Demographic and Regional Differences in Household Dietary Diversity in Bangladesh: Evidence from the 2010 Household Income and Expenditure Survey

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Abstract

The dietary diversity score is now being widely accepted as a tool to see the dietary intake pattern qualitatively. This tool can be used for a rapid proxy measure of household food access of the population. As the Household Income and Expenditure Survey of Bangladesh (HIES) are done routinely in many developing countries, this can be a good source of dietary data for the field of nutrition research. The study endeavoured to measure household dietary diversity scores (HDDs, 0-12) from a nationally representative population and frequency of food group consumption for the Bangladeshi population at different spatial levels from the HIES, 2010 dataset. The study found HDDs (Mean±SD) of 6.16±1.91 for Bangladeshi households. Households from Small Municipality Area (SMA) showed the highest HDDs of 6.95±2.34 followed by municipality (6.61±2.04) and rural areas (5.87±1.72). Chittagong and Sylhet division's households' diet is more diversified (7.09±2.12 and 6.95±1.83, respectively), whereas the lowest HDDs are found in Rajshahi (5.71±1.68). Mean differences of HDDs significantly vary by the education level of the mother, family size, number of earners, and religious status of the household. Overall, the percentages of households with no intake of meat and poultry, fruits, and milk and milk products were 43.1%, 28.2%, and 48.6%, respectively, in the survey period of 14 days. HDDs varies significantly by region and household characteristics. Animal-sourced foods (meat and poultry, milk and milk products, and eggs) and fruits should be made more accessible through policies and programs at the household level across divisions where consumption is low.

***Keywords**:* Household Income and Expenditure Survey, Household dietary diversity, Food security, Bangladesh

Introduction

A diversified diet is widely established and recognized by nutritionists as one of the key elements to maintaining sound health. The importance of dietary diversity is now perceived, and it has become increasingly popular in recent years (Darapheak et al., 2013; Jayawardena et al., 2013; M Savy et al., 2005; McDonald et al., 2015). A dietary diversity score is measured by summing the number of foods or food groups used in the household or by the individual over a reference period (Hoddinott, 1999; Löwik et al., 1999). Household dietary diversity scores (HDDs) enables one to assess the physical and economic accessibility of a household to diversified foods within a given period (Cordero-Ahiman et al., 2021) particularly for many poor sub-populations living in rural areas. The purpose of this research was to analyze the factors that determine the Household Dietary Diversity Score (HDDs). As the diversity of diet relies on availability and accessibility of foods, resource availability and food security condition of a household can be determined from HDDs (Hoddinott & Yohannes, 2002). Several studies also linked household dietary diversity scores to improve nutrient intake in developed and developing countries (Arimond et al., 2004; Kant et al., 2004; Steyn et al., 2006). A diverse diet is rare among poor populations in developing countries; though a non-diversified diet can have negative consequences on health, well-being, and development, as this type of diet is not likely to meet micronutrient requirements (Kant et al., 2004).

Household dietary diversity increases the probability of micronutrient adequacy of the household members (Mekonnen et al., 2020). Households having high dietary diversity are associated with the increased

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consumption of animal source food. A diverse diet not only fulfills micro and macronutrient requirements but also helps to prevent inflammatory disorders by providing fibre, a vast range of bioactive compounds, phytonutrients, and antioxidants from plant-based foods (Swindale & Bilinsky, 2006). Thus, a diversified, nutritionally adequate, and balanced diet reduces the prevalence of malnutrition and non-communicable diseases in the population (Obayelu & Osho, 2020). The dietary diversity score obtained from this promising measurement tool was found positively associated with the nutritional status of young children (Arimond & Ruel, 2002; Hatleiy et al., 2000; Tarini et al., 1998). Dietary diversity score was also found linked to the nutritional status of adult women (M Savy et al., 2005). Low HDDs has been found as a predictor of child stunting in Bangladesh (Rah et al., 2010).

Socio-demographic factors like the sex of the household head, educational qualification, family size, and income affect the diet pattern of a household (Ruel, 2003). Low social status, inadequate access to sanitation and safe water can limit the accessibility to diversified diets (Steyn et al., 2006). Access to various kinds of foods is also influenced by geographic location. For instance, in rural regions, food availability relies on existing natural resources, agricultural production, and access to the market (Cordero-Ahiman et al., 2021). Thus, their unwanted environmental and other condition might result in undesirable dietary situations. Most of the households of the low urban regions, due to their limited financial accessibility, consume fewer non-staple foods, which predispose them to consume less diversified diets (Hoddinott & Yohannes, 2002).

