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Research article

Determinants of minimum dietary diversity of lactating mothers in rural northern region of Bangladesh: A community-based cross-sectional study

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ABSTRACT

Background: Breastfeeding requires additional diversified foods for the nutritional requirements of mothers and children, especially in preventing micronutrient deficiencies. The minimum dietary diversity for women (MDD-W) is a proxy indicator of micronutrient adequacy for women.
Objectives: This study aimed to identify the determinants associated with MDD in lactating women.
Methods: A community-based cross-sectional study was conducted among lactating mothers having at least one live birth in last three years from two districts of Bangladesh between 31st May 2021 and 9th June 2021. Dietary and socio-demographic information was obtained using a single 24-h recall and socio-economic status questionnaires. MDD was defined as at least four food groups consumed in the last 24 hours. In binary logistic regression, adjusted models were used to assess the relationship between MDD and socio-economic factors.
Results: The mean Dietary Diversity Score (DDS) was 3.9 ± 1.2. The MDD was met by 29.7% of women. Respondent's ages 20–24 years [Adjusted Odds Ratio (AOR) = 0.5; 95% CI: 0.3–0.9], 25–34 years [AOR = 0.5; 95% CI: 0.3–0.8], and 35–49 years [AOR = 0.5; 95% CI: 0.2–0.9], husband's academic qualifications more than 12 years [AOR = 1.9; 95% CI: 1.0–3.7], family income more than 15000 BDT per month [AOR = 2.3; 95% CI: 1.2–4.3], and husband's profession as a day labor [AOR = 0.5; 95% CI: 0.3–0.7] were significant factors to have MDD.
Conclusions: DDS and MDD were very poor among the mothers, whereas women's age, husband's education, and the family's monthly income were independent determinants of MDD. Special interventions may be needed to improve MDD.

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1. Introduction

Mothers' quality of diet and lifestyle choices significantly impact the nutritional status and other health consequences on their post-partum period and children [1]. During lactation, women need more diversified diets than everyday life for their physiological and nutritional issues [2–4]. Diversified food and diet quality positively affect their nutritional status, recovery from pregnancy, increased breast milk production, and retention of balanced nutrition [1]. According to the Food and Agriculture Organization (FAO), minimum dietary diversity for women (MDD-W) is achieved when at least five out of ten specific food groups are consumed during the previous 24 h (day and night) preceding the survey day [5,6]. MDD-W is a dichotomous indicator for women of reproductive age (WRA) and is increasingly used as a proxy indicator for higher micronutrient adequacy, diet, nutritional quality, and household food security [7–9].

Malnutrition is a double burden for lactating mothers since it jeopardizes their newborn's nutritional status, delays neonatal physical growth and motor development, decreases IQ, harms children's health, and reduces the quality of life for mothers in the post-partum period [10,11]. It also increases the risk of infection, anemia, visual impairment, and goiter [12] and has adverse long-term effects on the mother [13]. Monotonous food practices result in micronutrient deficiencies and food insecurity [9]. Furthermore, inadequate maternal food intake, particularly a lack of essential nutrients, has been detrimental to the mother's and children's health [14]. In rural areas, women's household livelihood activities, agricultural production, market connections, and purchasing power allow for a minimum level of dietary diversity and the prevention of child malnutrition like stunting [15,16]. In addition, lactating mothers require additional nutrition, which nearly doubles their micronutrients requirements to promote breast milk production and its nutrients [17]. Therefore, a varied diet is necessary to enhance nutritional value and reduce the likelihood of mother and infant mortality and morbidity [18].

