

Research article

Household dietary diversity highly associated with socioeconomic status and livestock rearing practices: a cross-sectional study

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ARTICLE INFO

Article history:

Received: 10/11/2024

Accepted: 02/04/2026

Keywords:

Rural households, dietary diversity, factors, livestock, Bangladesh

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ABSTRACT

Household dietary diversity (HDD) allied with nutrient adequacy and thus drawn significant attention. The previous investigations on determinants of HDD in Bangladesh are scarce and showed inconsistent results. The purpose of the study was to determine the prevalence and factors of HDD in Bangladeshi rural households. A community-based cross-sectional survey was conducted in selected areas in Bangladesh. A total of 307 participants interviewed through a questionnaire survey. The HDD score derived from a 24-h recall of food intake of 12 food group. The nonparametric tests and multiple logistic regression model applied to know the association between HDD and other covariates. The mean HDD score was 7.20 (SD 1.20). The prevalence of low, medium and high HDD scores was 2.6%, 32.6%, and 64.8% respectively. Family income, nutritional knowledge, and maternal BMI were associated with HDD. People with lower income (OR: 0.24; CI: 0.141, 0.412) and less nutrition awareness (OR: 0.08; CI: 0.016, 0.343) had lower HDD scores. The HDD score was lower (OR: 0.54; CI: 0.193, 0.504) in underweight and higher (OR: 3.81; CI: 1.370, 10.576) in obese people than normal-weight people. HDD is still overlooked but a public health problem in Bangladesh. This study identified some key socioeconomic factors of HDD. More attention may be given on maternal nutritional knowledge targeting the low-income households to improve the HDD in the study area.

To cite this paper: M. R. Begum, I. Hasan, M. Ismail, Nazmunnaher, M. S. I. Khan, M. Marma, A. Rahman and S. N. Khanom, 2025. Household dietary diversity highly associated with socioeconomic status and livestock rearing practices: a cross-sectional study. *Bangladesh Journal of Veterinary and Animal Sciences*, 12(2): 28-38.

1. INTRODUCTION

Food is essential to human life because it gives us the energy to move about and create new

cells. A healthy diet shields the body from disease, infection, and weakness. Food is essential to human survival and has a good impact on the development of human resources.

Both national and individual nutrition guidelines should be taken into account (Firdaus and Cahyono, 2017). A well-known measure of food and nutrition security that captures the variety of foods ingested by people and households is dietary diversity (Fonger et al., 2019). Dietary diversity scores at the household level are seen as a measure of food security. Conversely, because the dietary diversity scores are associated with nutrition status and micronutrient consumption, they can be used as stand-ins for dietary quality and nutrition at the individual level (Fonger et al., 2019; Headey and Ecker, 2013).

Grain or tuber-based diet with inadequate animal products, fruits, and vegetables challenge the dietary diversity and diet quality in developing world (Mekuria et al., 2017). Research showed that dietary diversity, the number of unique foods or food groups consumed over a given period, impacted on nutrient adequacy and psycho-physical health (Hatloy et al., 2000; Daniels, 2009; Arimond and Ruel, 2002). More food groups in diet meet the maximum requirements of daily nutrition (Labadarios et al., 2011). Former studies prove that age, residency, family type, occupation and production of diversified farm products have impact on HDD (Mukherjee et al., 2018; Jones et al., 2014; Torheim et al., 2004). Furthermore, the higher HDD associated with financial status and household food security (HFS) (Huluka and Wondimagegnhu, 2019; Torheim et al., 2004). Animal origin food intake is one of the main indicators to assess dietary quality in low and middle-income countries (Allen, 2003; Neumann et al., 2002).

Majority of previous studies highlight conflicting association of socio-demographic parameters and agricultural production diversity with household dietary diversity score (HDDS) (Kabir et al., 2022). But diversity livestock production with its diversity and knowledge on livestock product specially milk and egg are rarely evaluated as the indicators of HDDS in Bangladesh. Those could confound the results as animal source food has been considered as quality indicators of diet (Allen, 2003; Neumann et al., 2002). Market access, in addition, a significant confounding variable, critically

enable smallholder farmers to sell a portion of their harvested crops and proceed to acquire more diverse food (Kabir et al., 2022).