Data obtained from the Household Income and Expenditure Survey (HIES) in the low and middle-income countries, now considered as a primer of food and nutrition analysts (Fiedler et al., 2012). Bangladesh is one of those countries where measurements of nutrient intakes are not carried out in a way that can be nationally representative. But HIES is conducted regularly in Bangladesh, which can become a potential source of high-quality data for food consumption, and an opportunity to look at the dietary pattern of the population at the national level. However, there are limited data on the national measurement of dietary diversity or diet quality for all Bangladeshi households. Having a better understanding of the status of the household dietary diversity or diet quality is a feasible way of obtaining food security indicator data and thereby monitoring the Sustainable Development Goal of eradicating hunger and food insecurity (United Nations Development Programme, 2017). This paper aimed to compute HDDs of Bangladesh from HIES 2010, as well as to delve into the differences in HDDs due to spatial (the regional variation), and household characteristics. This paper also looked at the frequencies of different food groups' consumption, especially animal source foods, in the 14 days of the survey period.

Methods

Study population

Data used in this study were from the HIES survey conducted in 2010 in Bangladesh (Household Income and Expenditure Survey (HIES), 2010). This was a national survey using a two-stage stratified random sampling technique under the framework of Integrated Multipurpose Sample (IMPS) design (HIES, 2010). A total of 12,240 households were observed by the HIES 2010. A total of 1419 households that did not provide food consumption data for each of 14 days were considered incomplete, hence counted missing in this study. So, only those households (10,821) that had 14 days of food consumption data were included in the study.

Food data

There was a distinguished part in the questionnaire of HIES 2010 with 145 lines or categories of food items, which was aimed to collect data on food consumption during the preceding 14 days (International Household Survey Network (IHSN), 2010). Each enumerator collected information on the food consumption of the households for 14 days by paying 7 visits. A total of 109 food items are included in this study. Food items listed in the questionnaire like tobacco and tobacco products, spices, betel leaf & chew goods, and food consumed outside were excluded during the calculation of household dietary diversity score.

Data management and analysis

Household dietary diversity score

HDDs were calculated from the HIES2010 data to measure the dietary diversity at the household level. HDDs is defined as the number of food groups consumed over a reference period of 24 h by a household. In the study, food consumption data of the first day of the fourteen days was considered for the measurement of HDDs. The diet was classified according to 12

food groups as recommended by Food and Nutrition Technical Assistance (IHSN, 2010), which includes 1) Cereals; 2) Root and tubers; 3) Vegetables; 4) Fruits; 5) Meat, poultry; 6) Eggs; 7) Fish; 8) Pulses/ legumes/nuts; 9) Milk and milk products; 10) Oil/fats; 11) Sugar/honey; 12) Miscellaneous. Miscellaneous foods comprise drinks & beverages, pickles, jam/jelly, amshatta, sauce/sirka, and others. Neither the frequency of consumption nor the amount of food consumed was taken into consideration. A score of 1 was given if the household consumed food items from a particular food and 0 for not consuming. So, from the 12 food groups, the highest score was measured to the level of 12. HDDs were discrete quantitative variables. Since, there is no international agreement on which cut-off values should be used (Cordero-Ahiman et al., 2017), HDDs was classified into three categories: HDDs 1-3, low dietary diversity; 4-6, medium dietary diversity; and 7-12, high dietary diversity.

Frequency of food group consumption

While measuring the HDDs, this study also looked at the frequency of household food groups' consumption during the 14 days of the survey period. To pursue this, the individual scores of fourteen days of each food group (0 and 1) were summed to a point, which shows the highest value of 14 and the lowest value of 0. This gives an idea of household access to different food groups in Bangladesh.