In developing and low-income countries, a lack of food diversity is the leading cause of malnutrition since the eating habits of impoverished people constitute the biggest obstacle [2,19,20]. Most consumed foods are cereals and starchy foods among lactating mothers, mainly in low and middle-income countries, making the mothers vulnerable to malnutrition due to a less diversified monotonous diet [21–23]. Bangladesh is a developing country with the lowest per capita energy availability in South Asia [24]. In comparison, only 46% of Bangladeshi women of reproductive age have access to adequate, diverse foods, according to the State of Food Security and Nutrition in Bangladesh 2018-19 Draft [25]. South Asian women are at high risk of food access and availability due to economic and socio-cultural barriers [26,27]. Furthermore, they neglect to eat the necessary quantity and variety of foods since they focus more on their husband's and children's diets [28]. A Bangladeshi study showed that women regularly take the latest and lowest meals [29]. Women from poor socio-economic conditions are more vulnerable to inadequate nutrients as they often eat poor-quality, monotonous diets [30]. In several studies, dietary diversity scores (DDS) were poor among women of reproductive ages [16,31,32]. Less than half of the participants met minimum dietary diversity in many types of research [16,31–33].

Even though numerous studies have been done to identify the elements that contribute to household food security [34], there is little data on what influences lactating women's dietary diversity in Bangladesh. This study sought to identify the factors influencing lactating women's minimum dietary diversity in a rural environment in Bangladesh's northern region.

2. Materials and methods

2.1. Study design, setting, and participants

In this community-based cross-sectional study, women who had at least one live delivery in the previous three years served as the participants. Three sub-districts of the Rangpur and Nilphamari districts data were gathered. Gangachara, located in the Rangpur district, and Jaldhaka and Dimla, situated in the Nilphamari district, were the sub-districts. The study area was chosen using a variety of convenience sampling techniques. The authors initially selected the districts using convenience sampling. The sub-districts were then selected using convenience sampling as well.

2.2. Survey questionnaire

A self-administered semi-structured questionnaire was formulated using the Kobo toolbox (a platform used for online and offline data collection). A 24-hour recall method was used to gather information on dietary habits, and the ten food groups recommended by the FAO were formatted using regional Bangladeshi names for the foods [5,35]. The questionnaire was translated into Bengali from the original English questionnaire by a bilingual researcher and transferred back into English by another bilingual researcher to check for consistency and prevent bias [36]. The index of Item Objective Congruence (IOC) and Cronbach's Alpha was conducted to validate the questionnaire [37]. Every question on the survey had an index of IOC value more than 0.75, which is regarded as the minimum threshold for item acceptance [38]. A pilot test with 40 mothers was conducted at first, and changes were made as a result. The reliability of the questionnaire was confirmed by the pilot test's strong internal consistency (Cronbach's Alpha, 0.83) [39]. It was divided into three parts in which, from the first section, personal consent to participate from respondents was collected. The other two parts were as follows: (2) Socio-demographic data (8 questions) - age of respondent, educational qualification of the respondent, educational qualification of the husband of the respondent, monthly household income of the family, is respondent involved in any income-generating activities, occupation of the husband, religion, household size; (3) dietary habits over the last 24 h (1 question)- did you consume the following foods over the previous 24 h; (food groups: grains, white roots and tubers, and plantains; pulses (beans, peas, and lentils); nuts and seeds; milk and milk products; meat, poultry, and fish; egg; dark green leafy vegetables; other vitamin-A rich fruits and vegetables; other vegetables; other fruits).

2.3. Sampling procedure, sample size, and data collection procedure

Figure 1 depicts the method used to choose study participants for this study. This study's sample size was calculated using the formula: $n = Z^2pq/d^2$. Here, n is the sample size. Considering the confidence interval at 95% ($Z = 1.96$), population proportion at 50% ($p = 0.5$), and margin of error at 3% ($d = 0.03\%$); the calculated sample size was 1067. The sample size was calculated with OpenEpi (Open Source Epidemiologic Statistics for Public Health) [40]. The location of the lactation women was collected from a reputed national non-government organization working in the study area. A total of 6651 mothers were found in the study area. Among them, data collectors went to 2320 lactating women's homes to collect data. 337 moms declined to take part in the study, 479 women were preoccupied with housework while the data was being collected, and 309 mothers were relocated permanently. Finally, a total of 1195 women responded to our study, of which 643 were from, Nilphamari and 552 were from the Rangpur district. Data were collected from May 31, 2021 and June 9, 2021 through the home visit of each lactating woman by trained data collectors (research members) via face-to-face interviews with the lactating women by convenient sampling technique and monitored by two supervisors (senior research team members) daily for the consistency of the quality of data. The inclusion criteria were (a) lactating women who had at least one live birth in three years, (b) lactating women who have physical wellness to attend the interview (c) lactating women who provided consent. The exclusion criteria were (a) Lactating women who had dietary restrictions, (b) lactating women who were unwilling to provide consent.