Considering the above facts, with the inclusion of confounding factors like livestock rearing, knowledge on livestock food (milk and egg), and market access, evaluation of factors of HDD in the area would provide a clear picture. It was hypothesized that this detail analysis will give in depth inside of the HDD in rural areas. A better understanding of key determinants will help government agencies in the development and implementation of guidelines and practices that can positively impact food security and improve dietary diversity in the study areas and other similar settings. This study planned to investigate the household dietary diversity (HDD) status and its association with livestock rearing, nutritional knowledge and other associated factors in rural Bangladeshi homes.

2. MATERIALS AND METHODS

Study setting and population

A community-based cross-sectional study was conducted in Boalkhali, Chakaria, and Raipura Upazillas of Chattogram, Cox's Bazar, and Narsingdi districts, respectively in Bangladesh. The total population of 223,125, 474,465 and 535,796 in Boalkhali, Chakaria and Raipura upazila respectively (BBS, 2011). These locations were selected purposively for easier access to rural location from district headquarters.

Sample size and sampling procedure

The required sample size calculated with single proportion formula considering the minimum dietary diversity of 27% (Sheikh et al., 2020). The estimated sample size was 302, taking a 5% level of significance, Z value = 1.96, a power of 80%, and the margin of error of 5%. We have worked with taking our whole sample size 307. Two stage random sampling used to select the sample from the list of all households in the study areas.

Study variables

The dependent variable was the HDD score and the independent variables were socio-

demographic factors (maternal age, height, weight, parents education and occupation, maternal body mass index), household factors (family size and type, capable family person for income, family income, rearing of livestock,

expenditure, income from livestock and related products, microcredit loan and grants and basic knowledge related to different livestock products).

