Dietary Diversity, Nutritional outcome and associated factors amongPregnant Women duringTheir First Trimester of Pregnancy in coastal region of Bangladesh: a cross-sectional study

Abstract

Introduction: A significant public health risk for expectant mothers is inadequate dietary diversification and undernutrition. Given that nutritional deficits may have a significant impact on the mother's and the fetus's health, optimal dietary diversity is crucial throughout pregnancy. The health status of expectant mothers in coastal area was unknown during the first trimester of pregnancy, despite their undernourishment and lack of dietary diversity. The aim of this study was to evaluate the nutritional status, dietary diversity, and related factors among pregnant women residing in the coastal region of Bangladesh.

Methods:416 pregnant women participated in a multi-stage sampling procedure and a community-based cross-sectional study design. A semi-structured questionnaire was used to collect the data. Data on dietary diversity were gathered using a modified version of the Food and Nutrition Technical Assistance questionnaire. Using a BMI measurement, the nutritional condition of expectant mothers was evaluated. Descriptive statistics were used to report the study participant's characteristics after the data were analyzed using SPSS25. To determine the variables influencing dietary diversity, a logistic regression model was constructed.

Results: Among 71.4% pregnant women, diverse diet was seen. Intake of nutrient-rich foods varied significantly according to women's employment status, educational level, family income level, and family type categories. Pregnant women, whose monthly family income was <15,000 BDT (OR 0.057**, 95% CI, 0.007- 0.469) and 15,000-40,000 BDT (OR 0.103*, 95% CI, 0.013-0.792) had respectively the tendency of having 0.057 times and 0.103 times low dietary diversity score than the pregnant women, whose monthly family income was >65,000 BDT that indicated a statistically significant relationship.

Conclusion: Pregnant women showed good levels of dietary diversity scores (DDS) that were considered acceptable (>5 food groups), and there was a significant relationship between DDS and participant's type of family, women's education, women's job, their family's monthly income and nutritional status.

Key-words: Dietary diversity, Pregnant women, Food groups, Socio-demographic factors.

Introduction

A diverse diet is one that includes a variety of foods or groups of food consumed during a predetermined length of time. Dietary diversity is also recognized as being essential to determining the accessibility, utilization, and quality of a person's or family's food (1). Diversity in diet can be used as a stand-in for adequate nutrition in pregnant women (2). Because pregnant women require more nutrients than other dietary types, it is highly advised that they diversify their diet. Therefore, in order to meet their nutritional needs and improve their nutritional status, pregnant women must eat a diversified diet, which will benefit both the mother and the unborn child(3).Individuals in low- and middle-income countries who are pregnant typically eat a diet high in cereals and low in animal products, vegetables, and fruits (4). For the mother and child's health and nutrition, dietary diversity (DD) and mothers' healthy eating habits are essential (5). DD is known as the total quantity of food categories consumed in a specific time period, including within and between food groups. Because it offers sufficient levels of micronutrients to meet pregnant women' nutritional demands, DD is the most significant factor in diet quality(6, 7). Maternity suffers from malnutrition because low-quality, repetitive diets are common in impoverished nations like Bangladesh (8). Poor DD is a reflection of the general nutritional status of pregnant women of reproductive age, with studies showing that 59% of Bangladeshi women have an inadequately diversified diet (9). Micronutrient deficiencies, such as those in zinc and iodine, have also been found to be particularly common in South Asian and Sub-Saharan African countries due to a diet lacking in fruits, vegetables, and animal products and a dependence on grains and tubers as staple foods(10). Reduced malnutrition may result from moms' diets being more varied and incorporating a variety of dietary categories (11). In light of this, figuring out the possible causes of moms' DD may aid in enhancing the dietary and medical standing of both the mother and child. Several research have looked into the variables related to a mother's varied diet (12). Previous studies discovered that the main variables causing DD