2.4. Operational definition

Dietary Diversity: The Minimum Dietary Diversity (MDD) for lactating women was measured by using 24 h dietary recall following the guidelines on minimum dietary diversity for women (MDD-W) developed by FAO and FANTA Project and defined elsewhere [6, 41]. Each of the ten food groups received a score of 1 if the respondent checked the box and 0 if they didn't. The overall Dietary Diversity Score (DDS) for each respondent could range from 0 to 10. According to FAO guidelines, respondents with a DDS of $\geq$5 were considered to achieve the MDD. The MDD also uses micronutrient adequacy to define one significant aspect of the quality of women's diets in national and subnational evaluations [5].

2.5. Statistical analysis

With Stata 12.0, the entire statistical analysis was completed. To ascertain the frequency and percentage of the variables, descriptive analysis was used. MDD, eating at least five food groups within the previous 24 h was the outcome variable for the multivariate logistic regression analysis. A Chi-Square test was also carried out between socio-demographic variables and the outcome variable. An entry method of binary logistic regression was conducted to determine the association between independent and outcome variables. The cut-off of the *p*-value was set at $p < 0.250$ in the Chi-square test to select independent variables for adjusting in binary

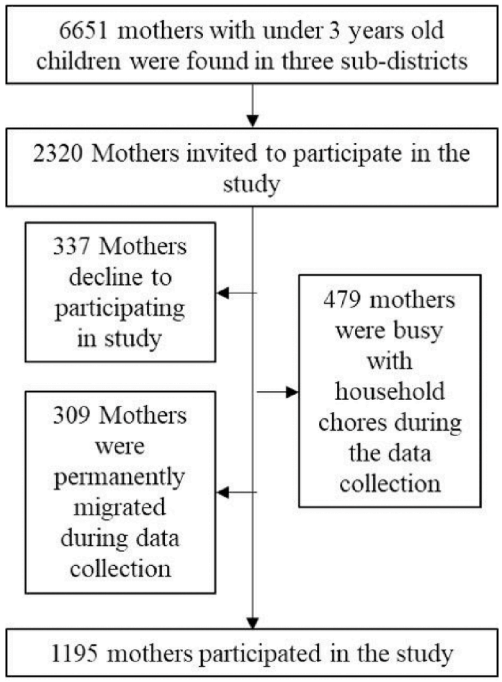

Figure 1. Study participant selection procedure.

logistic regression. The statistical significance level was set at 5% for binary logistic regression. We have tested Hosmer-Lemeshow goodness-of-fit test, which showed that the regression model is a good fit.

2.6. Ethical approval

The Institutional Ethical Committee of the Patuakhali Science and Technology University approved this study, which was carried out under the principles of the Declaration of Helsinki. Reference number for ethical approval: PSTU/IEC/2021/14.

2.7. Informed consent statement

Informed consent was taken from the respondents. Initially, in the survey, participants were asked whether they agreed or disagreed with participation. All respondents have been informed that all information will only be used for academic purposes. Besides, the purpose and assurance of confidentiality of data collection were given to the respondents at the beginning of the survey. The respondent's informed consent statement was as follows: I do hereby, after reading and hearing the research objectives and am participating in the survey share my information by answering the questionnaire consciously and willingly". All women participating in this study agreed to the aforementioned informed consent statement.

3. Results

3.1. Socio-demographic results and distribution of MDD against them

Table 1 below displays the socio-demographic information about the respondents who were the study's topic as well as the

Table 1
Association between Minimum Dietary Diversity (MDD) with socio-demographic characteristics (n = 1195).