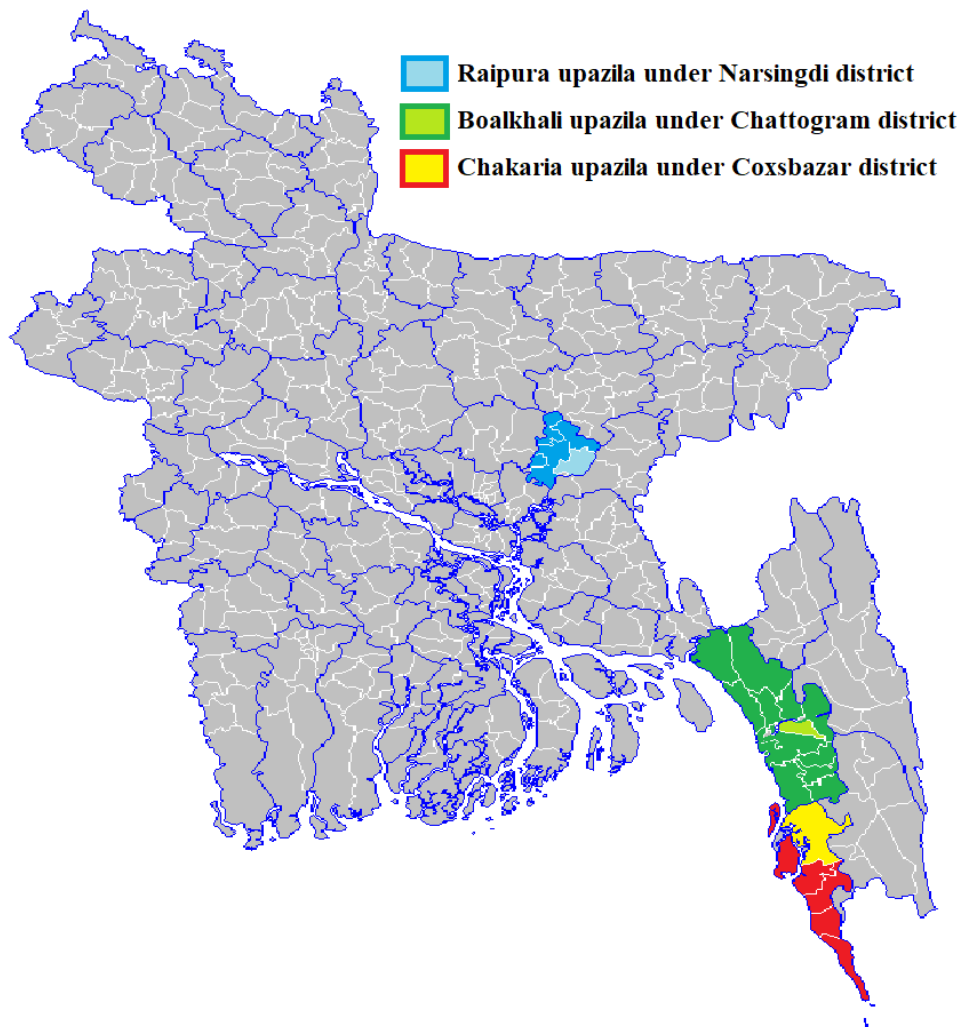


Fig. Map of Bangladesh highlighted the study area

Data collection procedure

The households selected when its' head interested to participate the survey. The investigator trained data collectors on questionnaire and variables and, data collection procedure and its ethical details. Those who aged bellow 18 years and not interested to participate were excluded from this study. Data were collected through face-to-face interview in the free time of the respondents. A semi structured questionnaire used to gather the information. HDDS is the number of food groups consumed by the households out of the

twelve food groups in previous 24 hours (FAO, 1970). A single tick optioned both for 'YES', if the food reference group consumed over the specific period and, "NO", if not consumed, in the respective boxes. Similar 1 value assigned for each YES and 0 for NO. HDD score ranged from 0 to 12. The HDD score was categorized into three based on score: low dietary diversity (LDD <3), medium dietary diversity (MDD = 4 to 6), and high dietary diversity (HDD ≥7) (Ahmed et al., 2019; Kundu et al., 2021). The score of the HDD showed right internal consistency with a Cronbach's alpha of 0.82.

Statistical analysis

Frequency, percentage, mean and standard deviation were performed. Prevalence of HDD and consuming foods from different food groups was explored. A bivariate distribution performed for HDDS across different socio-economic variables. Kruskal-Wallis test and Mann-Whitney test applied to discover the association between HDDS and categorical explanatory variables as HDDS was not found normally distributed. A multiple logistic regression model was applied to know the effect of different factors on HDDS. The Hosmer and Lemeshow goodness-of-fit test applied to select the final model and, the likelihood ratio test (LRT) used to evaluate the variables' significance. Multi-collinearity checked with the Variance inflation factor (VIF). Confidence intervals and odds ratios were used to report the relationship between the explanatory variables and HDD score. All statistical analyses were done using IBM SPSS 23.0 version, and p -value < 0.05 considered to report significant association.

Ethical considerations

This study was conducted in accordance with the ethical principle of the Helsinki declaration of 1964. First the purpose of the study was explained to the respondent and data were collected to those who were agreed to provide answer. The filled questionnaire was signed by the respondent.

3. RESULTS AND DISCUSSION

Descriptive analysis of different variables along with HDD

Summary statistics on socio-demographic, knowledge and other characteristics present in Tables 1 and 2. It was observed that average maternal age was 35.64 years (SD 11.39 years) and, 59.6% of mothers were over thirty. Paternal age was 42.68 years (SD 12.30 years) and about 45% of fathers were over forty. Near half (48%) of the fathers had secondary level education whereas 59.9% mothers secondary level educated. The average dietary diversity score of mothers' was 7.10 and 7.26 for age ≤ 30 and $>$

30 years respectively. A majority of mothers were housewives (92.2%), whereas one third (32.9%) of the fathers were day laborers followed by job holders (27.3%), and businessmen (24.2%). Almost half of the households (46%) monthly earned 150001-30000 BD taka. If we observe the family type, the majority of the families (82.1%) were nuclear. Over two-fifth (61.2%) of households reared livestock, 73.2% didn't took any microcredit loan and, majority (89.9%) had knowledge about energy gained by eggs and milk. Most of the mother's (64.6%) BMI was in the normal range. It was observed that the median of HDD score was significantly different from father's education, father's occupation, family income, family types, domestic animal rearing, knowledge about giving energy by eating eggs and milk, knowledge about eating eggs by adult people.

