

## Maternal Attributes for Optimal Nutrient Intake among Pregnant Women from Suburb Community in Ethiopia; a Facility Based Cross Sectional Study

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Received: February 07, 2020; Published: February 28, 2020

### Abstract

**Background:** Maternal undernutrition during pregnancy is likely to face a wide range of poor pregnancy outcomes in most developing countries including Ethiopia. Recent evidence in Ethiopia showed some reduction in the trend though the problem is still prevalent and underlines the need for uncovering the attributes for plausible intervention particularly among pregnant which this study has addressed.

**Objective:** To assess the maternal attributes for optimal nutrient intake among pregnant women that they are antenatal follow-up.

**Method:** Data from 380 of women of reproductive age was extracted from a large data set collected for partial fulfillment for master's in public health which is titled as Food consumption pattern, nutrient intake and associated maternal attributes of antenatal care attendees in Bishoftu town, eastern Ethiopia. A facility-based cross-sectional study. Dietary intake was assessed using a semi-quantitative food frequency questionnaire composed of 70 food items. Data were cleaned and analyzed using STATA version 12.1. Consumption patterns were identified using factor analysis and each pattern was further analyzed using a multivariate regression model adjusted for age and calorie intake. A P-value<0.05 was considered statistically significant.

**Result:** All women had low intake of calorie, fat, vitamin A, folic acid and calcium throughout their pregnancy period. Interestingly, inadequate intake of zinc was found only during third trimester. Older maternal age, being married, increased maternal and husband education, being employed, higher socioeconomic status, and snack habits were positively correlated while increasing household size and gravidity, fasting, food restriction and chronic diseases were negatively associated with adequacy of intake.

**Conclusion:** Except for zinc otherwise all the necessary nutrients taken by the participants were inadequate underscores the need for supplementary feeding targeting the most at risk groups.

**Keywords:** Pregnancy; Nutrient Intake; Factor Analysis; Supplementary Feeding; Ethiopia

### Abbreviations

ANC: Antenatal Care; Cp: Consumption Pattern; EDHS: Ethiopian Demographic Health Survey; FFQ: Food Frequency Questionnaire; TB: Tuberculosis; HIV: Human Immune Deficiency Virus; AIDS: Acquired Immune Deficiency Disease; RNI: Recommended Nutrient Intake

### Introduction

Consumption of food pattern refers to any edible or drinks taken during A specified period which could vary across different seasons, geographic locations, economic situations, physiological status and culture [1-6]. During pregnancy, women are advised to take more diversified food to get adequate energy and multiple nutrients to satisfy their demand as well as the growing fetus [7-9]. Such advice, however, in most developing countries including Ethiopia are not practiced and consequently results in multiple micronutrient deficiencies

[10,11]. Globally, maternal malnutrition accounts for 800,000 neonatal and about 3.5 million maternal and child deaths per year [12,13]. Also higher than 13 million newborns are born low birth weight each year [14].

To improve maternal health conditions in Ethiopia, several initiatives have been made by the government which ranged from expanding free reproductive health service packages that include free antenatal care (ANC) and assisted birth delivery services in all government-owned facilities among others. Despite all these activities, the problem of women's health particularly undernutrition remained a pressing public health problem in the country [15,16]. More importantly information on the issue under caption in the country as well as in the proposed study site are very limited in scopes, settings and methodologies. Some previous studies that attempted to document the magnitude as well as the attributes on maternal under nutrition had drawbacks and are reflecting the rural and exclude the suburbs and used only single 24-hour dietary recall methods and weighted food records which again could overestimate intake and consumption pattern suggesting a gap of information. Against this background information, we assessed maternal attributes for optimal nutrient intake among pregnant women from suburb community for some programmatic improvements.

## **Methods**

Data from 380 of women of reproductive age were extracted from a large data set collected for partial fulfillment for master's in public health which is titled as Food consumption pattern, nutrient intake and associated maternal attributes of antenatal care attendees in Bishoftu town, east Ethiopia which was facility-based cross-sectional study. The study was conducted in suburban communities (Bishoftu town) from February to March 2016. The town is nearly 50 km southeast of the capital city of Ethiopia. The town is a home for 176,743 with female population of 85,897 of which nearly 6,133 of them were pregnant in 2015.