Variables Name	Frequency (n)	Percentage (%)	Minimum Dietary Diversity (MDD)		Chi-square (χ^2)	p-value
			Yes	No		
Age (Mean ± SD[c])	26.5 ± 5.9					
Below 20	89	7.5	37 (41.6)	52 (58.4)	9.3069	0.025
20–24	362	30.3	113 (31.2)	249 (68.8)		
25–34	585	49.0	161 (27.5)	424 (72.5)		
Above 35	159	13.3	40 (25.2)	119 (74.8)		
Years of education of the respondent						
No education	293	24.5	70 (23.9)	223 (76.1)	42.328	0.000
≤5 years	537	44.9	134 (25)	403 (75.1)		
≤10 years	269	22.5	95 (35.3)	174 (64.7)		
>10 years	96	8.0	52 (54.2)	44 (45.8)		
Years of education of the husband						
No education	444	37.2	102 (23)	342 (77)	69.1358	0.000
≤5 years	457	38.2	117 (25.6)	340 (74.4)		
≤10 years	164	13.7	55 (33.5)	109 (66.5)		
>10 years	130	10.9	77 (59.2)	53 (40.8)		
Monthly Household income in BDT[a]						
<5000	262	21.9	57 (21.8)	205 (78.2)	87.6564	0.000
5000–10,000	663	55.5	156 (23.5)	507 (76.5)		
10,001–15,000	178	14.9	81 (45.5)	97 (54.5)		
>15,000	92	7.7	57 (62)	35 (38)		
Women currently working						
No	947	79.3	247 (26.08)	700 (73.92)	23.8095	0.000
Yes	248	20.8	104 (41.94)	144 (58.06)		
Occupation of the husband						
Agriculture	231	19.3	73 (31.6)	158 (68.4)	92.1033	0.000
Day Labor	602	50.4	110 (18.3)	492 (81.7)		
Driver	66	5.5	24 (36.4)	42 (63.6)		
Service Holder	111	9.3	55 (49.6)	56 (50.5)		
Business	141	11.8	65 (46.1)	76 (53.9)		
Other[b]	44	3.7	24 (54.6)	20 (45.5)		
Religion						
Islam	1129	94.5	326 (28.9)	803 (71.1)	2.4367	0.119
Hinduism	66	5.5	25 (37.9)	41 (62.1)		
Household Size						
<5	555	46.4	156 (28.1)	399 (71.9)	0.7985	0.372
≥5	640	53.6	195 (30.5)	445 (69.5)		

BDT[a] = Bangladeshi Taka; 10000 BDT = 118 USD.
Other[b] = Dead, overseas.
SD[c] = Standard Deviation.

distribution of MDD against them. Age was 26.5 (±5.9) on average. Between the ages of 25 and 34 made up the majority of the population (48.9%), followed by the 20 to 24 age group (30.2%). Less than 10% of the population was between the ages of 15 and 19. The proportion of those under 20 who had MDD (41.6%) was higher than that of people in the age groups of 20–24 years old, 25–34 years old, and over 35 years old (31.2, 27.5, and 25.2%, respectively). Nearly half of the respondents (44.9%) had only five years of schooling, and a substantially higher percentage of the population had no formal education. Fewer people continued to attend after ten years. Regarding the respondent's husband's educational background, illiteracy rates ranged from 37.2% to 38.2%, with five years of education being the next highest. As the number of school years increased, higher rates of meeting MDD were observed. It was 54.2% for those who had completed more than ten years of education, followed by those who had completed fewer than ten years (35.3%), and it was nearly equal for women who had completed at least five years of education but fewer than nine years (25%) and those who had never completed any education (23.9%). This trend matched the educational backgrounds of the respondent's husband. More than half of family (55.5%) had a monthly income between 5000 and 10000 Bangladeshi Taka (BDT), whereas below 10% have more than 15000 BDT per month. Women from the wealthiest families (those with monthly incomes over 15000 BDT) had more excellent rates of MDD (62%) than those from other economic groups, who were followed by those with households earning between 10,000 and 15,000 BDT (45.5%) each month. Nearly a quarter of each of the remaining two groups had MDD. Furthermore, just 9.2% of the husbands were service providers, 19.3% of them were farmers, and 50% of them worked as day laborers. The majority of the ladies (94.4%) came from Muslim backgrounds. Most families (53.5%) had five or more members.

