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# Dietary Diversity and Nutritional Practices Among Pregnant Women Attending Antenatal Clinic in a Tertiary Care Hospital in Kolkata, India: A Cross-Sectional Study

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ABSTRACT

**Background:** Maternal malnutrition during pregnancy contributes to adverse maternal and neonatal outcomes. Dietary diversity is an important indicator of nutrient adequacy and micronutrient sufficiency during pregnancy. However, evidence from Eastern India regarding dietary diversity and associated determinants among pregnant women remains limited.

**Purpose:** To assess dietary diversity and nutritional practices among pregnant women attending the antenatal clinic of a tertiary care hospital in Kolkata and to determine the association of dietary diversity with food security, nutritional knowledge, and sociodemographic factors.

**Methods:** A hospital-based descriptive cross-sectional study was conducted among 162 pregnant women. Data were collected using a predesigned, pretested semi-structured schedule incorporating the Minimum Dietary Diversity for Women (MDD-W) scale, Household Food Insecurity Access Scale (HFIAS), and nutritional knowledge assessment. Dietary diversity was considered adequate when ≥5 food groups were consumed in the previous 24 hours. Data were analysed using SPSS version 20.

**Results:** The mean age of participants was 23.9±4.95 years. Overall, 57.4% of women did not achieve minimum dietary diversity, while only 13.6% had adequate nutritional knowledge. Most participants (80.2%) were food secure despite low dietary diversity. Significant associations were observed between adequate dietary diversity and husband's secondary or higher education (aOR=3.39, p=0.002) and adequate maternal nutritional knowledge (aOR=43.14, p<0.001).

**Conclusion:** Dietary diversity among pregnant women attending the tertiary care hospital was suboptimal. Improving maternal nutritional knowledge and involving male partners in nutrition counselling may enhance dietary diversity during pregnancy. Strengthening antenatal nutritional counselling and promoting diversified diets remain essential public health priorities.

## 1. Introduction

Malnutrition affecting the health of pregnant women and children is an unending problem, which is rooted in and perpetuates inequality. Adverse outcomes of maternal malnutrition can be low birth weight, anaemia, toxaemia of pregnancy and postpartum haemorrhage, all leading to high mortality and morbidity among women and their infants (Basu *et al.*, 2022). Beyond these short-term adverse outcomes, nutrition during pregnancy is a determinant of lifetime risk of diseases. It is a potentially modifiable risk factor as well. The Indian Council of Medical Research (ICMR) and the National Institute of Nutrition (NIN) updated their nutritional recommendations in 2020 based on recent evidence according to which extra calories, protein and micronutrients are to be consumed

during pregnancy. Besides recording pregnancy weight gain, assessment of dietary diversity (DD) can allow for early detection of malnutrition and implementation of nutritional interventions. DD is defined as the ingestion of a wide variety of foods or food groups over a set period. It is regarded as a critical component in defining a person's or a family's nutrient adequacy in diet and sufficiency of various micronutrients and macronutrients (Kennedy *et al.*, 2011). Studies in India have reported a minimal dietary diversity of about 70% among rural pregnant women, who consume a largely cereal-based diet (Gokhale & Rao, 2022; Lander *et al.*, 2019). However, no such study among pregnant women has been conducted in the eastern part of India, where the dietary patterns and food taboos are somewhat different.

A diverse diet has been associated with crop diversity, education, income, distance to market, and nutritional knowledge (Nguyen *et al.*, 2019; Singh *et al.*, 2020). DD is also proposed as a measure for food security. Every percent point increase in DD results in an equal percentage of an increase in per capita consumption (Bakhtsiyarava *et al.*, 2021). A systematic review reported food insecurity in 8.7 to 99% of households from different Indian studies (McKay *et al.*, 2023). A study on nutritional knowledge of pregnant women in Telangana reports 27.74% of women being knowledgeable on various aspects of nutrition during pregnancy (Ravula *et al.*, 2024).