among pregnant women in underdeveloped nations were food security status, sociodemographic features of the household, economic issues, and a lack of nutrition advice (13). A small number of studies found a substantial correlation between the dietary diversity of lactating women in Sub-Saharan African nations and socioeconomic characteristics like the women's employment status, monthly income, household assets, family size, and knowledge about nutrition, sanitation, and food insecurity in the home(14). According to research by Shamim et al., the main factors influencing dietary diversity of pregnant women in rural area of Bangladesh were family size, husbands' occupations, and educational attainment (15). Inadequate nutritional diversity during pregnancy can lead to malnutrition, which presents a number of issues for both the mother and the fetus. Low birth weight, premature delivery, congenital disability, increased risk of intrauterine growth restriction, prenatal death, and morbidity and mortality in newborns are examples of fetal concerns. Undernutrition is a major public health concern for women of reproductive age, especially those who are pregnant, because of its negative consequences on pregnancy outcomes(16).As to a 2016 report by the United Nations Children Fund (UNICEF), access to health care facilities, maternal care practices, household food security, and a healthy environment are the fundamental determinants that determine a mother's nutritional status (17).

Sociodemographic factors such as age, wealth index, place of residence, occupation, size of farmland, illiteracy or low education, as well as maternal and health-care-related factors like age at marriage, ANC visits, counseling during antenatal care, level of knowledge, awareness, attitude, and practices regarding nutritious food intake, food taboos, women's empowerment, and cravings, all have an impact on pregnant women's dietary diversity and nutritional status(18).The majority of earlier studies addressed DD in pregnant women, as was discussed above. In Sub-Saharan African nations, not much research has been done to determine the risk factors for diabetes in nursing mothers. Studies on mothers' DD in South Asian contexts—particularly Bangladeshi contexts—are scarce. Few research conducted in Bangladesh have determined the variables affecting the DD of rural women. Because it determines the DD of mothers in urban settings and identifies the determinants of DD, this study contributes to the body of current literature.

By assessing the predisposing factors (level of knowledge, attitude, and practices regarding optimal nutrition and health) and reinforcing factors (women's decision-making power and support from family and community since giving birth), this study adds to the body of literature

on predictors of dietary diversity and nutritional status of pregnant women in the first trimester of pregnancy.Regional differences in socioeconomic characteristics, culture, ethnicity, and geography may also have an impact on risk factors for dietary diversity and undernutrition.It is appropriate to investigate the factors influencing the nutritional status and diversity of a pregnant woman's diet during the early stages of pregnancy in order to plan suitable and successful treatments for the subsequent phase of pregnancy. Similarly, health care professionals could focus on significant modifiable risk factors based on study results.

Unfortunately, pregnant Bangladeshi women may not become aware that they are in the first trimester of their pregnancysince their eating habits were identical to their pre-pregnancy habits.Pregnant women who follow a diverse diet are less likely to have maternal death and morbidity, and their developing fetus will thrive and experience fewer complications from perinatal outcomes. On the other hand, inadequate food intake during pregnancy has an additional effect on the well-being of the mother, the growing fetus, and the baby.This study is therefore unique from the others, the initial trimester of pregnancy, it was carried out, a gestational age at which the majority of studies have not been conducted. As a result, the aim of this study was to evaluate the nutritional status, dietary diversity, and related factors among pregnant women residing in the coastal region of Bangladesh.

Methods and Materials

Study design

Data collection in the research area took place in June and July of 2023 through a community-based cross-sectional survey.

Study area and population

The study was conducted among pregnant women in the first trimester of pregnancy of Patuakhali Sadar Upazilla (sub-district) and Noakhali Sadar upazilla (sub-district) of Patuakhali and Noakhali district, Bangladesh. Patuakhali and Noakhali both are the south-eastern coastal district of Bangladesh in Barisal and Chattogram division. The area was selected randomly from this district by multistage cluster sampling procedure.

study population

The study population was made up of randomly chosen pregnant women from the designated study area, whereas the source population comprised all pregnant women from the Patuakhali & Noakhali district.

Inclusion criteria

In order to participate in this study, pregnant women between the ages of 18 and 49 who had lived in the study area for at least six months had to be in the first trimester of their pregnancy, as confirmed by a lab test.

Exclusion criteria

Pregnant ladies who were really ill or incapable of answering the questions were excluded. Pregnant women with chronic conditions such as diabetes mellitus, hypertension, and TB had different dietary behaviors and nutritional needs than their counterparts, hence these women were not included in the study.

Sample size and Sampling technique

The sample size was estimated using a single population proportion with the assumption that 38.7% of pregnant mothers had poor diet diversity during pregnancy. This gave us a sample size of 416 pregnant women, with a 5% margin of error, a 95% confidence level, a design effect of 2, and a 10% non-response rate. The study's participants were selected through a multistage sampling procedure. Simple random selection was used to choose eligible homes from among the districts that were chosen, with a computer-generated random number that was proportionate to each Upazilla's size allocation.

