DDS [17]. In addition, urban residency, treated water for drinking, latrine, home garden, a bank account and use of a mobile phone were associated with high DDS [22]. Moreover, another study in Southwest Ethiopia reported that the high prevalence of under-nutrition and low DDS were associated with family size, wealth status, household food security, birth interval, educational status, nutritional knowledge and meal frequency [23]. As revealed by this study, increased gravidity and parity, being housewives and civil servants, not sharing toilets with other households, prenatal folic acid consumption, acquiring knowledge and health education about MMN, supplementation of participants with vitamin A, D, $B_{12}$, and Fe, being in a higher DDSg reduced the risk of low FCG independently. A previous study from the region also reported the prevalence of under-nutrition in rural areas, with low educational status, high parity, anemia and intestinal parasitic infections was 16.2% [15]. while other studies found family size of more than four were associated with better dietary quality and nutritional scores [17, 24]. Larger households associated with a higher number of working members who could contribute to the household through the greater provision of farm labor or non-farm incomes [17] could explain the increased DDS in this and similar studies with increased family size. Previous studies also reported that a significant reduction in FCS was associated with place of residence and religion [16] although it was not observed at a significant level in this study.

Other factors found to increase malnutrition among pregnant women were illiteracy, low monthly income, poor dietary diversity, absence of antenatal care, unplanned pregnancy and less than three meals a day. However, iron supplementation during pregnancy significantly reduces the risk of malnutrition among pregnant women [25]. In general, low availability and affordability of animal foods, parasitic infections such as malaria, hookworm, whipworm, and schistosomiasis, agricultural revolution, restricted only to plant-based diets, contributed to low DDS and MN deficiency [26, 27].

# 5. Conclusion and Recommendation

Dietary diversity is very essential in indemnifying positive pregnancy by making micronutrients accessible for physiological necessities. Fostering those factors that increase DDS and FCS will minimize micronutrient deficiency and its undesired effects on the pregnant mother. This is very essential especially in LMICs where restoring the defect is extremely daring. In this study, the DDS was low in more than half of the participants resulting in micronutrient deficiency. Moreover, about one-fifth of the participants also had low FCS suggestive of less consumption of animal products and food insecurity. Factors like junior school (6-8 levels) education, low FCG, alcohol and frequent coffee consumption were significant risks for low DDS. In addition, sharing toilets with other households and low DDS were associated with low FCS. Besides, poor WI and low MUAC were risk factors of poor dietary diversity as revealed by the bivariate analysis. Therefore, to curtail low dietary diversity, avoiding risky behaviors such as alcohol and coffee consumption, empowering women to achieve a higher level of education are recommended. In addition, availability of toilets for individual households, production and consumption of animal products, dietary diversification via increased production and consumption of a variety of foods (from animal and plant origin), fortification of food or supplementation of micronutrients are recommended to increase the FCS. Minimizing malnutrition as evidenced by low MUAC, low BMI and poorest WI will also promote the health of the women by raising DDS and FCS to achieve sufficient micronutrient provision. Finally, further studies with a larger number of participants are recommended to examine the effect of rural versus urban residence on dietary diversity.

# 6. Limitations of the Study

There could be a recall bias while collecting data regarding FCS as the participants were expected to report the weekly dietary intake. There was also a higher urban to rural proportion of the participants which limited the significant effect of place of residence on FFC and DDS. As the data was collected from pregnant women who visited the ANC clinics of the health centers or hospitals, it may not entirely represent the rural community where traditional delivery and loss to follow-up are very common. In addition, women from wealthier households may choose to seek care in private clinics and referral hospitals than patronize governmental health centers and primary hospitals. Furthermore, women from poor households may not seek ANC at all.

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## Disclosure

The authors declare that they have no competing interests.

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