The Global Hunger Index 2023 measures the impact of undernutrition during pregnancy specifically in terms of child undernutrition. It points out India has a serious level of hunger (*India*, n.d.). Despite awareness and antenatal services, food taboos may lead to maternal malnutrition. As pregnancy requires additional macronutrients and micronutrients to support foetal growth and development, maintaining maternal health and dietary diversity is the key to preventing micronutrient deficiencies. Thus, more understanding is needed on the pathways to assess and prevent undernutrition during the critical developmental stage of pregnancy. In this background, the present study was conducted with the objectives of assessing dietary diversity patterns and examining the associations between dietary diversity score, food security, nutritional knowledge and selected socio-demographic variables among pregnant women attending the antenatal clinic of a tertiary care centre in Kolkata.

## 2. Methodology

This descriptive study with a cross-sectional design was conducted among pregnant women of the second and third trimesters attending the antenatal clinic of a tertiary care center in Kolkata from June to August 2023. Individuals not willing to participate and those who had fasted or feasted on the previous day of data collection were excluded. Sample size (N) was calculated using the formula.

$$N = \frac{Z^2}{L^2} P \times Q$$

Where Z was taken as 1.96, P was the prevalence of high diet diversity among pregnant women considered from a previous study as 10.3% (Gokhale & Rao, 2022); Q was (1-P), and L was the absolute precision taken as 5%. Considering 9% non-respondents, the sample size was calculated to be 162. Systematic random sampling was applied. The number of pregnant women each day was collected from the antenatal register. The total population was calculated by averaging the number of pregnant women attending the antenatal clinic in one week, and the sampling interval came to 9. The selection of participants is summarized in Figure 1.

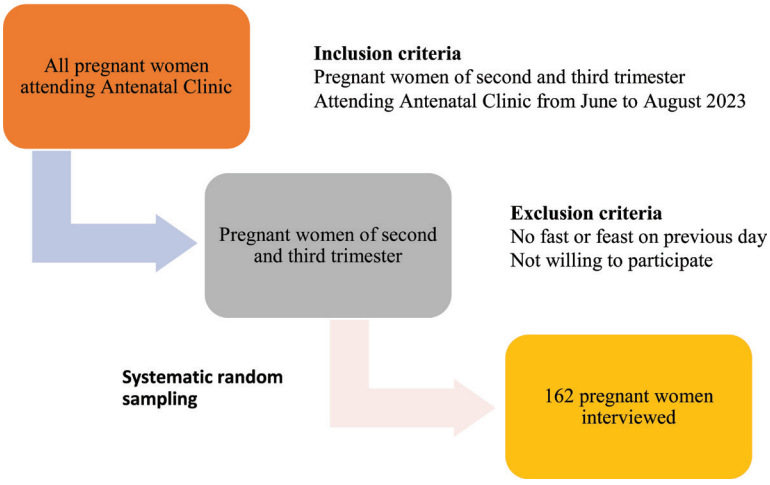


**Figure 1:** Process Flow Diagram

Data were collected by interviewing every 9th pregnant woman based on 24-hour recall. Study subjects were interviewed with a predesigned, pretested, semi-structured schedule. The study tool was prepared in English using various questions to assess sociodemographic characteristics, food taboos, the Household Food Insecurity Access Scale (HFIAS), nutritional knowledge during pregnancy, and the Minimum Dietary Diversity Scale for Women (MDD-W). Food taboo is defined as at least one food item culturally or socially prohibited or eschewed during pregnancy based on beliefs, traditions, religion, or social norms (Meyer-Rochow, 2009). Nutritional knowledge during pregnancy was extracted from the FAO Knowledge, Attitude, and Practice Manual, while the Minimum Dietary Diversity Scale for Women (MDD-W) is a validated scale used in several cross-sectional studies (Coates *et al.*, 2007; Fautsch Macías & Glasauer, 2014; Shrestha *et al.*, 2021; Zelalem *et al.*, 2017). A diverse diet was considered if the pregnant woman consumed 5 or more food groups out of 10 food groups in the last 24 hours using the MDD-W tool (*Minimum Dietary Diversity for Women*, 2021). HFIAS is calculated by adding the information on the prevalence of households showing one or more behaviors in the three domains of HFIAS, namely anxiety and uncertainty, insufficient quality, and insufficient food intake and its physical consequences in the last four weeks. For the HFIAS score, the frequency of occurrence of all cases with the response 'no' was coded as 0 and the response 'often' as 3. Hence, the minimum score of a household was 0 and the maximum score was 27. HFIAS for each household was categorized into category 1 as food secure, category 2 as mildly food insecure access, category 3 as moderately food insecure access, and category 4 as severely food insecure access (Coates *et al.*, 2007). For calculating the nutritional knowledge during pregnancy, a score of 1 was given to each demonstrated knowledge for the knowledge variable; thereby, a total score range of 0 to 9 was obtained. Adequate knowledge was considered if the score was 6 and above and inadequate knowledge if the score was less than 6 (Shrestha *et al.*, 2021). The schedule was peer reviewed and validated by a panel of experts of public health. It was then translated in Bengali and was retranslated by a bilingual expert. Pretesting of the tool was done among 20 pregnant women who were excluded from the main study. Minor modifications were made in the schedule according to the result of pretesting. Data collection was started after getting approval from the Institutional Ethics Committee (IEC) of RG Kar Medical College, Kolkata, with number RKC/806, dated 29-05-2023. Descriptive statistics were done for univariate data using SPSS version 20. Frequency and percentage were used for categorical data and mean (SD) or median (IQR) was used for continuous data after judging their normality. A chi-square test was done to see the significance level of differences between groups. A p-value of 0.05 or less was considered significant. An odds ratio was calculated as a measure of effect size, followed by binary logistic regression.