Study variables

Dietary variety status was the dependent variable in this study, whereas the independent variables included pregnant women's nutritional status, age, marital status, occupation, residence area, and level of education.

Data collection tools and procedures

A semi-structured English questionnaire was used to collect data. To preserve uniformity, language experts translated the questionnaire into Bengali and then back into English. The questionnaire was pretested on 5% of the entire sample size in order to find any ambiguities and assess its completeness, consistency, and acceptability. Face-to-face interviews with pretested structured and semi-structured questionnaires drawn from several literary genres were used to

gather the results(19). There were three sections to the questionnaire. Sociodemographic information (age, marital status, place of residence, size of family, education, employment, and so forth) is included in the first section. Dietary information questionnaires, which were taken from the Food and Agriculture Organization of the United Nations (FAO) 2016 and modified, made up the second section(1). Based on their nutritional makeup, the ten food groups on the dietary diversity questionnaire are as follows:1) grains, white root, tubers, and plantains, 2) pulses (beans, peas, and lentils), 3) nuts and seeds, 4) dairy, 5) meat and fish (poultry and fish), 6) eggs, 7) dark green leafy vegetables, 8) vitamin A-rich fruits and vegetables, 9) others vegetables, and 10) others fruits. Using 24-hour open dietary recall techniques, it was evaluated. Each food group consumed in the 24 hours before to the survey period received one point. In the third section, the BMI score was used to determine the nutritional condition of expectant mothers based on their height and weight.

Data analysis

All the data was entered in SPSS 25.0. The data was cleaned and all outliers were discarded after verification with actual questionnaires. Data editing, coding, recoding, missing values and other problems about data was identified and rechecked if necessary. Data was analyzed using SPSS Software package (SPSS 25.0), and ENA (Emergency Nutritional Assessment). The number of food types ingested throughout the course of 24 hours was characterized as the individual Dietary Diversity Score (DDS). The Food and Agriculture Organization (FAO) recommendations were followed in the process of grouping the items contained in the questionnaire into ten categories in order to establish the Women Dietary Diversity Score (WDDS). The ten food category categories were utilized to measure dietary variety, and a cut-off score of ≥5 was used as the minimal cut-off point for having a high dietary diversity during analysis since it was deemed appropriate (maximum sensitivity and specificity).

Results

General information

The different characteristics of study population described below includes 416 pregnant women were selected for this study, eighteen to twenty-three years of ages with 9.1%, pregnant women (age between 24-36 years) 90.1% and thirty-seven to forty-nine years of age of .7% of the total

study populations. In general, the education level of the women's showed that 7% were completed primary level education with respect to the educational level 41.1% had completed secondary level, and a larger proportion 51.9% had completed higher secondary education. Large numbers of women were unemployed like 87.7% mothers were housewife of the study region. At the same time, 12.3% had been occupied. Most of women about 86.3% of them reside in urban area. The monthly income level of the households was less than 15000 Tk of monthly income with 11.1%, monthly income between 15000 – 40000 Tk with 40.6% & monthly income 40000-65000 Tk of 44.2% of the total study households respectively. The assessed information was summarized in Table 1.

Table 1, Descriptive statistics of Socio-demographic variables

Variable	**Percentage (%)**	**N (416)**
Age (years)		
18-23 years	9.1	38
24-36 years	90.1	375
37-49 years	0.7	3
Family Type		
Nuclear family	81.5	339
Joint family	18.5	77
Women's Education		
Primary	7	29
Secondary	41.1	171
Higher Secondary	51.9	216
Women's Employment		
Unemployed	87.7	365
Employed	12.3	51
Family Income		
< 15000 BDT	11.1	46
15000- 40000 BDT	40.6	169
40000- 65000 BDT	44.2	184
> 65000 BDT	4.1	17
BMI		
Underweight	33.4	139

Normal	65.6	273
Obese	1.0	4
Minimum Dietary diversity		
No	28.6	119
Yes	71.4	297

Dietary diversity and socio-demographic status among pregnant women in the study area