The above sample size was estimated using single population formula assuming a prevalence of poor intake of 66% among pregnant women [18] with a precision of 95% and a margin error of 5% with a 10% non-response rate which yielded 380. All pregnant women in their reproductive age that had regular antenatal follow up and were in apparent good health that consented to participate were enrolled systematically until the sample size was obtained.

To identify the commonly consumed food items and the utensils used at the study site a preliminary survey using 24-hour dietary recall and market inspection was done. Then data on dietary intake a month before the interview was assessed using Semi-quantitative FFQ adapted from Willets FFQ [19] and improved to include all identified food items in the community which composed of nine different food groups with a total of 70 food items. The FFQ also had a space for estimated usual portion size and nine choices for frequency of consumption. The frequency of consumption was assessed on monthly, weekly and daily basis varying from "Never to more than three times in a day". Majority of the food items were cooked and measured using identified utensils by the principal investigator at Ethiopian Public Health Institute. Cooked food items were limited from 2 to 4 commonly consumed portions. For countable items like fruits, egg, potato, sweet potato and chilly medium size of each was quantified and taken as standard portion. Each measured portion was coded and photographed to facilitate the interview and recall process. Data were collected using pretested tools by trained five females who completed grade 12 and one diploma clinical nurse who were fluent in the local language on daily basis from Monday to Friday through face to face exit interview.

Respondents were asked to recall and state whether they consumed the food items or not including its frequency based on nine lists of food frequency options. In addition, participants were asked to indicate the utensils they commonly used from prepared photographic atlas and amount of portion they usually consumed on average at a single meal. To ensure quality of the data colored photographs were used to facilitate the recall process and the data collection process was supervised by the supervisor as well as the principal investigator.

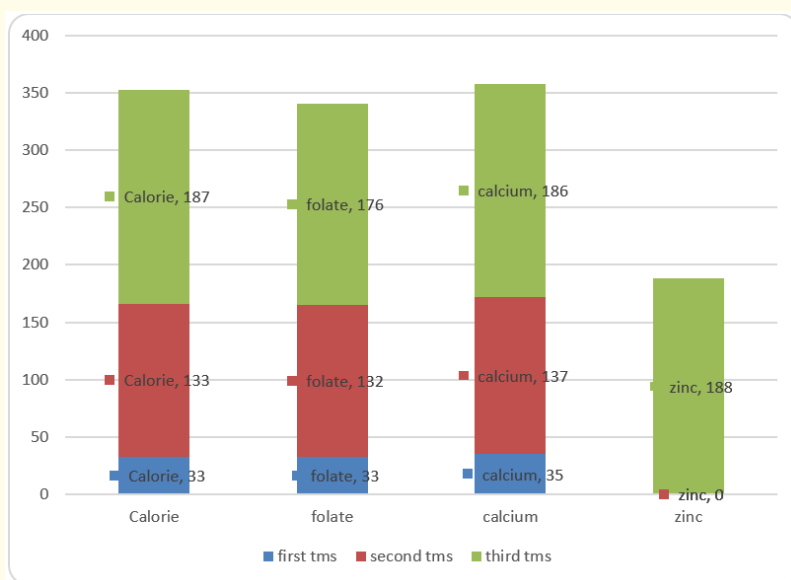
The collected data were coded and entered into Epi info version 7.1 and exported to STATA 12.1 software for further cleaning and statistical analysis. Data are described using frequency, mean, standard deviation and median as appropriate. Factor analysis was used to

identify food consumption patterns. The details are seen in [20,21]. Nutrient intake was calculated using Esha food processor software. Linear regression using, Student’s t-test for continuous variables while logistic regression with chi-square test was used for categorical variables to look for association between independent and outcome variables. All factors with p-value < 0.2 in any of identified patterns were then taken into multivariate model adjusted for age and calorie intake for further analysis [3]. A p-value < 0.05 was considered statistically significant.

## Result

The vast majority (97.0%) responded adequately while eleven of them declined due to personal reason making the non-response rate 3.0%.