## 3. Results

In this study, we could include 162 antenatal women as participants. Their sociodemographic characteristics are shown in Table 1. The mean age of the study participants was 23.9 years (± 4.95 years), and ages ranged from 16 years to 40 years. Most women were homemakers (90.1%), Hindu by religion (56.8%), lived in large joint families (87.7%), and were educated up to the primary level (46.3%). Almost half of the participants reported their husbands' occupation as service or business; however, the highest proportion (47.5%) among them had a monthly family income of ≤ 10,000 INR.

**Table 1:** Distribution of study participants according to sociodemographic characteristics (N=162)

| Variables | Number | Percentage |
|---|---|---|
| **Age (completed years)** | | |
| Less than 20 | 49 | 30.2 |
| 20 to 30 | 95 | 58.6 |
| More than 30 | 18 | 11.2 |
| **Current living arrangement** | | |
| In laws' house | 93 | 57.4 |
| Parents' house | 67 | 41.4 |
| Only with husband | 2 | 1.2 |
| **Religion** | | |
| Hindu | 92 | 56.8 |
| Muslim | 70 | 43.2 |
| **Type of family** | | |
| Joint family | 142 | 87.7 |
| Nuclear family | 20 | 12.3 |
| **No. Of family members** | | |
| Less than 4 | 62 | 38.3 |
| More than 4 | 100 | 61.7 |
| **Participant's occupation** | | |
| Homemaker | 146 | 90.1 |
| Housemaid | 7 | 4.3 |
| Service | 3 | 1.9 |

| | | |
|---|---|---|
| Business | 6 | 3.7 |
| **Age of marriage (completed years)** | | |
| Less than 18 | 61 | 37.7 |
| More than 18 | 101 | 62.3 |
| **Educational status of participant** | | |
| Upto primary completed | 75 | 46.3 |
| Secondary completed | 43 | 26.5 |
| Higher secondary completed | 23 | 14.2 |
| Graduation and above | 21 | 13 |
| **Educational status of husband** | | |
| Upto primary completed | 88 | 54.3 |
| Secondary completed | 46 | 28.4 |
| Higher secondary completed | 17 | 10.5 |
| Graduation and above | 11 | 6.8 |
| **Monthly income of family (Rs)** | | |
| Less than 10000 | 77 | 47.5 |
| 10000 to 15000 | 57 | 35.2 |
| More than 15000 | 28 | 17.3 |
| **Husband's occupation** | | |
| Service | 34 | 21 |
| Business | 50 | 30.9 |
| Driver | 24 | 14.8 |
| Daily wage | 46 | 28.4 |
| Others | 8 | 4.9 |

Dietary diversity during pregnancy, among other things, can be shaped by food taboos. There were 89 (54.9%) women who had a taboo on fruits like papaya or pineapple. However, only 29 (32.6%) of them could give any specific reason for such taboo, which was for all cases, harm to the fetus.