In this section, we established correlational aspect to understand the relation between dietary diversity score categories & several socio-demographic indices of different indicators of pregnant women. The dietary diversity score of the study pregnant women is significantly describe by the various socio-demographic and economic factors namely women's education, women's employment, family income level & family size because the Pearson Chi-square (p-value) significance level is .000 (.05) for each of the dietary diversity indicator. Table 2 describes that 86.6% of pregnant women's have low household dietary diversity score whom living in nuclear family. Also, 49.6% mothers were secondary educated having poor food consumption of the respective women. At the same time, women whom family monthly income level between 15000-40000 BDT were belonging with the larger rate 53.8% of low diversity score in the respective study participants, 51.9% of women whom family income level between 40000-65000 BDT having high dietary diversity. This means that the dietary diversity of the pregnant women's is greatly influenced with socio-demographic factors. The observed dietary diversity is strongly correlated with sociodemographic parametersand significant difference exists between the socio-demographic factors and dietary diversity for the respective households.

Table 2. Relationship between related socio-demographic characteristics and the Dietary Diversity Score (DDS).

Characteristic	**N (416)**	**Dietary Diversity Score n(row%)**		**p-value**
		<5	**≤5**	
Family Type				
Nuclear family	339	103 (86.6)	236 (89.5)	0.042

Joint family	77	16 (13.4)	61 (20.5)	
Women's Education				
Primary	29	17 (14.3)	12 (4.0)	
Secondary	171	59 (49.6)	112 (37.7)	0.000
Higher Secondary	216	43 (36.1)	173 (58.2)	
Women's Employment				
Unemployed	365	118 (99.2)	247 (83.2)	0.000
Employed	51	1 (.8)	50 (16.8)	
Family income				
< 15000 BDT	46	24 (20.2)	22 (7.4)	
15000- 40000 BDT	169	64 (53.8)	105 (35.4)	0.000
40000- 65000 BDT	184	30 (25.2)	154 (51.9)	
> 65000 BDT	17	1 (.8)	16 (5.4)	

*5% level of significance Note: 10 food categories were considered as recommended by FANTA. Individual dietary diversity is categorized as "low dds" if less than 5 food groups consumed, and as "diverse" if ≥5.

Factors related with pregnantwomen dietary intake

Table-3 described that, the study had examined the relation of dietary diversity score associated with some factors such as family type, women's education, women's occupation, living area and family income among households of pregnant women in the study area which were statistically significant. women belonging to nuclear family (OR 0.601*, 95% CI, 0.331-1.092) were 0.601 times less likely to achieve higher dietary diversity score than the pregnant from joint family and the association was significant. Participants, whose women had completed primary (OR 0.175**, 95%, 0.078-0.395) education and secondary (OR 0.472**, 95% CI, 0.298-0.747) education had respectively 0.175 times and 0.472 times low tendency of receiving higher dietary diversity score than those whose women had completed higher secondary education. Here, the correlations were statistically significant ($p < 0.01$). Respondents, whose women were unemployed/housewives (OR 0.042**, 95% CI, 0.006-0.307) were 0.042 times less likely to achieve higher dietary diversity score than the women who were employed. women, who lived in the rural area (AOR 2.20, 95% CI, 1.05-4.61) were 2.20 times more likely to gain higher dietary diversity score than those who lived in urban area. Pregnant women, whose monthly family income was <15,000

BDT (OR 0.057**, 95% CI, 0.007- 0.469) and 15,000-40,000 BDT (OR 0.103*, 95% CI, 0.013-0.792) had respectively the tendency of having 0.057 times and 0.103 times low dietary diversity score than the women whose monthly family income is >65,000 BDT that indicated statistically significant relationship.

Table 3. Factors related with pregnant womendietary intake

Variables	**Minimum Dietary diversity (No/Yes)**	
	Crude OR, 95% CI	AOR, 95% CI
Family Type		
Nuclear family	.601* (.331-1.092)	.654 (.330-1.29)
Joint family	1	1
Women's Education		
Primary	.175** (.078-.395)	.162** (.064-.414)
Secondary	.472** (.298-.747)	.580* (346-.971)
Higher Secondary	1	1
Women's Employment		
Unemployed	.042** (.006-.307)	2.203 (1.05-4.61)
Employed	1	1
Living area		
Rural	1.592 (.810-3.130)	2.20* (1.05-4.61)
Urban	1	1
Family income		
< 15000 BDT	.057** (.007-.469)	.162 (.018-1.47)
15000- 40000 BDT	.103* (.013-.792)	.235 (.028-1.98)
40000- 65000 BDT	.321 (.041-2.512)	.674 (.079-5.71)
> 65000 BDT	1	1