Figure 1 displays the mean nutrient compared to recommended nutrient intake (RNI) of individuals. The mean intake for carbohydrate, protein, vitamin B1, B2, C and iron was in line with the recommendation. Whereas intake of calorie, fat, vitamin A, folate, calcium and zinc were below RNI. Of the total participants, median intake of fat and vitamin A was deficient in 326 (88.3%) and three fourth 279 (75.6%) of pregnant women, respectively.



**Figure 1:** Number of antenatal care attendees, by trimester and mean nutrient intake below the recommended nutrient intake at Bishoftu town, 2016 (n = 369).

Table 1 summarizes socio, economic and obstetric characteristics of respondents. The mean age of the participants was 25.97 ranging from 17 to 38 years. The majority (84.3%) had some form of formal education and in marital union, and over half (55.0%) were currently not working. The median household size was 2. The proportion of participants from poorest wealth quintile was slightly higher (23.9%) than the rest wealth quintile categories. Slightly over half (52.8%) were primigravida and about the same proportion of them were in their third trimester (51.9%).

Table 2 presents dietary practice, health status and service utilization characteristics of study participants. Nearly half (48.2%) of them didn’t have the habit of eating snack and about three-quarters (74.5%) were fasting during the current pregnancy. Food aversion, craving and restrictions due to the culture were mentioned in 153(41.5%), 156(42.3%) and 43(11.7%), respectively. Over half (53.7%) of them were their first ANC visit and 185(50.1%) received nutrition counseling during ANC visit.

| Characteristics            | Category                     | Frequency (n) | Percentage (%) |
|----------------------------|------------------------------|---------------|----------------|
| Age of respondents         | 15 - 24 yrs                  | 151           | 40.9           |
|                            | 25 - 34 yrs                  | 203           | 55.0           |
|                            | ≥ 35 yrs                     | 15            | 4.1            |
|                            | Mean (SD)                    | 25.97 ± 4.38  |                |
| Maternal education         | No education                 | 35            | 9.5            |
|                            | Read and write               | 23            | 6.2            |
|                            | Primary                      | 129           | 35.0           |
|                            | Secondary                    | 108           | 29.3           |
|                            | Tertiary (Collage and above) | 74            | 20.0           |
| Currently in Marital union | Yes                          | 349           | 94.6           |
|                            | No                           | 20            | 5.4            |
| Maternal occupation        | Currently not working        | 203           | 55.0           |
|                            | Currently working            | 166           | 45.0           |
| Household size             | 1 - 4                        | 188           | 50.9           |
|                            | ≥ 5                          | 181           | 49.1           |
|                            | Median household size        | 2 [2,3]       |                |
| Wealth quintile            | Poorest                      | 88            | 23.9           |
|                            | Poor                         | 60            | 16.3           |
|                            | Middle                       | 74            | 20.0           |
|                            | Rich                         | 74            | 20.0           |
|                            | Richest                      | 73            | 19.8           |
| Gravidity*                 | Primigravida                 | 195           | 52.8           |
|                            | Multigravida                 | 172           | 46.6           |
| Trimester                  | First trimester              | 36            | 9.8            |
|                            | Second trimester             | 141           | 38.3           |
|                            | Third trimester              | 191           | 51.9           |

**Table 1:** Socio demographic/economic and obstetric characteristics of antenatal care attendees, Bishoftu town, 2016 (n = 369).

Mean ± SD and median value is also presented for continuous variables. ANC: Antenatal Care;

\*: Percent do not add up to 100 because of missing values.