Study participants had a mean dietary diversity score of 4.54 (SD 1.24). Scores ranged from a minimum of three to a maximum of eight. There were 42.6% participants who consumed foods and beverages from more than five food groups during the previous day. All women consumed cereals, and around 70% women ate pulses and animal-based foods as well (Figure 2).

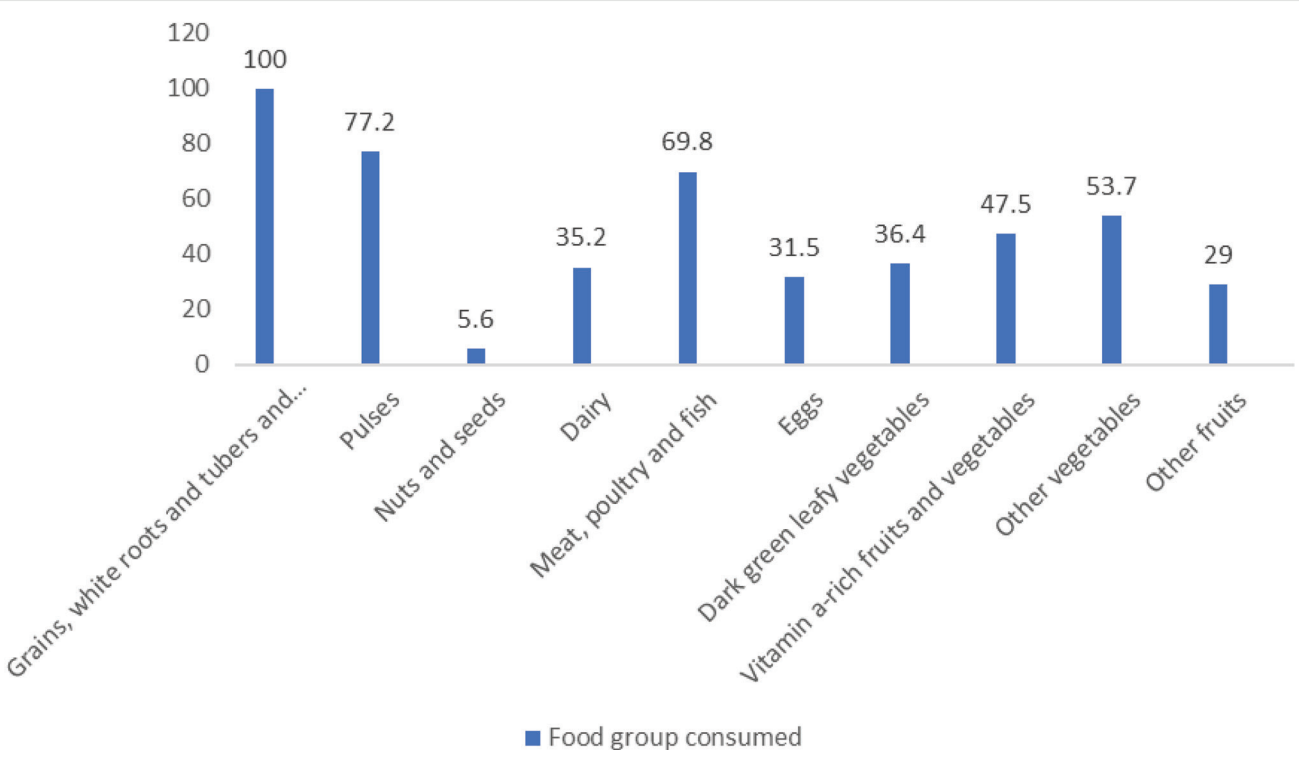


**Figure 2:** Distribution of study participants according to food taboo practice, IFA consumption, calcium tablet consumption and food group consumed in last 24 hours (N=162)

Mean score for knowledge on appropriate nutrition during pregnancy was 4.34 and SD 1.872. Based on cut-off scores, knowledge was poor, with only 13.6 % women having adequate nutritional knowledge, majority (80.2%) of the participants were food secure, but DD was low at 42.6%. (Table 2)

