**Chapter 1: Introduction**

Food security is defined as the state of having reliable access to a sufficient quantity of affordable, nutritious food. food security has decline dramatically in many countries. It is categorized as a reasonable calculation of food security among household or as an individual, normally last 30 days. Several additional factors have been associated with Household Food Security(HFS) such as socio-economic status, family income, education level and family size(Kiboi*et al*.,2017). HFS defined asqualitative food intake indicator that reflects access to foodsecurity in any specific regions population or household. Appropriate nutrient consumption is required for healthy nourishment. Proper health has been linked to dietary diversity and the diet quality of individuals.HFSof a certain population in a region is determined by numerous aspects, comprising the community's previous consumption behaviour, formal manners, and the extent of technology associated with food production, processing, preparation, and storage (Keding *et al*., 2013), the season (Kinabo*et al*., 2003), agricultural biodiversity in the region and diversity of its farming systems (Herforth, 2010), and the population's economic status (Taruvin, 2010). HFScan be assessed on an individual or household basis. It is commonly considered as an estimate of food access at the family level, that is, a household's proficiency to collect a sufficient amount of quality and quantity food to fulfil all family members' nutritional prerequisites for efficient lives, where it is measured by estimating the number of food groups consumed rather than individual food items eaten. It can be used to assess food access at the household level (for example capacity of households to receive luxurious food groups). Furthermore, it symbolizes dietary quality at the individual level, particularly the diet's micronutrient sufficiency. Food security reference periods may fluctuate, but the most common is 30 days.

A recent nationwide survey by BRAC, a development organisation in Bangladesh, showed that 93 % of participants have suffered a loss of earnings, with 54 % reporting no income in March 2020(Mirmiran et al., 2006). Moreover, disruption in transportation systems has caused the dumping of perishable food products and dramatic price reductions, affecting food security for rural producers(Alam et al., 2018). Thus, despite several steps taken by the Bangladeshi government to address food insecurity. Another key indicator of a household’s ability to not only provide enough food, but a diverse range of foods for good nutrition, is dietary diversity. Household dietary diversity (HDD) is a proxy indicator measuring the economic ability of a household to access a variety of foods during a determined period and is widely used as an indicator of food security as a whole(Huluka andWondimagegnhu, 2019).Children under five years are especially vulnerable to undernutrition and burden of undernutrition is higher in the rural areas compared to the burden in urban areas due to inequity in availability and accessibility of food items.Infant and young child feeding (IYCF) practices in Bangladesh is not satisfactory (Kimmons*et al*., 2005).

**1.1 Objectives**

The goal of this study was 1) to evaluate the factors associated with HFS 2) to determine the correlation between HFS with HDD and CDD.

**Chapter 2: Materials and Methods**

**2.1 Study setting and population**

A community based cross-sectional study was conducted in Boalkhali, Chakaria and Raipuraupazilafrom Chottogrm, Coxbazar and Narsingdi district of Bangladesh. The study population were the list of all households from the selected upazila. A stratified random sampling technique was applied for data collection. 307 households were randomly picked from Boalkhali, Chakaria, and Raipuraupazilas during the months of March to May 2021.

**2.2Study variables**

The dependent variable of the study was the HFS score.The independent variables were mothers’ age, parent’s education and occupation, mothers’ body mass index (BMI),family size and type, family income, rearing of livestock, expenditure and income from livestock and related products, microcredit loan, basic knowledge related to different livestock products, household and individual DD.

**2.3 Data collection procedures and measures**

Face-to-face interviews were used to fill out sociodemographic questionnaires, food security questionnaires, household and children DD questionnaire. The pre-study questionnaire was written in English, and two bilingual researchers translated it into the local language (Bengali). Another independent bilingual expert backtranslated the questionnaire to check for consistencies and to prevent any bias. The electronic forms were shared in the local language (Bengali).

**2.3.1 Household food security scale**

We created a HFS scale from an 11-item food security measure (Frongillo et al., 2003; Ahmed et al., 2019; Kundu et al., 2021). The items covered frequency of food purchased (rice and perishable food, e.g. vegetables, fish, and meat), frequency of cooking, borrowing or lending (food and money), and whether there was ready access to adequate meals and snacks. Higher scores were assigned to those experiences that indicated better food security status. For example, for frequency of purchasing rice, a score of 1 was assigned to those who purchased rice 4–5 times a week, which indicated that the household had a little or no store of rice and had to buy rice almost every day to meet their need. A score of 5 was assigned to those who had not purchased rice in the last 30 d, which indicated the household had an adequate store of rice and did not need to buy rice for a long time.

**2.3.2 Household dietary diversity (HDD) scale**

Household Dietary Diversity Score (HDDS) was calculated by summing up the number of food or food groups eaten over the past 24 h by any member of the household (Swindale A &Bilinsky, 2006; Kundu *et al*.,). In total, the 12 food groups (FG) were as follows: (FG1) cereals; (FG2) tubers and roots; (FG3) vegetables; (FG4) fruits; (FG5) meat, poultry, organ, etc.; (FG6) eggs; (FG7) fish and others seafood; (FG8) pulses, legumes and nuts; (FG9) milk and other dairy products; (FG10) oils and fats and butter; (FG11) sugar and honey; and (FG12) miscellaneous foods such as condiments and processed foods like snacks, and beverages. The authors’ assigned values for each group as ‘0’ for the negative answer (not consumed), or ‘1’ for the positive answer (consumed). Higher dietary diversity was indicated by a higher score, ranging from 0 to 12. We used the HDDS scale both as a continuous and categorical variable for analyses. For categorical HDD, scores were divided into three categories: high dietary diversity (7–12), medium dietary diversity (4–6) and low dietary diversity (0–3) (Ahmed *et al*., 2019)

**2.3.3 Children dietary diversity (CDD) scale**

Children DD scale was created based on the mother's recall of the food thatgave her child 24 hours before the date of the interview. According to WHO IYCF guidelines (WHO, 2007) the foods were classified into seven food groups: (1) grains, roots and tubers, (2) legumes and nuts, (3) dairy products, (4) flesh foods, (5) eggs, (6) vitamin A rich fruits and vegetables and, (7) other fruits and vegetables. The possible answers were "yes, consumed" (score 1) and "no, not consumed" (score 0). These were summed to generate a children DD score in the range of 0-7. Children were considered to have adequately diversified dietary intake (ADDI) if they had food items from at least four of the seven food groups, while a score of 3 or less was considered to be inadequate (WHO, 2007).