Table 3 depicts factor loadings used to identify each pattern. As shown, four major consumption patterns were identified. Food items with higher factor loadings under factor 1 included fermented white Tef eragrositis (*Nech teff injera*), cracked and boiled oats mixed with butter (*Aja kinchie*), pasta, unleavened bread cut into pieces mixed with butter (*Chechebsa*), Stew made of dried split lentil with chili sauce (*Misir kik wot*), peanut butter, Porridge made of refined false banana (*bullu genfo*), banana, orange, avocado, papaya, mango, lettuce or raw salad (*selata*), Boiled green peas (*Fosoliya*), raw chili (*kariya*), Stew made from beef and chilli sauce (*Siga wot*), fried beef, fried fish, fried egg, boiled milk, yoghurt, burger, french fries, soft drink (*Mirinda*) and honey. This pattern was also characterized by low consumption of fermented red Tef eragrositis (*Key teff injera*) and Stew made of roasted pea flour and chili sauce (*Shiro wot*) and thus Varied consumption pattern was given to this factor.

| Dietary practice, and service utilization in the current pregnancy | Frequency (n) | Percentage (%) |
|--|---------------|----------------|
| <b>Habit of eating snack*</b>                                      |               |                |
| Yes  | 189           | 51.2           |
| No   | 178           | 48.2           |
| <b>Fasting *</b>   |               |                |
| Yes  | 92            | 24.9           |
| No   | 275           | 74.5           |
| <b>Food aversion</b>   |               |                |
| Yes (Coffee, Egg, Meat, Banana, Milk, Porridge, Shiro)             | 153           | 41.5           |
| No   | 216           | 58.5           |
| <b>Craving for any food item</b>                                   |               |                |
| Yes (meat, Vegetables, Fruit, Fish, Milk)                          | 156           | 42.3           |
| No   | 213           | 57.7           |
| <b>Food restriction by culture/community</b>                       |               |                |
| Yes (banana, porridge, yoghurt, potato, sesame seed, chilli)       | 43            | 11.7           |
| No   | 110           | 29.8           |
| <b>Number of current ANC visit</b>                                 |               |                |
| < 2 (new)  | 198           | 53.7           |
| ≥ 2 (repeat)   | 171           | 46.3           |
| Mean (SD)  | 2.7 ± 1.0     |                |
| <b>Received nutrition counseling during ANC</b>                    |               |                |
| Yes  | 185           | 50.1           |
| No   | 184           | 49.9           |

**Table 2:** Dietary practice, and service utilization of antenatal care attendees, Bishoftu town, 2016 (n = 369).

Mean ± SD and median value is also presented for continuous variables. ANC: Ante Natal Care;

\*: Percent do not add up to 100 because of missing values.

Factor 2 was highly loaded with, fermented white Tef eragrositis (*Nech teff injera*), pasta, stewed cabbage (*Tikil gommen*) and tea thus, named as “cereal, vegetable and tea based consumption pattern”. This pattern was also characterized by low consumption of fermented Red Tef eragrositis (*Key teff injera*), fried fish and burger.

Factor 3 seemed to load mainly consumption of macaroni, fried mutton (*Beg tibs*) and honey mixed with water (*Birz*) and hence named as “cereal, meat and sweet based consumption pattern”.

Factor 4 was highly loaded with maccaronie, Porridge made of refined false banana (*Bulla genfo*), gruel made of refined false banana (*Bulla atmit*) and coffee. Hence was named as “cereal, root and tuber and coffee based consumption pattern”. The name for each pattern was assigned based on the food group to which each food item with higher factor loading belongs to.

Table 4 and 5 summarize the characteristics of respondents across tertile classification for each consumption pattern in age and calorie adjusted model. Pregnant women with high score for “varied consumption pattern” were the older women, currently married, with higher level of education, working, whose husbands were educated grade 10 and above, with high socioeconomic status, living in smaller