**Table 2:** Distribution of study participants according to Knowledge on appropriate nutrition, Household food security according to HFIAS and Dietary diversity (N=162)

| **Variables** | **Number** | **Percentage** |
|---|---|---|
| **Knowledge on appropriate nutrition during pregnancy** | | |
| Not knowledgeable | 140 | 86.4 |
| Knowledgeable | 22 | 13.6 |
| **Household food security according to HFIAS** | | |
| Category 1 | 130 | 80.2 |
| Category 2 and 3 | 32 | 19.8 |
| **Dietary diversity** | | |
| Present | 69 | 42.6 |
| Absent | 93 | 57.4 |

Bivariate analysis and binary logistic regression of factors associated with dietary diversity among study participants are summarized in Table 3. There was a significant association between dietary diversity with educational status of husband and woman's nutritional knowledge. Husband's education resulted in higher likelihood of DD. Pregnant women whose husbands had secondary or higher education were more likely to consume a diverse diet (aOR=3.39, 95% CI= 1.58-7.28; p=0.002). Likewise, pregnant women with knowledge of appropriate nutrition during pregnancy were more likely to have dietary diversity than women without such knowledge (aOR=43.14, 95% CI=5.4-344.63; p=0.000). Household food security was not associated with dietary diversity. Nagelkerke $R^2$ for the logistic regression model was 0.341, which could explain 34% of the observed variation.

**Table 3:** Bivariate analysis and binary logistic regression of factors associated with dietary diversity among study participants (N = 162).

| **Variables** | **Dietary diversity** | | **Bivariate analysis** | | | **Multivariable analysis** | |
|---|---|---|---|---|---|---|---|
| | **Diverse N(%)** | **Not diverse N (%)** | **cOR (95% CI)** | **Chi Square value** | **p value#** | **aOR (95% CI)** | **P value** |
| **Age (completed years)** | | | | | | | |
| Less than 20 | 23(46.9) | 26(53.1) | 1.29 (0.56-2.351) | 0.543 | 0.461 | Ref 0.790(0.25-2.47) | 0.685 |
| More than 20 | 46(40.7) | 67(59.3) | | | | | |
| **Age of marriage (completed years)** | | | | | | | |
| Less than 18 | 22(36.1) | 39(63.9) | 0.648(0.34-1.24) | 1.705 | 0.192 | Ref 1.791(0.67-4.77) | 0.243 |
| More than 18 | 47(46.5) | 54(53.5) | | | | | |
| **Educational status of husband** | | | | | | | |
| Upto primary completed | 28(31.8) | 60(68.2) | 0.38(0.19-0.713) | 9.146 | **0.002*** | Ref 3.394(1.58-7.28) | **0.002*** |
| Secondary and above | 41(55.4) | 33(44.6) | | | | | |
| **Monthly income of family (Rs)** | | | | | | | |
| Less than 12000 | 42(46.2) | 49(53.8) | 1.397(0.74-2.63) | 1.077 | 0.299 | Ref 0.547(0.25-1.17) | 0.122 |
| More than 12000 | 27(38.0) | 44(62.0) | | | | | |
| **Gravida** | | | | | | | |
| Primigravida | 38(46.3) | 44(53.7) | 1.365(0.73-2.55) | 0.954 | 0.329 | Ref 0.815(0.35-1.89) | 0.635 |
| Second or higher gravida | 31(38.8) | 49(61.2) | | | | | |
| **Knowledge on appropriate nutrition during pregnancy** | | | | | | | |
| Not Knowledgeable | 35(29.2) | 85(70.8) | 10.32(4.35-24.51) | 34.122 | **0.000*** | Ref 43.144(5.40-344.63) | **0.000*** |
| Knowledgeable | 34(81.0) | 8(19.0) | | | | | |
| **Household food security according to HFIAS** | | | | | | | |
| Food not secure | 10(31.3) | 22(68.8) | 1.828(0.80-4.165) | 2.098 | 0.147 | Ref 1.327(0.51-3.43) | 0.561 |
| Food secure | 59(45.4) | 71(54.6) | | | | | |

*Denotes statistically significant at p <0.05

# denotes Chi square test

**cOR:** crude odds ratio; **aOR:** adjusted odds ratio; **CI:** confidence interval.

## 4. Discussion

The present study assessed dietary diversity and nutritional practices among pregnant women attending the antenatal clinic of a tertiary care teaching hospital in Kolkata. In this study, only 42.6% of pregnant women consumed a minimally diverse diet despite 80.2% belonging to food-secure households, while only 13.6% of women demonstrated adequate nutritional knowledge. Dietary diversity was significantly associated with the husband's educational status and the woman's nutritional knowledge. These findings highlight the multidimensional nature of maternal nutrition and indicate that household food security alone is inadequate for dietary quality.