3.2. Individual food group consumption

Figure 2 displays the proportions of each food group that participants consumed during the course of the past 24 h. Staple or cereal foods made up the majority of the participant's diets (94.7%), followed by meat, fish, and poultry (64.6%), and pulses (62.5%). However, compared to only 16.4% who consumed other fruits, a much higher percentage of respondents (41.1%) ingested other fruits and vegetables high in vitamin A. Milk production and consumption were both in short supply (18.1%). Consumption of leafy green vegetables was also lower (21.5%) among moms. Nearly a third of the nursing mothers consumed eggs and other veggies.

3.3. Frequency of consumed food groups

The study population's daily consumption of various food groups is depicted in Figure 3 for the research population. Four food groups were ingested by the majority of people (35%), then five or more food groups (29.4%). Another quarter (24.5%) consumed food from all three food groups. The mothers' consumption of only one or two food groups was much lower.

3.4. Dietary diversity

The FAO states that for women to be considered to have a minimal amount of dietary diversity, which is commonly phrased as Minimum Dietary Diversity for Women, they must consume at least five of the 10 food groups (MDD-W) [5,6]. Figure 4 demonstrates

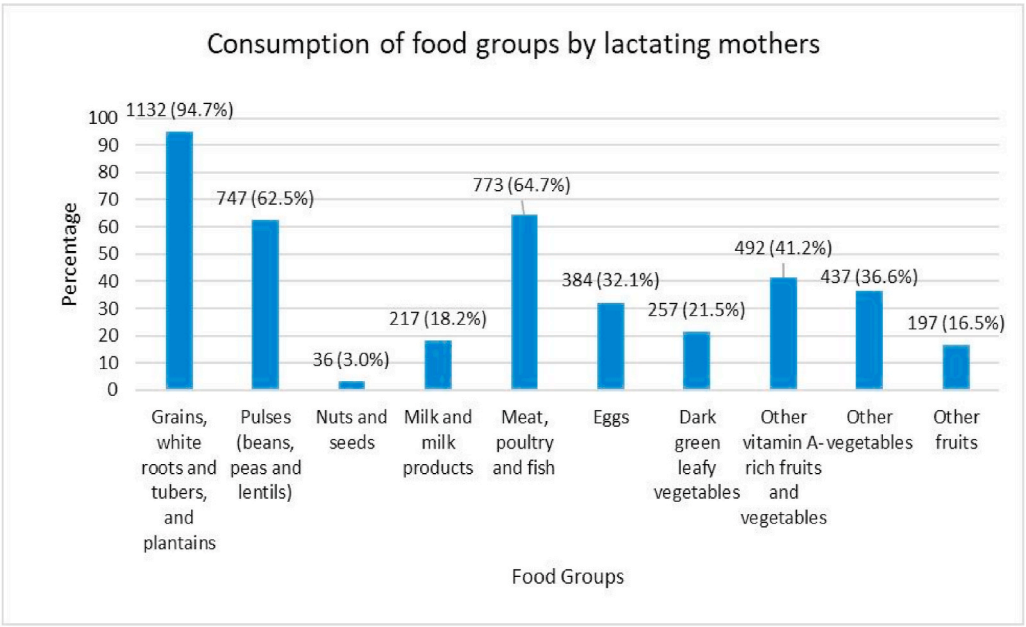

Figure 2. Percentages of lactating mother's 24-h consumption of various dietary groupings.