| Food item   | Factor loadings |          |          |          |
|---|-----------------|----------|----------|----------|
|   | Factor 1        | Factor 2 | Factor 3 | Factor 4 |
| White tef eragrositis fermented injera ( <i>Nech teff injera</i> )            | 0.40            | 0.47     |          |          |
| Red tef eragrositis fermented injera ( <i>Key teff injera</i> )               | -0.41           | -0.46    |          |          |
| Cracked and boiled oats mixed with butter ( <i>Aja kinchie</i> )              | 0.35            |          |          |          |
| Pasta   | 0.36            | 0.32     |          |          |
| Maccaronie  |                 |          | 0.31     | 0.32     |
| Unleavened bread cut into pieces mixed with butter ( <i>Chechebsa</i> )       | 0.32            |          |          |          |
| Stew made of roasted pea flour and chilli sauce ( <i>Shiro wot</i> )          | -0.39           |          |          |          |
| Stew made of dried splitted lentil with chilli sauce ( <i>Misir kik wot</i> ) | 0.32            |          |          |          |
| Peanut butter   | 0.42            |          |          |          |
| Porridge made of refined false banana ( <i>Bulla genfo</i> )                  | 0.36            |          |          | 0.31     |
| Gruel made of refined false banana ( <i>Bulla atmit</i> )                     |                 |          |          | 0.32     |
| Banana  | 0.64            |          |          |          |
| Orange  | 0.47            |          |          |          |
| Avocado   | 0.41            |          |          |          |
| Papaya  | 0.52            |          |          |          |
| Mango   | 0.38            |          |          |          |
| Stewed cabbage ( <i>Tikil gommen</i> )  |                 | 0.33     |          |          |
| Lettuce or raw salad ( <i>Selata</i> )  | 0.37            |          |          |          |
| Boiled green peas ( <i>Fosoliya</i> )   | 0.37            |          |          |          |
| Raw chilli ( <i>kariya</i> )  | 0.31            |          |          |          |
| Stew made from beef and chilli sauce ( <i>Siga wot</i> )                      | 0.63            |          |          |          |
| Fried beef  | 0.58            |          |          |          |
| Fried mutton ( <i>Beg tibs</i> )  |                 |          | 0.42     |          |
| Fried fish  | 0.46            | -0.37    |          |          |
| Fried egg   | 0.61            |          |          |          |
| Boiled cow's milk   | 0.49            |          |          |          |
| Yoghurt   | 0.36            |          |          |          |
| Burger  | 0.51            | -0.43    |          |          |
| French fries  | 0.49            |          |          |          |
| Soft drink ( <i>Mirinda</i> )   | 0.37            |          |          |          |
| Tea   |                 | 0.34     |          |          |
| Coffee  |                 |          |          | 0.36     |
| Honey mixed with water ( <i>Birz</i> )  |                 |          | 0.37     |          |
| Honey   | 0.43            |          |          |          |

**Table 3:** Distribution of factor loadings for the four major consumption patterns identified by factor analysis of antenatal care attendees, Bishoftu town, 2016 (n = 369).

Excluded food items from the table and empty spaces above indicated those with factor loading < |0.3| for all consumption patterns. Words in parenthesis are local terms used for the food types.

household size, primigravida, do not fast during pregnancy, had habit of eating snack, were less likely to adhere to food restriction following cultural belief, had no chronic disease and increased calorie intake. In addition, participants less likely to practice food craving adhere to “cereal, root & tuber and coffee based consumption pattern”. Otherwise there was no significant difference between low and high consumers for the rest of the patterns.