Characteristics of households

Information on different characteristics of the household was included in the study to see the differences in HDDs due to variability in the settlement, region, sex of a head member, education level of the mother, number of members, number of earning members, and religion of the household. The statistical metropolitan area includes Municipal corporations and adjacent localities having urban characteristics. Household religion status was assumed from the status of head member of the household. Due to the low count of Hinduism, Buddhism, Christianity, and others, all of them were grouped as others with the Islam religion. The mother of the household was identified using the variable named relation to household head of the HIES dataset. The wife of the household head in a male-headed family and head of the female-headed family was assumed as a mother of the household. Information on other potential variables was also incorporated accordingly.

Statistical analysis

The datasets of HIES were provided in separate files. Food consumption data were found already treated but cleaned again for this study. The whole process of cleaning and preparing the dataset to create desired variables was done using the software SPSS (IBM Corp., 2011). An extensive syntax was prepared and used for the computation of the HDDs of fourteen separate days. Other socio-demographic and household characteristic representing variables were extracted from the appropriate dataset and merged into the food consumption dataset. Before the final analysis, all the steps were reviewed meticulously. The first step of the analysis was to see the variation in the HDDs due to the regional variation and settlement of households. HDDs (Mean ± SD) have been calculated from the previous 24 hours and the food consumption frequency from the last 14 days. Levene test of homogeneity of variance was conducted before ANOVA. However, the ANOVA test did not consider controlling other variables during analysis. A Chi-square test of independence was also conducted to see the relations of different categories of HDDs. In the second step of the analysis, the frequency of food groups consumed in the survey periods was computed. Here, a score of '1' was given if the food was consumed from the particular group and '0' for not consuming. ArcGIS was used to produce a map for spatial analysis.

Results

Characteristics of the survey households

The study included 10,821 households, among those 64.7% (n=6999), 26.4% (n=2855), and 8.9% (n=967) households were from rural, municipality and statistical metropolitan area, respectively (Table 1). The number of total members in these households was 50,294 and the average household size was 4.65. Among the households, 86.4% (n=9335) were male-headed, whereas the rest were female-headed. Mothers of 10548 households could be identified, among them, 55.6% (n=5863) had no education at all. About 66.3% (n=6529) households had only one earner. Looking at the religious status of the households in the study, it was found that 87.5% (n=9475) were Muslim.

Table 1. Distribution of the households by demographic and spatial variables (N=10821)

Variables	Categories	*n* (%)
Settlement of households	Rural	6,999 (64.7)
	Municipality	2,855 (26.4)
	Small Municipality Area (SMA)	967 (8.9)
Sex of the household head	Male headed	9335 (86.4)
	Female-headed	1486 (13.6)
Education level of mother	No education	5863 (55.6)
	With education	4685 (44.4)
Earner group	One earner	6529 (66.3)
	More than one earner	3316 (33.7)
Religion	Islam	9475 (87.5)
	Others	1346 (12.5)
Region by division	Barisal	836 (7.73)
	Chittagong	2,052 (19.0)
	Dhaka	3,159 (29.2)
	Khulna	1,581 (14.6)
	Rajshahi	1,246 (11.5)
	Rangpur	1,125 (10.4)
	Sylhet	822 (7.6)

Household dietary diversity score

As stated in Table 2, nationally, the household dietary diversity score was 6.16. It can be illustrated from the findings that more than half (58.7%) of the households had a middle dietary diversity score, whereas 3.6% had low and only 37.8% had a high dietary diversity score (Table 2).

HDDs and regional variation

Households from SMA were found to have the highest mean HDDs (6.95±2.34); of them, 51.8% of households consumed high diversified foods. 63.6% of households in rural areas exhibited the middle HDDs category. Mean differences of HDDs due to the settlement was identified to be significant ($p<0.001$). Differences in dietary diversity categories were also found significant ($p<0.001$). Chittagong and Sylhet division had higher HDDs (7.09±2.12 and 6.95±1.83, respectively) than the other regions of the country. High diversified diet consumption was more prevalent in Chittagong compared to the other divisions of the country (57.7% *vs.* 37.8% nationally). Rajshahi division exhibited the lowest HDDs of 5.71±1.68, whereas HDDs of Barisal, Dhaka, Khulna, and Rangpur were 5.81±1.78, 5.91±1.78, 5.83±1.67, and 5.84±1.88, respectively. Households of Barisal, Rangpur, and Rajshahi were highest in percentage in terms of consuming a less diversified diet (5.1%, 4.9%, and 4.8%, respectively). However, mean differences of HDDs among regions, and differences between HDDs categories in the regions, were stated as significant ($p<0.001$) in the study (Table 2).