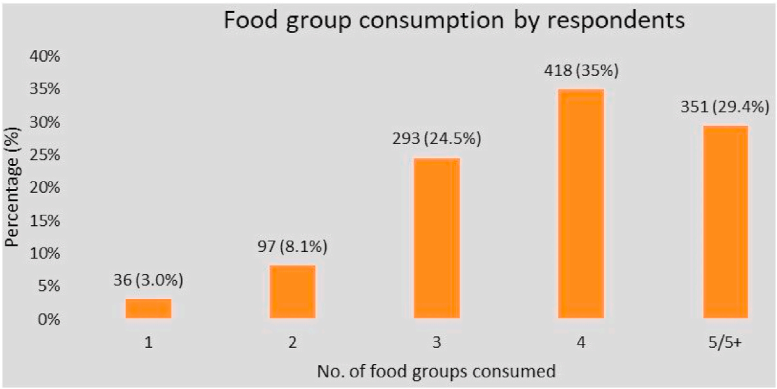

Figure 3. Number of food groups consumed by respondents over the last 24 h.

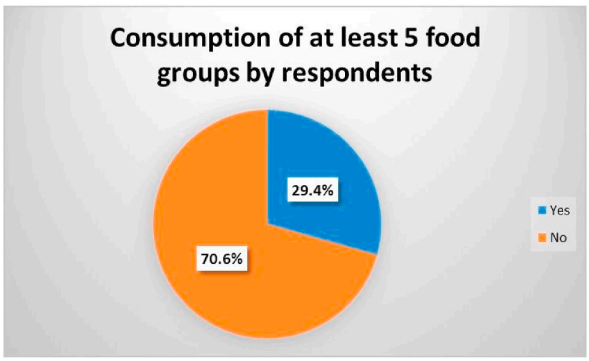

Figure 4. Percentage of those polled who ingested at least five different food groups in the previous day.

that over seventy percent of the mothers in the study lacked access to the bare minimum of a diverse diet. Dietary diversity has a mean score of 3.9 (±1.2), with 1 and 8 being the lower and higher values, respectively.

3.5. Association between factors and minimum dietary diversity

The risk factors for lactating mother's MDD are listed in Table 2. This shows that the nutritional variety of mothers decreased as their ages increased. The odds of MDD were 0.5 times lower in women aged 20 to 24 than in other age groups [Adjusted Odd Ratio (AOR) = 0.5; 95% CI: 0.3 to 0.9]. Similar to that, as compared to their reference group, the probabilities of developing MDD were 0.5 times lower for both age groups of 25–34 years (AOR = 0.5; 95% CI: 0.3–0.8) and 35 years and older [AOR = 0.5; 95% CI: 0.2–0.9]. Table 2 also showed a strong correlation with the husband's educational background. Compared to illiterate husbands, the odds were 1.9 times higher for those with more than ten years of schooling [AOR = 1.9; 95% CI: 1.0–3.7]. Results from our study also show a correlation between MDD and a higher monthly family income. Compared to other families, those with more than 15000 BDT every month had odds of 2.3 times higher [AOR = 2.3; 95% CI: 1.2–4.3]. However, the husband's job as a day laborer negatively correlated with MDD. Women working as day laborers had 0.5 lower odds of developing MDD than those working in agriculture [AOR = 0.5; 95% CI: 0.3–0.7].

4. Discussion

This study looked into the factors affecting minimal dietary diversity of lactating women, and as per our knowledge this study is the first approach in identifying the causes of MDD among rural Bangladeshi breastfeeding women. According to this study, MDD was substantially correlated with respondent's ages, the husband's educational level, the family's monthly income, and occupations. However, there is no significant connection between respondent's employment status and years of education.

Overall, a substantially lower mean dietary diversity score of 3.9 (SD ± 1.2) was obtained. Several studies of Bangladesh (mean DDS 4.28), Nepal (DDS 3·9 ± 1·0) and Pakistan (mean food group diversity score 4 ± 1) helped to support the DDS score of our study [23,42,43]. Furthermore, this result was consistent with other investigations [16,31,32], whereas other studies show higher DDS [18, 44,45]. DDS score fluctuated due to women's monotonous eating patterns during their reproductive years [46,47]. Cereals and other starchy foods were the most popular among the respondents. Almost 95% of the study participants eat cereals, grains, tubers, or other

Table 2
Factors associated with the minimum dietary diversity (5/5+ food groups).