| Characteristics             | CP1            |                |         | CP2            |                |       |
|-----------------------------|----------------|----------------|---------|----------------|----------------|-------|
|                             | T1             | T3             | Model   | T1             | T3             | Model |
| Age (in years)              | 25.0 ± 4.7     | 26.8 ± 3.8     | -       | 25.7± 4.3      | 26.1 ± 4.3     | -     |
| Calorie (kcal)              | 1472.6 ± 450.6 | 1964.3 ± 417.7 | -       | 1661.8 ± 509.6 | 1845.5 ± 368.3 | -     |
| Currently married (Yes)     | 108 (31.0)     | 121 (34.8)     | 0.14**  | 116 (33.3)     | 118 (33.9)     | 0.06  |
| Maternal education (Higher) | 15 (8.3)       | 106 (58.6)     | 0.48*** | 52 (28.7)      | 63 (34.8)      | -0.01 |
| Currently working (Yes)     | 43 (25.9)      | 82 (49.4)      | 0.27*** | 56 (33.7)      | 53 (31.9)      | -0.04 |
| Husband education (Higher)  | 38 (15.5)      | 118 (48.2)     | 0.36*** | 72 (29.4)      | 86 (35.1)      | -0.01 |
| High socioeconomic status   | 42 (28.6)      | 73 (49.7)      | 0.25*** | 55 (37.4)      | 46 (31.3)      | -0.05 |
| Household size              | 2.9 ± 1.3      | 2.6 ± 0.9      | -0.13*  | 2.8 ± 1.1      | 2.7 ± 0.9      | -0.02 |
| Gravidity (primigravida)    | 61 (31.4)      | 71 (36.6)      | 0.13*   | 63 (32.5)      | 60 (30.9)      | -0.06 |
| Month of current pregnancy  | 6.5± 2.0       | 6.5± 1.8       | 0.04    | 6.5± 2.0       | 6.4± 1.9       | -0.02 |
| Number of ANC visit         | 2.6 ± 1.4      | 2.7 ± 1.2      | 0.03    | 2.7 ± 1.3      | 2.7 ± 1.2      | 0.00  |
| Nutrition counseling (Yes)  | 48 (25.9)      | 73 (39.5)      | 0.09    | 61 (32.9)      | 61 (32.9)      | -0.02 |
| Currently fasting (No)      | 85 (31.0)      | 104 (37.9)     | 0.16**  | 90 (32.8)      | 87 (31.7)      | -0.07 |
| Snack habit (Yes)           | 32 (17.0)      | 93 (49.5)      | 0.26*** | 57 (30.3)      | 69 (36.7)      | 0.02  |
| Aversion (No)               | 78 (36.3)      | 70 (32.6)      | -0.04   | 66 (30.7)      | 76 (35.3)      | 0.05  |
| Craving (Yes)               | 41 (26.3)      | 51 (32.7)      | -0.04   | 54 (34.6)      | 49 (31.4)      | -0.05 |
| Food restriction (yes)      | 18 (41.9)      | 9 (20.9)       | -0.15*  | 15 (34.9)      | 11 (25.6)      | -0.04 |
| Chronic disease (No)        | 91 (31.4)      | 103 (35.5)     | 0.13**  | 94 (32.4)      | 96 (33.1)      | 0.01  |

**Table 4:** Antenatal care attendees according to consumption pattern tercile categories (CP1 and CP2), Bishoftu town 2016 (n = 369).

Data is presented as mean ± SD or number (percentage) of participants. \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

Model shows characteristics in each tercile categories of identified patterns based on linear and logistic regression analysis for continuous and categorical variables respectively adjusted for age and calorie intake. Standardized regression coefficients are presented under the model.

CP: Consumption Pattern; T: Tercile; ANC: Antenatal Care.

## Discussion

The present study aimed to assess the food consumption pattern (CP), nutrient intake and associated maternal attributes among pregnant women attending ANC. Accordingly, Four different CPs labeled as, “varied pattern”, “Cereal, vegetable and tea based pattern”, “Cereal, meat and sweet based pattern” and “cereal, root and tuber, and coffee based pattern” were identified. All participants intake for calorie, fat, vitamin A, folic acid and calcium was deficient. The CP of participants was affected by the socio demographic, economic, obstetric, dietary habit and maternal health status.

All CPs identified were highly loaded with cereal based food items followed by root and tubers. Except for the first CP, the rest were not characterized by higher consumption of egg, meat and dairy products. This finding was consistent with the national food consumption