** Significant at <0.01; * significant at <0.05; the study also considered women's education, living area and family income for controlling their effects; "Yes" being the reference in the outcome variables

Discussion

The purpose of this study was to evaluate the degree of dietary diversity, nutritional status, and related variables among first-trimester pregnant women (20).According to our data, 71.4% of pregnant women in the first trimester of their pregnancy had a high level of dietary diversity (95% CI: (23.5, 29.6) (21). Our results were similar to those of the Dhaka town research (65.4%)(12) and the government of Ethiopia's Southern Nations, Nationalities, and Peoples' area (SNNPRG) area (67%) (22). Still, it outperforms the results of a similar study carried out in Kenya, Ethiopia (40.3%)(2)and (20.2%), respectively, and although it is less than research conducted in Ghana (40.3%), Kenya (60.6%), and the United States (54%) (23-25) . Their research methodology, gestational age, geographic location, sociodemographic, and seasonal variations could all be factors contributing to the potential discrepancy. Variations in the methods used to measure dietary diversity also lead to variations in the prevalence of dietary diversity; for example, some research employed ten food groups, while others used fourteen, and some studies used different cutoff points to classify dietary diversity as high or low(26). The results of the study showed a substantial relationship between pregnant women's dietary diversity and their nutritional condition (27).According to the study, a pregnant woman's living environment had a substantial impact on her nutritional state (undernutrition) (28). Pregnant women who reside in an urban family are more likely to have adequate nutritional status (29). This suggests that pregnant women who live in rural areas will eat fewer different types of foods, which may have an impact on their nutritional condition (30).

The study revealed a noteworthy correlation between the nutritional condition of pregnant women and the dietary diversity score. When compared to their counterparts, women with high dietary diversity scores were more likely to be well-nourished(31). This result is consistent with research conducted in Ethiopia's and Kenya's central refit valley(32). The explanation for this could be because a varied diet can be used as a stand-in for adequate nutrition, which would strengthen immunity and hence improve nutritional status(33). Pregnant women's nutritional status was also substantially correlated with their practices of nutrition and health(34). In comparison to their counterparts, the women who practiced optimal nutrition and health were more likely to be well-nourished. This may be explained by the fact that women's nutritional status is impacted by their eating practices when they follow health-related activities and maintain adequate nutrition(35). Predisposing factors like level of knowledge, attitude, and

practices regarding optimal nutrition and health; and reinforcing factors (women's decision-making power and support from family and community) were among the study's main strengths. Most studies have not assessed the magnitude of dietary diversity, nutritional status, and associated factors in pregnant women in the first trimester of pregnancy, which is very important to provide effective intervention for the next stage of pregnancy(37).

Due to respondents' potential forgetfulness of their previous day's meals, recall bias on food consumption may exist. An approach known as multiple pass 24-hour probing was used to lessen recollection bias. Seasonal fluctuations were not taken into account, and the cross-sectional design of the study makes it impossible to prove the temporal or causal relationship between the independent and outcome variables.

Conclusion

The current study found that among pregnant women in the study area who were in their first trimester, there was a significant prevalence of undernutrition and limited dietary diversity. Pregnant women's dietary diversity score was significantly correlated with their positive attitude, good knowledge, and living in food-secure households; on the other hand, nutritional status (undernutrition) was predicted by household size, food security status, dietary diversity score, and nutrition and health practices. Pregnant women's needs in terms of dietary diversity and nutritional status necessitate alterations in nutrition, health behavior, and communication.

Authors Contributions

Nahian Rahman and Zannatul Ferdowsi conceptualized the idea, study design and collected and analyzed updated evidence, conducted the study, analyzed the data and prepared the manuscript and drafting.

Ethical approval and Consent

After receiving approval from the Noakhali Science and Technology University Ethics Council permission from head of the school, the research was carried out. Before any data was collected, all participants gave their informed consent and the benefits and drawbacks of the study were thoroughly reviewed.