Different food group consumption by household

Table 3 represents the proportion of consumption of each food group by the respondent in the previous 24 hours. Diversity and amount of food intake are major indicators and recent concern regarding quality of diet, and energy and nutrient intake particularly developing countries like Bangladesh. This study reported over eighty percent of households consumed cereals, tubers, roots, and vegetables which was in line with previous investigations for cereals and vegetables (Kennedy et al., 2007; Ekesa et al., 2011; Drammeh et al., 2020; Kundu et al., 2021). Another research in rural Bangladesh indicated that participants consumed rice every 7 days in a week (Rahman et al., 2022). The higher percentage of cereals intake may be due to popularly consumption of staple food rice. It is a good sign to see the highest proportion (85%) of the respondents received vegetables. Because vegetables provide essential vitamins and micronutrients that may increase the food security status of the study population.

More than half of the respondents consumed eggs, almost three-fourths consumed fish, and other seafood, and about half of the

respondent's consumed meat, and poultry organs in the last 24 hours of the interview date.

Table 1. Mean HDD scores across different socioeconomic characteristics in rural areas of Bangladesh (N=307)

Determinants	N (%)	Mean DDS (SD)	P values (Kruskal-Wallis tests)	P values (Mann-Whitney test)
Maternal age				
≤ 30	124 (40.4)	7.10 (1.93)		0.491
>30	183 (59.6)	7.26 (2.04)		
Paternal age				
≤ 40	160 (52.12)	7.15 (1.89)		
> 40	137 (44.63)	7.38 (2.04)		
Paternal education				
No formal education	4(1.4)	4.75** (2.22)	0.000	
Primary	54(18.2)	6.88 (2.49)		
Secondary	142(48.0)	7.26 (1.89)		
Higher secondary and above	96(32.4)	7.40 (1.74)		
Maternal education				
No formal education	4 (1.3)	5.50 (3.0)	0.068	
Primary	52 (16.9)	5.72 (1.74)		
Secondary	184(59.9)	7.70 (1.90)		
Higher secondary and above	67 (28.8)	7.35 (1.78)		
Paternal occupation				
Job	79 (27.3)	7.38** (1.99)	0.000	
Business	70 (24.2)	7.36 (1.72)		
Foreigner	45(15.6)	8.27 (1.75)		
Day labor	95 (32.9)	6.59 (2.0)		
Maternal occupation				
Homemaker	283 9(92.2)	7.18 (1.99)		0.521
Job	24 (7.8)	7.38 (2.08)		
Monthly Family income				
≤15000	95 (30.9)	6.22** (1.97)	0.000	
15001-30000	141 (46.0)	7.13 (1.61)		
>30000	71 (23.1)			
Family member				
≤ 4	138(45.0)	7.44 (2.05)		0.087
> 4	169 (55.0)	6.99 (1.93)		
Family type				
Nuclear	252 (82.1)	7.10* (2.02)		0.024
Joint	55 (17.9)	7.65 (1.82)		

SD standard deviation, * Significant at p <0.05; **Significant at p<0.001 (Authors' field survey data from Boalkhali, Chakaria and Raipura upazila under Chattogram, Coxsbazar and Narsingdi district respectively.)