| Characteristics             | CP3            |                |       | CP4            |               |         |
|-----------------------------|----------------|----------------|-------|----------------|---------------|---------|
|                             | T1             | T3             | Model | T1             | T3            | Model   |
| Age (in years)              | 25.6 ± 4.3     | 26.3 ± 4.4     | -     | 26.1± 4.3      | 26.1 ± 4.5    | -       |
| Calorie (kcal)              | 1462.5 ± 428.7 | 1844.3 ± 452.0 | -     | 1806.2 ± 497.8 | 1716.9± 471.9 | -       |
| Currently married (Yes)     | 116 (33.3)     | 115 (33.0)     | -0.01 | 120 (34.5)     | 115 (33.0)    | -0.01   |
| Maternal education (Higher) | 45 (24.9)      | 57 (31.5)      | -0.08 | 67 (37.0)      | 58 (32.0)     | -0.02   |
| Currently working (Yes)     | 50 (30.1)      | 56 (33.7)      | -0.01 | 59 (35.5)      | 49 (29.5)     | -0.08   |
| Husband education (Higher)  | 66 (26.9)      | 81 (33.1)      | -0.06 | 87 (35.5)      | 81 (33.1)     | 0.00    |
| High socioeconomic status   | 41 (27.9)      | 57 (38.8)      | 0.08  | 56 (38.1)      | 47 (31.9)     | -0.03   |
| Household size              | 2.8± 1.2       | 2.8± 0.9       | 0.02  | 2.8± 0.9       | 2.8± 1.1      | 0.05    |
| Gravidity (primigravida)    | 68 (35.0)      | 56 (28.9)      | -0.10 | 62 (31.9)      | 65 (33.5)     | 0.02    |
| Month of current pregnancy  | 6.5± 2.2       | 6.4± 2.0       | -0.03 | 6.4± 2.0       | 6.6± 1.9      | 0.07    |
| Number of ANC visit         | 2.6± 1.3       | 2.6± 1.3       | -0.00 | 2.7± 1.4       | 2.7± 1.1      | 0.02    |
| Nutrition counseling (Yes)  | 61 (32.9)      | 61 (32.9)      | -0.03 | 63 (34.0)      | 66 (35.7)     | 0.05    |
| Currently fasting (No)      | 82 (29.9)      | 99 (36.1)      | 0.09  | 95 (34.7)      | 87 (31.7)     | -0.06   |
| Snack habit (Yes)           | 50 (26.6)      | 67 (35.6)      | -0.00 | 75 (39.9)      | 59 (31.4)     | -0.05   |
| Aversion (No)               | 67 (31.2)      | 74 (34.4)      | 0.02  | 67 (31.2)      | 79 (36.7)     | 0.09    |
| Craving (Yes)               | 50 (32.0)      | 51 (32.7)      | -0.02 | 67 (42.9)      | 39 (25.0)     | -0.15** |
| Food restriction            | 21 (48.8)      | 9 (20.9)       | -0.13 | 16 (37.2)      | 14 (32.6)     | 0.07    |
| Chronic disease (No)        | 92 (31.7)      | 91 (31.4)      | -0.06 | 94 (32.4)      | 95 (32.8)     | -0.01   |

**Table 5:** Antenatal care attendees according to consumption pattern tercile categories (CP3 and CP4), Bishoftu town 2016 (n = 369).

Data is presented as mean ± SD or number (percentage) of participants. \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

Model shows characteristics in each tercile categories of identified patterns based on linear and logistic regression analysis for continuous and categorical variables respectively adjusted for age and calorie intake. Standardized regression coefficients are presented under the model; CP: Consumption Pattern; T: Tertile; ANC: Antenatal Care.

survey conducted among women of similar age and reported that cereal groups are most commonly consumed food groups followed by root and tubers, legumes and oilseeds respectively. In addition, meat and egg consumption was found to be very limited in the country [15]. It is expected that pregnant women intake from this community will also be similar. Two patterns labeled as “varied pattern” and “cereal, vegetable and tea-based consumption pattern” were characterized by intake of fast foods like chips and burger which is currently the emerging nutritional problem of people residing in most cities of developing countries. This may be an alarming event that needs intervention given that higher intake of energy dense foods will bring long lasting health risk to both the mother and the growing fetus [23]. The diet of pregnant women in most developing countries lacks diversity and it is commonly cereal or plant based consisting of polyphenols and consequently exposes the women to multiple micronutrient deficiencies [10].

Even though cereals CP dominated, unexpectedly calorie intake was found to be below the RNI across all trimesters. This finding was also consistent with most studies conducted in developing countries [24-30]. Lower energy intake may be due to consumption of smaller portions of food items, under reporting of actually consumed amount or lack of snack habit as reported by nearly half of the respondents. The observed deficient intake of micronutrients which included vitamin A, folate and calcium across all trimesters of pregnancy was concordant with the studies conducted in Africa, Asia and Latin America [17,29,31,32]. In contrast, studies from southern Thailand and Nigeria [24,29], intake above the RNI was reported. This difference may be due to the restricted consumption of fruits and vegetables among pregnant women of this study. On the other hand, most developing countries report folic acid deficiency as was the case in our