Table 2. Household dietary diversity score by settlements and region

	HDDs (Range, 1-12) Mean±SD	p-value[1]	% With low diversity (1–3 food groups)	% With middle diversity (4–6 food groups)	% With high diversity (7–12 food groups)	p-value[2]	Total household, N
National	6.16±1.91		3.6	58.7	37.8		10821
Settlements							
Rural	5.87±1.72	<0.001*	4.2	63.6	32.2	<0.001*	6999
Municipality	6.61±2.04		2.3	51.0	46.6		2855
SMA	6.95±2.34		2.5	45.7	51.8		967
Region							
Barisal	5.81±1.78	<0.001*	5.1	62.3	32.5	<0.001*	836
Chittagong	7.09±2.12		1.3	40.9	57.7		2052
Dhaka	5.91±1.78		4.2	64.8	31.0		3159
Khulna	5.83±1.67		3.7	66.8	29.5		1581
Rajshahi	5.71±1.68		4.8	67.3	27.9		1246
Rangpur	5.84±1.88		4.9	63.9	31.1		1125
Sylhet	6.95±1.83		1.2	39.9	58.8		822

*p-value <0.05 was considered significant; [1] ANOVA; [2]Chi-squared test

HDDs and household characteristics

The study also measured the HDDs and observed the differences in the score due to various household characteristics. Mean HDDs in the male-headed households was significantly different from the female-headed ones (6.17±1.90 *vs.* 6.13±1.99, p=0.011) and within HDDs categories (p=0.041). The presence of the educated mother in the households resulted in a higher HDDs mean (6.78±2.02), compared to the household with an uneducated mother (5.68±1.66). About 51.0% of households having educated mothers consume food of high diversity, whereas this percentage is only 27.3% in households having an uneducated mother. Mean HDDs was found 6.41±1.92 in the households consisting of more than four members, and in the households having less than 4 members, the HDDs was 5.94±1.88. Households having more than one earner had higher HDDs (6.36±1.91) than those having only one earner (6.03±1.88). In the context of religion, consumption of a more diversified diet (6.43±1.85) was found in the other religions than the major religion Islam (6.13±1.92) in Bangladesh. However, differences in both mean HDDs and inter-HDDs categories in terms of household head, education level of the mother, family size, number of earners, and religions were reported to be highly significant (p<0.001) (Table 3).

Frequency of different food group consumption

All the households reported in the survey consumed food items from the cereals and oil/fats groups in the survey period of 14 days. Though vegetables were consumed in 79.7% of total households (11 to 14 days), a minute percentage of households reported having food items from meat and poultry, eggs, fruits, and pulses groups. The study identified better consumption of fish items than meat and poultry. One of the notable findings of the study was that more than 40% of the households of the country did not consume any food items from meat and poultry and milk and sugar groups (43.1%, 48.6%, and 44.0%) (Table 4).

Table 3. Household dietary diversity score by sex of the household head, education level of the mother, family size, earner group and religion

	HDDs (Range 1-12) Mean±SD	p-value[1]	% With low diversity (1–3 food groups)	% With middle diversity (4–6 food groups)	% With high diversity (7–12 food groups)	p-value[2]	Total household N
Sex of the Household head							
Male-headed	6.17±1.90	0.011*	3.4	58.9	37.6	.041*	9335
Female-headed	6.13±1.99		4.8	56.7	38.4		1486
Education level of Mother							
No education	5.68±1.66	<0.001*	4.9	67.7	27.3	<0.001*	5863
With education	6.78±2.02		1.7	47.3	51.0		4685
Family size							
Up to 4	5.94±1.88	<0.001*	4.5	62.7	32.7	<0.001*	5690
More than 4	6.41±1.92		2.5	54.1	43.3		5131
Earner group							
One earner	6.03±1.88	<0.001*	4.0	61.1	34.9	<0.001*	6529
More than one earner	6.36±1.91		2.7	55.6	41.7		3316
Religion							
Islam	6.13±1.92	<0.001*	3.8	59.4	36.8	<0.001*	9475
Others	6.43±1.85		2.1	53.6	44.3		1346

*p-value <0.05 was considered significant; [1] ANOVA; [2]Chi squared test

When the study looked at the households with no consumption from a particular food group, all of these consumed cereals, oil and fats in the preceding 14 days, a very negligible number was found to have the fish, root and tubers, and vegetable groups (Table 4). Rural households showed a greater percentage with no intake of meat and poultry, eggs, milk and dairy, fruits, and sugar as compared to the municipality and SMA (Table 5).