The proportion of pregnant women achieving minimum dietary diversity in the present study was lower than that reported in several studies from other parts of India, where dietary diversity ranged from 69% to 77% (Lander *et al.*, 2019; Basu *et al.*, 2022; Gokhale & Rao, 2022; Shumayla *et al.*, 2022). Findings from our study are closer to the observations from Pune and Rajasthan (Deshpande *et al.*, 2024; Sharma *et al.*, 2024). Regional differences across studies may be explained by variations in availability of food, agricultural activities, food habits in different cultures, affordability of diverse foods, and urban–rural differences in accessing various foods. In rural populations, dietary diversity is strongly influenced by agricultural production, whereas in urban populations, dietary choices are more dependent on purchasing capacity and food affordability. Dietary diversity in our study is very similar to that in neighboring Bangladesh, where minimum dietary diversity among pregnant women was reported to be approximately 38%-51% (Shamim *et al.*, 2016; Hossain *et al.*, 2021).

In the present study, poor dietary diversity coexisted with relatively high household food security. This apparent paradox points out the distinction between food security and dietary quality. Food security indicators primarily assess access to sufficient quantities of food, but they may not adequately capture dietary diversity. Households of low and middle-income settings may achieve food security through cereal-based foods from public distribution systems but may lack access to nutrient-rich foods such as fruits, vegetables, dairy products, and nuts. This finding is in agreement with research findings across several low and middle-income countries, where development interventions improved food availability but had comparatively limited effects on dietary diversity (Sibhatu *et al.*, 2026). Studies from Nepal, Ghana, Bangladesh, and Ethiopia suggest that various factors like women's empowerment, household income, food prices, nutrition awareness, and cultural food practices affect dietary diversity (Shrestha *et al.*, 2021; Agyei *et al.*, 2021; Hossain *et al.*, 2024; Tilahun & Kebede, 2021). "Hidden hunger" arising from deficiencies of essential micronutrients can occur even in the setting of adequate calorie intake.

In our study all participants consumed cereal staples, and approximately 70% consumed pulses and flesh foods, but intake of fruits and vegetables remained comparatively low. Similar dietary patterns among pregnant women have been reported from Delhi, Karnataka, Ethiopia, and Pune (Lander *et al.*, 2019; Tilahun & Kebede, 2021; Gokhale & Rao, 2022; Deshpande *et al.*, 2024). Such dietary monotony predisposes pregnant women to deficiencies of iron, folate, calcium, vitamin A, and vitamin B12 despite apparently adequate food consumption. In a study by Lander *et al.* (2019), a high prevalence of micronutrient deficiency was reported among pregnant women in low- and middle-income countries, including India. Seasonal variation in availability and affordability of fruits and vegetables may also contribute to low dietary diversity (Hanley-Cook *et al.*, 2022).

In this study, women's nutritional knowledge was associated with dietary diversity. Pregnant women having adequate nutritional knowledge were significantly more likely to consume a diverse diet even after adjusting for other variables. Similar associations have been reported from studies conducted in Nepal, Addis Ababa, and Uttar Pradesh (Nguyen *et al.*, 2019; Shrestha *et al.*, 2021; Kebede *et al.*, 2022). Nevertheless, only a small proportion of women in the present study demonstrated adequate nutritional knowledge, indicating ineffective antenatal nutritional counseling.