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References

1. FAO F. Minimum dietary diversity for women: a guide for measurement. Rome: FAO. 2016;82.
2. Kahanya KW. Dietary diversity, nutrient intake and nutritional status among pregnant women in Laikipia County, Kenya. International Journal of Health Sciences & Research. 2016;6.
3. Pasricha S-R, Drakesmith H, Black J, Hipgrave D, Biggs B-A. Control of iron deficiency anemia in low-and middle-income countries. Blood, the Journal of the American Society of Hematology. 2013;121(14):2607-17.
4. Lee SE, Talegawkar SA, Merialdi M, Caulfield LE. Dietary intakes of women during pregnancy in low-and middle-income countries. Public health nutrition. 2013;16(8):1340-53.
5. Quansah DY, Boateng D. Maternal dietary diversity and pattern during pregnancy is associated with low infant birth weight in the Cape Coast metropolitan hospital, Ghana: A hospital based cross-sectional study. Heliyon. 2020;6(5).
6. Tilahun AG, Kebede AM. Maternal minimum dietary diversity and associated factors among pregnant women, Southwest Ethiopia, 2021. BMC nutrition. 2021;7(1):1-10.
7. Sabuj MP, Chowdhury R, Al Mamun MA, Kabir MR, Ghosh S, Alam MR, et al. Assessment of dietary diversity of mothers (0-2 years childbearing) in Noakhali District of Bangladesh. Journal of Noakhali Science and Technology University (JNSTU). 2020;4(1&2):1-11.
8. Andrews C, Shrestha R, Ghosh S, Appel K, Gurung S, Ausman LM, et al. Consumption of animal source foods, especially fish, is associated with better nutritional status among women of reproductive age in rural Bangladesh. Maternal & Child Nutrition. 2022;18(1):e13287.
9. Hasan M, Islam MM, Mubarak E, Haque MA, Choudhury N, Ahmed T. Mother's dietary diversity and association with stunting among children< 2 years old in a low socio- economic environment: A case–control study in an urban care setting in Dhaka, Bangladesh. Maternal & child nutrition. 2019;15(2):e12665.
10. Shrestha V, Paudel R, Sunuwar DR, Lyman ALT, Manohar S, Amatya A. Factors associated with dietary diversity among pregnant women in the western hill region of Nepal: A community based cross-sectional study. PloS one. 2021;16(4):e0247085.
11. Biradar KB. Assessment of nutritional supplements prescribed in pregnant women and pediatric patients in Basaveshwara teaching and general hospital. J Food Nutr. 2015;1:1-9.
12. Desta M, Akibu M, Tadese M, Tesfaye M. Dietary diversity and associated factors among pregnant women attending antenatal clinic in Shashemane, Oromia, Central Ethiopia: a cross-sectional study. Journal of nutrition and metabolism. 2019;2019.