Among all the regions, a surprising number of households of Rajshahi, Rangpur, and Barisal showed that those did not consume food from the particular group. In Sylhet, Barisal, and Rajshahi 52.4%, 46.5%, and 45.3% respectively did not consume meat and poultry in the last 14 days. Around half of the households in the Barisal (57.5%), Khulna (56.2%), Rangpur (52.6%), and Rajshahi (47.2%) region were found to have no milk and dairy food consumption (Figure 1).

Table 4. Percent distribution of households with the frequency of different food groups consumption in the 14 days of the survey

Food groups/items	No intake in last 14 days	1-4 intakes in last 14 days	5-7 intakes in last 14 days	8-10 intakes in last 14 days	11-14 intakes in last 14 days
Cereals*	0	0	0	0	100.0
Root and tubers	0.2	7.5	17.5	26.5	48.3
Vegetables	0.1	0.9	4.3	15.0	79.7
Fruits	28.2	34.4	13.8	10.4	13.1
Meat and poultry	43.1	50.8	4.9	1.0	0.1
Eggs	26.1	53.4	12.0	4.8	3.6
Fish	1.2	12.3	19.2	28.5	38.7
Pulses/legumes/nuts	8.3	42.5	24.6	12.8	11.7
Milk and milk products	48.6	17.3	3.7	3.2	27.2
Oil/fats	0	0	0	0	100.0
Sugar/honey	44.0	23.6	5.4	4.0	22.9
Miscellaneous	55.1	19.1	3.7	2.8	19.4

*Cereals, oil and fats were found in each of 14 days

Table 5. Percent distribution of households with no intake from the specific food groups in the 14 days of the survey, by settlements.

Settlements	Pulses	Meat and poultry	Fish	Eggs	Vegetables	Milk and dairy	Fruits	Miscellaneous	Sugar
Rural	10.6	49.1	1.3	31.1	0.0	52.3	30.2	59.4	47.7
Municipality	4.7	34.5	0.9	18.8	0.1	42.1	24.3	47.9	37.2
Small Municipality Area (SMA)	2.5	24.7	1.0	11.4	0.0	41.0	25.4	45.1	37.6

Note. No households were found with no intake from cereal, and oil and fats group