Variables	Unadjusted Model			Adjusted Model[a]		
	OR[d]	95% CI	P Value	OR	95% CI[e]	P Value
Age (in years)						
<20	Ref			Ref		
20–24	.6	0.3, 1.0	0.064	**.5**	0.3, 0.9	**0.025**
25–34	.5	0.3, 0.8	0.007	**.5**	0.3, 0.8	**0.007**
> 35	.4	**0.2, 0.8**	0.008	**.5**	0.2, 0.9	**0.040**
Year of education of the respondent						
No education	Ref			Ref		
≤5 years	1.0	0.7, 1.4	0.734	.8	0.5, 1.2	0.335
≤10 years	1.7	1.2, 2.5	0.003	.8	0.5, 1.3	0.482
>10 years	3.7	2.3, 6.1	0.000	1.0	0.5, 2.1	0.818
Year of education the husband						
No education	Ref			Ref		
≤5 years	1.1	0.8, 1.5	0.358	1.1	0.7, 1.6	0.491
≤10 years	1.6	1.1, 2.5	0.009	1.1	0.7, 1.9	0.517
>10 years	4.8	3.2, 7.3	0.000	1.9	1.0, 3.7	**0.040**
Monthly HH income (BDT[b])						
<5000	Ref			Ref		
5000–10,000	1.1	0.7, 1.5	0.564	.9	0.6, 1.3	0.684
10,001–15,000	3.0	1.9, 4.5	0.000	1.8	1.1, 2.9	0.684
>15,000	5.8	3.5, 9.7	0.000	2.3	1.2, 4.3	**0.010**
Women currently working						
Yes	Ref			Ref		
No	2.0	1.5, 2.7	2.04	1.2	0.9, 1.7	0.158
Occupation of the husband						
Agriculture	Ref			Ref		
Day Labor	.4	0.3, .6	0.000	.5	0.3, 0.7	**0.001**
Driver	1.2	0.7, 2.1	0.467	.9	0.5, 1.7	0.856
Service	2.1	1.3, 3.3	0.001	1.0	0.5, 1.8	0.962
Business	1.8	1.2, 2.8	0.005	1.2	0.7, 2.0	0.328
Other c	2.6	1.3, 5.0	0.004	2.1	1.0, 4.2	0.328

Hosmer-Lemeshow Chi-Square[a] = 7.9, $p = 0.440$.
BDT[b] = Bangladeshi Taka; 10000 BDT = 118 USD.
Others[c] = Dead, overseas.
OR[d] = Odds Ratio.
CI[e] = Confidence Interval.

starchy foods. This result was consistent with several prior studies conducted among WRA and in different African countries [16, 31–33]. About 29.3% of the surveyed women of this study met the MDD. Several studies found similar results to our findings [16,33, 48] while some studies from African countries showed higher rates of participants who met MDD [45,49,50]. Many women end up eating less fruits because they run the danger of eating a smaller range of foods because they have to sacrifice their meals for their partners and children when there is food instability in the home [18]. Numerous investigations have discovered MDD, which is ensured by the family's food security [16,31–33]. Research shows that enhanced meal frequency increases dietary diversity [49–51]. Another study found that women from rural areas have lower MDD [33]. Additionally, several studies have demonstrated a beneficial relationship between MDD-W and increased ANC visits (Antenatal Care) [44]. Furthermore, the impact on the accessibility of family purchasing by women increases the possibility of having MDD [48,52]. We suggest implementing adequate nutrition-sensitive and nutrition-specific interventions to promote MDD among lactating women, especially in rural settings. We may suggest implementing programs including improving maternal nutrition knowledge and 'husband's nutritional knowledge as these were found effective in improving dietary diversity among women of reproductive ages [53,54]. Another intervention, homestead gardening, which has been found to improve dietary diversity and household food security, would be exceptionally effective [52,55,56].