13. Ali F, Thaver I, Khan SA. Assessment of dietary diversity and nutritional status of pregnant women in Islamabad, Pakistan. Journal of Ayub Medical College Abbottabad. 2014;26(4):506-9.
14. Shamim AA, Mashreky SR, Ferdous T, Tegenfeldt K, Roy S, Rahman AF, et al. Pregnant women diet quality and its sociodemographic determinants in southwestern Bangladesh. Food and nutrition bulletin. 2016;37(1):14-26.
15. Fufa DA, Laloto TD. Assessment of dietary diversity and associated factors among lactating mothers in Debub Bench District. Heliyon. 2021;7(8).
16. Dalky HF, Qandil A, Alqawasmi AA. Factors associated with Undernutrition among pregnant and lactating Syrian refugee women in Jordan. Global Journal of Health Science. 2018;10(4):58.
17. Islam MM, Khan MN, Mondal MNI. Does parental migration have any impact on nutritional disorders among left-behind children in Bangladesh? Public health nutrition. 2019;22(1):95-103.
18. Chakona G, Shackleton C. Food taboos and cultural beliefs influence food choice and dietary preferences among pregnant women in the Eastern Cape, South Africa. Nutrients. 2019;11(11):2668.
19. Hailu S, Woldemichael B. Dietary diversity and associated factors among pregnant women attending antenatal care at public health facilities in Bale Zone, Southeast Ethiopia. Nutrition and Dietary Supplements. 2019:1-8.
20. Ghosh S, Spielman K, Kershaw M, Ayele K, Kidane Y, Zillmer K, et al. Nutrition-specific and nutrition-sensitive factors associated with mid-upper arm circumference as a measure of nutritional status in pregnant Ethiopian women: implications for programming in the first 1000 days. PLoS One. 2019;14(3):e0214358.
21. Tang AM, Chung M, Dong KR, Bahwere P, Bose K, Chakraborty R, et al. Determining a global mid-upper arm circumference cut-off to assess underweight in adults (men and non-pregnant women). Public Health Nutrition. 2020;23(17):3104-13.
22. Gyimah LA, Annan RA, Apprey C, Edusei A, Aduku LNE, Asamoah-Boakye O, et al. Dietary diversity and its correlates among pregnant adolescent girls in Ghana. PLoS One. 2021;16(3):e0247979.
23. Nana A, Zema T. Dietary practices and associated factors during pregnancy in northwestern Ethiopia. BMC pregnancy and childbirth. 2018;18(1):1-8.
24. Tsegaye D, Tamiru D, Belachew T. Factors associated with dietary practice and nutritional status of pregnant women in rural communities of Illu aba Bor zone, Southwest Ethiopia. Nutrition and Dietary Supplements. 2020:103-12.
25. Jemal K, Awol M. Minimum dietary diversity score and associated factors among pregnant women at Alamata General Hospital, Raya Azebo Zone, Tigray Region, Ethiopia. Journal of nutrition and metabolism. 2019;2019.
26. Lama N, Lamichhane R, Bhandari R, Shreejana K, Bhandari GP, Sharma D, et al. Factors influencing dietary diversity of pregnant women attending antenatal care in western regional

hospital, Nepal: a cross-sectional study. Journal of Karnali Academy of Health Sciences. 2019;2(3):189-96.
27. Katenga-Kaunda LZ, Kamudoni PR, Holmboe-Ottesen G, Fjeld HE, Mdala I, Shi Z, et al. Enhancing nutrition knowledge and dietary diversity among rural pregnant women in Malawi: a randomized controlled trial. BMC Pregnancy and Childbirth. 2021;21(1):1-11.
28. Desyibelew HD, Dadi AF. Burden and determinants of malnutrition among pregnant women in Africa: A systematic review and meta-analysis. PloS one. 2019;14(9):e0221712.
29. Shiferaw A, Husein G. Acute under nutrition and associated factors among pregnant women in Gumay District, Jimma Zone, South West Ethiopia. J Women's Health Care. 2019;8(459):2167-0420.1000459.
30. Lama N, Lamichhane R, KC S BG, Wagle R. Determinants of nutritional status of pregnant women attending antenatal care in Western Regional Hospital, Nepal. Int J Community Med Public Health. 2018;5:5045-51.
31. Zewdie S, Fage SG, Tura AK, Weldegebreal F. Undernutrition among pregnant women in rural communities in southern Ethiopia. International Journal of Women's Health. 2021:73-9.
32. Acharya SR, Bhatta J, Timilsina DP. Factors associated with nutritional status of women of reproductive age group in rural, Nepal. Asian Pacific Journal of Health Sciences. 2017;4(4):19-24.
33. Kim HJ, Oh K. Household food insecurity and dietary intake in Korea: results from the 2012 Korea National Health and Nutrition Examination Survey. Public Health Nutrition. 2015;18(18):3317-25.
34. Wen LM, Flood VM, Simpson JM, Rissel C, Baur LA. Dietary behaviours during pregnancy: findings from first-time mothers in southwest Sydney, Australia. International Journal of Behavioral Nutrition and Physical Activity. 2010;7:1-7.
35. Shemsu S, Argaw A, Zinab B. Dietary practice and nutritional status among pregnant women attending antenatal care at Mettu Karl referral hospital, southwest Ethiopia. The Open Public Health Journal. 2020;13(1).
36. Boke MM, Geremew AB. Low dietary diversity and associated factors among lactating mothers in Angecha districts, Southern Ethiopia: community based cross-sectional study. BMC research notes. 2018;11:1-6.
37. Shenka A, Damena M, Abdo M, Roba KT. Dietary diversity and nutritional status of pregnant women attending public hospitals in dire dawa city administration, eastern Ethiopia. East African Journal of Health and Biomedical Sciences. 2018;2(1):10-7.