A similar report for egg investigated by Kundu et al. (2020) but well below by for fish (6.638 %) reported by Hossain (2019), although Rahman (2022) showed almost similar at 5 days/week. The higher fish intake in this study could be parts of study setting are in Chattogram and Cox’s Bazar, located near the Bay of Bengal, the major sea fish landing areas in Bangladesh. Households were low diversified in fruits, milk, and other dairy products compared to cereals and vegetables. Similar findings were found by the authors in Bangladesh, Vietnam, Ethiopia, and Tanzania (Nguyen et al., 2013; Kneuppel et al., 2010). Households rely heavily

on cereals rather than sufficient dietary groups such as animal source foods would suffer for low quality diet. Inadequate intake of fruits also implies that there may increase the risk of micronutrient deficiency. Almost half of the respondents ate meat and poultry; pulse, legumes and nuts; oils, fats and butter; and. Sugar and honey. All those groups reported lower, ranging from 25-38%, in a previous study in Bangladesh may be due to the study was undertaken during Covid-19 when people were confined and market flow of food items were interrupted (Kundu et al., 2020).

Table 2. Mean HDD scores across knowledge and other characteristics in rural areas of Bangladesh (N=307)

Determinants	N (%)	Mean DDS (SD)	P values (Mann-Whitney test)
Domestic animal rearing			
Yes	188 (61.2)	7.54** (2.05)	0.000
No	119(38.8)	6.65 (1.79)	
Microcredit loan taking			
Yes	51(26.8)	7.94 (2.05)	0.168
No	139 (73.2)	7.40 (2.02)	
Knowledge about energy by eating eggs & drinking milk			
Yes	276(89.9)	7.45** (1.89)	0.000
No	31 (10.1)	4.97 (1.52)	
Knowledge about eating eggs by adult people			
Yes	160 (52.1)	7.61** (1.71)	0.000
No	147 (47.9)	6.73 (2.17)	
Maternal BMI			
Underweight	22 (7.2)	7.82 (2.28)	0.329
Normal	197(64.6)	7.11 (1.95)	
Overweight	64 (21)	7.19 (2.09)	
Obese	22 (7.2)	7.68 (1.59)	

SD standard deviation, * Significant at p <0.05; **Significant at p<0.001 (Authors’ field survey data from Boalkhali, Chakaria and Raipuraupazila under Chattogram, Coxsbazar and Narsingdi district respectively.)

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Table 3. Food groups consumption by households

Food groups	Consumed		Not consumed	
	N	%	N	%
Cereals (FG1)	256	83.4	51	16.6
Tubers and roots (FG2)	255	83.1	52	16.9
Vegetables (FG3)	261	85.0	46	15.0
Fruits (FG4)	114	37.1	193	62.9
Meat, poultry organ (FG5)	153	49.8	153	49.8
Eggs (FG6)	180	58.6	126	41
Fish and other sea food (FG7)	216	70.4	90	29.3
Pulses, legumes and nuts (FG8)	150	48.9	157	51.1
Milk and other dairy products (FG9)	110	35.8	197	64.2
Oils, fat and butter (FG10)	142	46.3	165	53.7
Sugar and Honey (FG11)	153	49.8	154	50.2
Miscellaneous (FG12)	223	72.6	84	27.4

(Authors' field survey data from Boalkhali, Chakaria and Raipura upazila under Chattogram, Coxsbazar and Narsingdi district respectively.)

Prevalence of HDD score

Since the low DD score frequency was very low so, we have created HDD scores in two categories based on the mean (≤ 7.20 means inadequate DDS and > 7.20 means adequate DDS) (Kennedy et al., 2011). The mean HDD score was 7.20 (SD 1.20). This score was higher (9.7) in China, Indonesia (9.1) and Soth Africa (8.0) and lower (6.22) in Bangladesh (Zhao et al.2020; Mahmudiono et al. 2017; Chakona and Shackleton, 2018; Kundu et al., 2020). Research in Bangladesh conducted during Covid-19 time imposed economic stress to reduce dietary