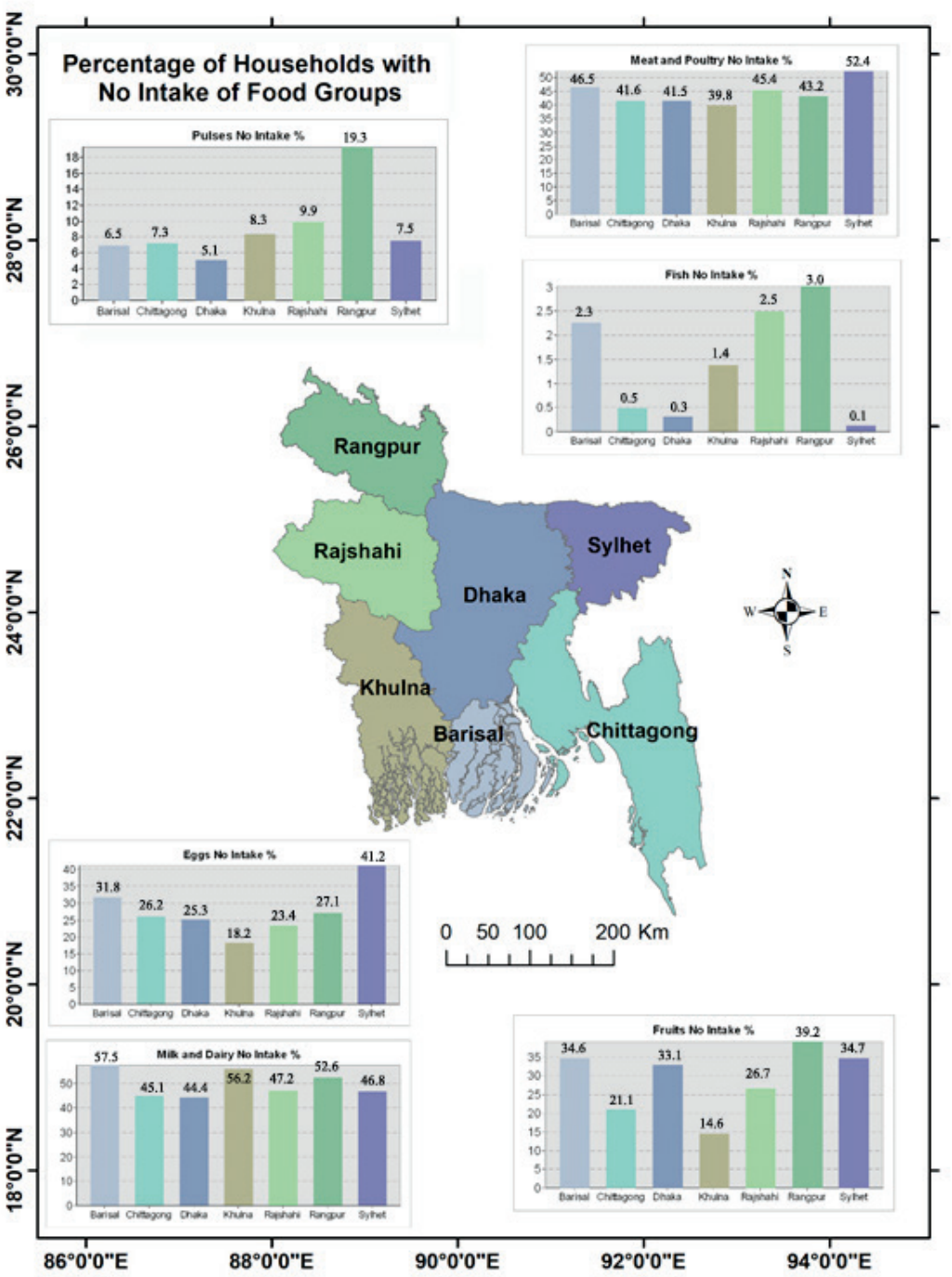

Figure 1. Percentage of households with no intake from speacific food groups/items in the 14 days of the survey

Discussion

The objective of the study was to look at the household dietary diversity and dietary quality of Bangladeshi households. This study took the opportunity to demonstrate the computation of HDDs and frequency of food group consumption from the HIES 2010 data set and give estimates of nationally representative HDDs. The study significantly linked dietary diversity with socio-demographic characteristics and regional variations in Bangladesh. The national dietary diversity score was medium (6.16). The study underscored rural areas, and particularly Rajshahi and Rangpur division with the lowest HDDs.Settlement status, regions of living, and different sociodemographic factors such as education level of the mother, family size, religion, and earner groups were significantly associated with both mean HDDs and HDDs categories. More than forty per cent of the households of the country did not consume meat and poultry, milk, and milk products. Though there was regional variation observed in terms of food groups, Rajshahi seems to have consistently low consumption of animal food group consumption.

The findings of the study in terms of HDDs appear to be consistent with the findings of the largest food security and nutrition surveillance project of Bangladesh (FSNSP) despite the sampling design, and different DDs (9 food groups were used in FSNSP) computation methodology. However, an almost similar difference in DDs was speculated due to spatial difference (Hellen Keller International (HKI) and James P. Grant School of Public Health (JPGSPH), 2016). FSNSP also reported rural areas (4.2) and particularly Rajshahi (4.0) and Rangpur division (3.80) with the lowest DDs. Findings for dietary inadequacy of women in the report (FSNSP) are also in line with the study considering the settlement and regional variable. Previous literature found that DDs was low among the rural Bangladeshi population who had lower attainment of education (Rashid et al., 2011). Rural diet may be showed less diversified due to the lesser purchasing power, inappropriate cooking practices, and choice of recipes. It is established that dietary diversity score can be used as a proxy indicator of micronutrient intake (Fujita et al., 2012; Hoddinott& Yohannes, 2002). The study also found an apparent relationship of specific micronutrient deficiency prevalence from the national micronutrient survey with HDDs of the study (Institute of Public Health Nutrition, 2013). Iron, Vitamin A, and Zinc deficiency in children and women of rural areas, and particularly in Rajshahi, Rangpur, Barisal division was high, which might be associated with our findings as households of these areas are reported poor HDDs.The relation of anaemia and HDDs was found corroborated when compared with the anaemia prevalence from BDHS 2011 (National Institute of Population Research and Training (NIPORT), 2011).