Although there was a significant correlation between lactating women's educational background and MDD-W in the logistic regression test's unadjusted model, we could not detect this link when adjusted [57,58]. However, previous research shows that odds are significantly higher among educated mothers than those not formal schooling [31–33,48]. More studies may be needed to identify the causes behind this output. A study from Belgium indicated that educational background and nutritional knowledge have independent associations among young and middle-aged women [59]. However, nutritional knowledge is a prerequisite for having MDD [33,52,60]. Awareness should be raised about nutritional knowledge and its importance.

This study revealed that the husband's educational level of more than ten years was positively associated with MDD. A study from Ethiopia found no relationship between these two variables [61]. This might be due to the fact that spouses with higher education levels have a better understanding of nutrition, which in turn affects mothers' habits, attitudes, and knowledge. The spouse makes decisions for the family in the Bangladeshi culture, which may greatly impact the family members' dietary preferences. Our study shows that MDD-W was positively associated with higher family income. This tendency was also found in other studies in rural Mali [16] and Nepal [7]. Other studies also showed that higher income has a higher chance of MDD-W [45,48,62]. Another finding from

Ethiopia revealed that lactating mothers from wealthy families were more likely to have minimum dietary diversity [52]. The family's medium and higher wealth indices have higher MDD-W [32,33,63].

Additionally, we discovered that women with daily-working spouses were less likely to develop MDD than those with farmers. This may be because day laborers, whose jobs are not often permanent, can afford less diverse food options for their families. We did not, however, discover any correlation with husband's other employment. We can recommend more targeted studies to look into the relationship between lactating women's MDD and their husbands' occupations.

5. Conclusions

Starch was the most popular food, followed by meat, fish, poultry, and pulses. While the overall DDS scores were low, the survey respondent's rates of MDD were lower. The age of the mother and their husband's occupation (day labor) revealed a poor correlation with MDD. On the other hand, a statistically significant positive link between MDD and higher family income and spouse education was found.

5.1. Strengths, limitations, and further scopes

One of the advantages of this study is that it was conducted with a bigger sample size. In contrast to 7-day food frequency questionnaires, we adopted the 24-h dietary recall approach, which may reduce recall biases. One of the limitations of our study is that we have only conducted one 24-h recall method that is not representative of women's dietary diversity throughout a year. To determine the women's actual dietary habits, we could advise undertaking extensive and numerous days of recall while taking into account distinct seasons. Moreover, this study is a community-based cross-sectional study that cannot conclude any causal relationship between the factors studied. Furthermore, our study population was selected from a rural area in the northern region. So, the results cannot reflect the dietary behavior of other parts, especially for urban women. We also did not count other socio-economic factors, including the age of the children, the duration of breastfeeding, the amount of diet eaten by women, women's living place, whether it was father's house or husband's, presence of mother-in-law, nutritional knowledge, food security of the household, meal frequency, decision making capability by respondents, home gardening by women, having livestock, household head, antenatal care visits, illness of respondents, lifestyle practices, situations, health (incl. diabetes), social equity, indigenous, birthing, transgender, level of awareness on danger signs and support from the husband, which may affect our results. Seasonal foods, including fruits and vegetables, are significant factors in changes in dietary diversity [64]. So, we strongly recommend conducting studies regarding all seasons. Market access by women was not also included in this study. However, this study would be helpful for future studies to identify the determinants of MDD in other regions or other contexts.

This study finds the factors that circulated the MDD and DDS score among the studied participants. The results of this study would help design and implement successful interventions by government or non-government authorities by addressing the issues that regulate the MDD and DDS among women in rural entities.

Author contribution statement

Md Mahbubul Alam Shaun, Md Wahidur Rahman Nizum: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data, Wrote the paper.

Md Asaduzzaman Shuvo, Fahmida Fayeza, Md Omar Faruk, Md Fakrul Alam: Performed the experiments; Analyzed and interpreted the data.

Mohammad Delwer Hossain Hawlader: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Sujan Kanti Mali: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be available upon request from the corresponding author upon reasonable requests as we are not considering to make the raw data public.

Declaration of competing interest

The authors declare that they have no competing interests.

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