diversity particularly for those households where family income affected. HDDS reflect the food accessibility of household and consistent low HDDS affect the nutritional status of family members (Chakona and Shackleton, 2018). In Bangladesh, stunting of children aged 24-59 months was found to be associated with HDDS (Rah et al., 2010). The low HDDS underscore the importance of diet related policies and practices in rural areas targeting the households with little access to food. It was observed that the prevalence of low, medium, and high dietary diversity (DD) scores was 8 (2.6%), 100 (32.6%), and 199 (64.8%) respectively. Another

study conducted in rural areas of Tanzania in four villages of Morogoro and Dodoma regions showed a high prevalence of low HDD were 20% and 35% respectively, could be due to the low education level and occupation of the

respondent (Mbwana et al., 2016). Because, household heads' educational levels and occupation had close association with HDDS (Kundu et al., 2020).

Table 4. Association of socio-demographic and other characteristics with HDD score in rural areas of Bangladesh

Parameter	Estimate	Standard Error	Odds ratio (OR)	CI	P value
Intercept	-1.2223	0.4124	-	-	0.0030
Family income (≤ 20000 vs > 20000)	-0.7104**	0.1364	0.24	0.141-0.412	< 0.0001
Knowledge about nutrition (no vs yes)	-1.2942**	0.3873	0.08	0.016-0.343	0.0008
BMI (overweight vs normal)	0.2664	0.2864	1.81	0.930-3.529	0.3523
BMI (underweight vs normal)	-0.9473*	0.4057	0.54	0.193-0.504	0.0196
BMI (obese vs normal)	1.0088*	0.4035	3.81	1.370-10.576	0.0124*

* Significant at $p < 0.05$; ** Significant at $p < 0.001$

(Authors' field survey data from Boalkhali, Chakaria and Raipuraupazila under Chattogram, Coxsbazar and Narsingdi district respectively.)

Households with a monthly income of 20000 BDT or less were 0.24 times lower odds of inadequate This viewing concurred with different investigations (Drammeh et al., 2020; Kundu et al., 2020; Ongosi et al., 2014). Additionally, households with a monthly income above 5000 BDT had higher HDD status. Households with income levels above this threshold can purchase more varied food from markets (Dillon et al., 2015). Families with a higher income had a better chance of consuming a diverse diet. This conclusion could be explained by the fact that low-income households had a negative impact on their dietary preferences in terms of the quantity and quality of various food categories consumed. Research revealed that, Nutrition knowledge and a positive attitude are known to influence dietary practices (Kumar and Gautam., 2022). We found the probability of HDDS was 0.08 times lower without nutritional knowledge by eating eggs and milk compared to having knowledge about nutrition which supports the findings of Kigaru et al. (2015). Nutritional knowledge is crucial to select diverse and essential diets so that can prevent any diseases.

Furthermore, this study shows that the HDDS was 0.54 times lower for underweight people and 3.81 times higher for obese people compared to normal-weight people (Karimbeiki et al. 2018). Also, the higher HDDS associated with obesity may be due to variety of brands and unhealthy food in market. Sri Lankan research reported HDDS increase with the BMI and, highest DDS found among obese adults (Jayawardena et al., 2013). This result recommends that both nutritious and healthy food should be considered to improve HDDS.

In this study, inclusion of confounding variables like nutritional knowledge and diversity livestock production gave the clear picture of HDD and its factors in rural areas. However, this study had some limitations. This study conducted in selected areas may reduce the generalizability of results. This study failed to explore the seasonal variation of HDD due to its cross-sectional nature. All information was self-reported by the respondents and may induce reporting bias.

4. CONCLUSION

This study explored the status of household dietary diversity (HDD) and its associated factors in rural Bangladesh. Household dietary diversity (HDD) is crucial for quality diet. We found over three-fifths of studied households reported HDD. And family income, maternal nutritional knowledge, and mothers BMI were associated with HDD. Higher income encourages rural households to access more

varieties of food that might improve HDDS. Proper nutritional knowledge facilitates households to choose more diversified and quality foods which may lead to alleviate malnutrition including obesity. So, awareness and intervention focusing on nutritional knowledge targeting the low-income households may be undertaken to improve more the HDD and reduce the malnutrition in the study area.

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