Demography and household characteristics were found to be associated with the mean DDs and DDs category. Similar to these findings, previous literature also reported significant roles of income, education, as determinants of household dietary diversity (Rashid et al., 2011). The male-headed household came up with an insignificantly higher diversity score than the female-headed one, though the difference is negligible but still coherent with other studies (Lee & Brown, 1989; Rashid et al., 2011). Our finding of the presence of educated mothers in a family resulted in the consumption of food from more diversified sources is supported by the previous studies (Moon et al., 2002; Rashid et al., 2011). The study suggests that mothers with schooling can play a key role in menu planning and preparation of food in a family, which she usually practices for increasing the nutrition quality of diet and upholding the health status of her family members. We found family size has an effect on the dietary score and the consumption of high diversity foods is also consistent with other studies (Lee & Brown, 1989; Moon et al., 2002; Rashid et al., 2011). There might be some reasons that this can happen due to the presence of more members in family dietary choices also increase. The presence of more members also impacts the family income, gardening, raising poultry and live stocks, and food preparation, which could affect the DDs. It is already established that income plays an important role in consumer demand of food diversity, in the study we did not compute household income level but families with more than one earner group showed better dietary diversity scores. Dietary diversity was found more predominant in the follower of religions like Hinduism, Christianity, and Buddhism comparing Islam. This may be due to the unique food preferences, and practice of different cooking procedures of the follower of the religions.

Among the food group consumptions, we found that more than forty per cent of the households in this study did not consume meat and poultry, and milk products in the last 14 days. This means that half of the population has very poor access to these to more expensive/animal foods in our country. This is consistent with earlier findings where it was seen that animal food consumption has not increased significantly throughout these years

(Al Hasan et al., 2019). This study used data derived from the FAO's food balance sheets. We used joinpoint regression analysis to identify significant changes in the temporal trends. The annual percent change (APC). When DD is affected by economic accessibility, it results in lower consumption of proteins/ animal source foods which are more expensive (Contreras Díaz, J.; Paredes, M.; Turbay, 2017). However, vegetable intake was found to be common in the households over the survey periods. Local production, homestead gardening, and increased availability of agricultural products might be a reason behind this (Shamim et al., 2016). Our analysis identified rural regions as being vulnerable to poor diet quality. From this study, it can be speculated that consumption of plant-based food persists throughout the country whereas limited consumption of animal foods has been observed. Although seasonal variation influences the consumption of varied diets from diversified sources, the study was unable to take it into account during the analysis due to the unavailability of data. The concept of availability of particular food items in particular regions was also not considered in the analysis. The quantity of food and nutrient intake were not considered and need to be studied further.

Conclusion and policy recommendations

This study computed HDDs and looked at the frequency of specific food group consumption at household and regional levels. The analysis indicates a huge variation in diet diversity exists within the nation. Animal foods are less consumed compared to plant-based foods across the country which might lead to low DDs attainment. Food insecurity in terms of availability or accessibility can also lead to such conditions in the regions. While speculating the reasons it was found that demographic and household characteristics were significantly associated with dietary diveresity. Therefore, it is recommended to take initiatives to address barriers related to decreased consumption of diverse food throughout the nation. A targeted approach to improve diet quality in locations like Rajshahi and Rangpur should be promoted. Further, the computation procedure used in this study would add more usability of HIES data for the nutritionists and policymakers for assessing diet quality in Bangladesh as well as for other developing countries. Data should be available at the district/subdivision level to detect the differences in HDDs more succinctly, which in turn would help identification of a group of people consuming a less varied diet, which is the immediate cause of micronutrient malnutrition.

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