Our study also reported an association between husbands' educational status and dietary diversity. Women whose husbands had secondary or higher education were more likely to consume a diverse diet. Male education may influence dietary practices through improved household income, greater awareness of maternal nutrition, and enhanced support for healthcare utilization and healthy food purchasing decisions. This finding also highlights that maternal nutrition is shaped by household-level determinants rather than individual behavior alone. There is a potential value of targeting couples during antenatal nutritional counseling instead of women-only counseling. Food taboos during pregnancy were common among study participants; particularly, avoidance of papaya and pineapple was reported due to perceived harmful effects on the fetus. Similar food taboos have also been mentioned in studies from West Bengal and South India (Chakrabarti & Chakrabarti, 2019; Placek & Hagen, 2015). Such culturally held beliefs may further reduce dietary diversity by limiting consumption of nutrient-rich fruits and vegetables during pregnancy. Since food taboos are often reinforced by family members and community traditions, community-based

counseling and nutrition education for families may be more effective in addressing these practices (Iradukunda, 2020).

Evidence increasingly supports the use of multiple micronutrient supplementation during pregnancy instead of iron-folic acid supplementation alone, particularly in populations with low dietary diversity (Parisi *et al.*, 2019; Keats *et al.,* 2019). However, supplementation should complement rather than replace efforts to improve dietary quality through behavioral counseling, improved food access, and diversified dietary practices before and during pregnancy.

The present study has certain limitations. We assessed dietary diversity using a single 24-hour dietary recall, which may not reflect habitual intake and is susceptible to recall bias. The cross-sectional design limits causal inference. The generalizability of the study is limited, as we conducted this study at a single tertiary care government hospital predominantly serving urban populations. Objective correlates of dietary diversity, like anthropometric and biochemical indicators, were not assessed. Despite these limitations, the study contributes important evidence about nutritional practices among pregnant women in Eastern India, where such data is scanty.

## 5. Conclusion

In the present study, dietary diversity among pregnant women was 42.6%, which is low compared to studies conducted in other parts of India. However, the dietary pattern of cereal and pulses with low consumption of fruits and vegetables is in agreement with available literature. Dietary diversity was likely to be higher for women with adequate nutritional knowledge and higher education for husbands.

Ideally, nutritional interventions should be started from the preconception period. Supportive supervision is necessary to ensure the quality of nutritional counseling during the pre-conception and antenatal periods. The modulating effect of husbands' education on dietary diversity indicates that male participation during nutrition **counseling** can improve outcomes. Besides promoting a diverse diet, multiple micronutrient supplementation should also be considered during pregnancy.

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## Authorship Contribution

**Mousumi Datta:** Conceptualization, Methodology, Experimentation, Investigation, Visualization, Validation, Formal Analysis, Project Administration, Resources, and Writing – Review & Editing; **Manisha Das:** Methodology, Software, Data Curation, Experimentation, Visualization, Validation, Formal Analysis, Writing – Original Draft, and Writing – Review & Editing; **Archita Bhattacharya**: Conceptualization, Software, Data Curation, Investigation, Visualization, Validation, Formal Analysis, Project Administration, Resources, Writing – Original Draft, and Writing – Review & Editing; **Srayashi Debbarma:** Methodology, Software, Data Curation, Investigation, Validation, Formal Analysis, Resources, Writing – Original Draft, and Writing – Review & Editing; **Sourav Kumar Ghosh:** Methodology, Software, Data Curation, Experimentation, Validation, Formal Analysis, Resources, and Writing – Original Draft; **Ajila A S:** Methodology, Software, Data Curation, Experimentation, Validation, Resources, Writing – Original Draft, and Writing – Review & Editing; **Kabita Kumari:** Methodology, Data Curation, Experimentation, Validation, Formal Analysis, Project Administration, Resources, and Writing – Original Draft.

## Ethical Approval

Ethical approval for the study was obtained from the Institutional Ethics Committee. The approval was granted vide Memo No. RKC/806 dated 29/05/2023.

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## Declarations

The authors declare that the manuscript is original, has not been published previously, and is not under consideration for publication elsewhere. All sources of information used in this study have been appropriately acknowledged and cited.

## Data Availability Statement

Authors declare that the data supporting the conclusions of this study can be obtained upon request from the corresponding author, (A Bhattacharya). The data is not publicly accessible due to information that may compromise the privacy of research participants.

## Human and Animal Rights

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee.

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## Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

## AI Disclosure Statement

The author(s) confirm that no AI-assisted tools or technologies were used in the preparation of this manuscript.

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