study [17,26-29,31] and attributed to lower intake or limited consumption of folate rich foods. Likewise calcium deficiency observed in the present study concurs with some previous studies [17,24,27,29,31-33] and attributed to limited consumption of milk and dairy products. It is apparent that nutrient requirement varied with physiological status of women particularly during pregnancy in general and in particular in third trimester to meet the demand of required by herself and the fetus. Thus, the increased requirement (RNI) along with limited consumption of meat, egg, poultry and dairy products probably led third trimester pregnant women to experience zinc deficiency.

Participants who tend to adhere to the relatively healthier pattern called varied pattern were those older women who are currently married, with higher level of education, workers, whose husbands were educated at higher level, with high socio economic status, living in smaller household size, primigravida, do not fast during pregnancy, had habit of eating snack and higher calorie intake. This finding is consistent with the study conducted in southern Brazil where “varied pattern” was practiced by older women, living with a partner, being employed with higher levels of education and higher socioeconomic status [4]. Similarly, another study from Rio de Janeiro, Brazil found that married older women, educated at higher level and thus with higher socioeconomic status adhere to healthier dietary pattern [3]. This finding was further strengthened by a result from south east of England in which a pattern labeled as “health conscious” was practiced by married older women with higher education and currently employed [1]. Another study from Finland identified a similar pattern called “healthy” pattern and was characterized by older maternal age, higher maternal education and increased calorie intake [2]. A study from Nigeria also found that older pregnant women with higher level of education and high socioeconomic status tend to choose healthier pattern and had increased calorie intake [34]. Likewise, study from Tanzania also found significant positive association between older maternal age, higher level of maternal education and high socioeconomic status to consume healthier diet with increased calorie intake during pregnancy [30]. Similarly, marital status and maternal education were negatively associated with less healthy dietary pattern [3-5].

### **Strength and Limitations**

All health facilities of the town were included in the dietary assessment and the study is first of its kind which identified food consumption pattern among pregnant women. In addition, the use of the prepared photographic atlas of standardized portions which could serve as an input for future studies minimized information biases. Despite the aforementioned strengths, the findings need to be interpreted in the context of the following limitations. The semi quantitative FFQ used may over or underestimate the foods portion consumed though maximum effort was made through reducing the recall duration to one month. Other than this, semi quantitative FFQ does not tell us the actual intake rather it is a snapshot of habitual intake of individuals. Although, factor analysis is good to identify consumption pattern and classify risk groups, it is subjected to personal decisions leading to desirability bias.

### **Conclusion**

The study has highlighted the four major consumption patterns that best fit into the dietary habit of pregnant women. All of the patterns were highly loaded with cereal based diet. Three patterns among the four were less healthy as they lack variety. As a result, participants were subjected to multiple nutrient deficiencies. Single/divorced, educated at lower level, currently not working and with low socioeconomic status, living in larger household size and multigravida women were the vulnerable risk groups. The solution requires effective action across a several and areas that include food, health, social welfare, education, water, sanitation, and women. Thus, the current nutrition counseling practices need to be strengthened and health professionals working with pregnant women should target and give special emphasis to identified risk groups. During counseling, capitalize on the importance of balanced diet that includes dietary diversity with more emphasis on foods that are good sources of the deficient micronutrients.

Used to develop grain storage technology, add alternative to chemical processing. Such a “reagent-free” technology can be introduced at granaries to urgently solve the problem of storing grain with increased initial moisture, which will reduce the microflora content in it to regulatory requirements and position grain of non-standard quality as a potential food raw material. A more detailed study of the issue, namely, obtaining experimental data with an increase in the duration of contact of the UGSS with grain raw materials (more than 5 days), will make it possible to assess the possibility of increasing the stored storage ability of grain by preventing the development of bacterial

microflora as a result of non-reagent processing. The study of the properties of UDHSS in contact with other crops and their effects on microorganisms of various taxonomic groups will expand ideas about the potential of natural raw materials.

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**Volume 15 Issue 3 March 2020**

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