**2.4 Statistical analysis**

Descriptive analysis of frequency, percent, mean and standard deviation was calculated for all variables. The household food security (HFS) score was not normally distributed. We have applied Kruskal-Wallis test for more than two samples and Mann-Whitney test for two samples of nonparametric test to find out the association between HFS across socio-demographic and other characteristics. A Spearmen rank correlation was applied to find out the relationship between HFS with household and children DD score. The data was analyzed using IBM SPSS 23.0 statistical software, with a significance level of P <0.05 maintained throughout.

**2.5 Ethical considerations**

This research was carried out in conformity with the Helsinki Declaration's ethical principles from 1964. After explaining the study's purpose to each responder, they signed a consent form.

**Chapter 3: Results**

**3.1 Socio-demographic and other characteristics**

Table 1 presents the frequency and percentages of socio-demographic and other characteristics in rural areas of Bangladesh. It was observed that, 59.6% mothers were aged above thirty and rest of them were less than or equal thirty. Our result indicate that the average age of mother was 35.64 years (Sd 11.39 years). The type of occupation one acquires is mostly determined by one's educational background, which in turn is likely to influence one's income. Near to half of the total fathers (48%) had secondary education whereas, most of the women (59.9%) reported secondary education as their highest level of education. Assessment of the respondent’s occupation distribution indicates that majority of mothers were housewives (92.2%), whereas one third (32.9%) of the fathers worked as day laborers followed by job holder (27.3%), businessmen (24.2%), foreigners (15.6%). The average family income was 27398 (SD 17192 taka). In respect to family income the study shows that most of the households had a monthly income in between 150001-30000 taka (46%). If we observe the family type, the majority of the families (82.1%) were nuclear whereas 55% of the families consist of more than four members. 61.2% of households rear livestock, 73.2% doesn’t possess any microcredit loan and the majority of the population (89.9%) have knowledge about energy gain by egg and milk. The average BMI was 23.18 (SD 4.17). Most of the mothers (64.6%) BMI was in normal range. More than three fourth (79.7%) and more than half (64.8%) of the respondents were from the adequate children DD and high household DD. On the contrary, 20.3% and 2.6% respondents come from the inadequate children DD and low household DD.

**Table 1: Frequency and percent of household food security (HFS) of different socio-demographic characteristics in rural areas of Bangladesh.**

|  |  |  |
| --- | --- | --- |
| **Deteminants** | **n** | **Percentage (%)** |
| **Age of mother** |  |  |
| 30 | 124 | 40.4 |
| > 30 | 183 | 59.6 |
| **Education of father** |  |  |
| Primary | 58 | 19.6 |
| Secondary | 142 | 48 |
| Higher secondary and above | 96 | 32.4 |
| **Education of mother** |  |  |
| Primary | 56 | 18.2 |
| Secondary | 184 | 59.9 |
| Higher secondary and above | 67 | 21.8 |
| **Profession of father** |  |  |
| Job | 79 | 27.3 |
| Business | 70 | 24.2 |
| Foreigner | 45 | 15.6 |
| Day labor | 95 | 32.9 |
| **Profession of mother** |  |  |
| Homemaker | 283 | 92.2 |
| Job | 24 | 7.8 |
| **Family income** |  |  |
| 15000 | 95 | 30.9 |
| 15001-30000 | 141 | 46.0 |
| >30000 | 71 | 23.1 |
| **Family member** |  |  |
| 4 | 138 | 45 |
| > 4 | 169 | 55 |
| **Type of family** |  |  |
| Nuclear | 252 | 82.1 |
| Joint | 55 | 17.9 |
| **Domestic animal rearing** |  |  |
| Yes | 188 | 61.2 |
| No | 119 | 38.8 |
| **Microcredit loan taking** |  |  |
| Yes | 51 | 26.8 |
| No | 139 | 73.2 |
| **Knowledge about energy by eating egg & drinking milk** |  |  |
| Yes | 276 | 89.9 |
| No | 31 | 10.1 |
| **Knowledge about eating egg by adult people** |  |  |
| Yes | 160 | 52.1 |
| No | 147 | 47.9 |
| **BMI of mother** |  |  |
| Underweight | 22 | 7.2 |
| Normal | 197 | 64.6 |
| Overweight | 64 | 21 |
| Obese | 22 | 7.2 |
| **Children DD score** |  |  |
| Inadequate DD ( 4) | 52 | 20.3 |
| Adequate DD ( 4) | 204 | 79.7 |
| **Household DD score** |  |  |
| Low DD ( 3) | 8 | 2.6 |
| Medium DD (4 to 5) | 100 | 32.6 |
| High DD ( 6) | 199 | 64.8 |

**3.2** H**ousehold food security (HFS) across socio-demographic and other characteristics**

From table 2 it was observed that HFS was significantly associated with parents education, family income, domestic animal rearing, micro-credit loan receiving, knowledge about giving energy by eating egg and milk, knowledge about eating egg by adult people, BMI of mother, children and household DD wherever age of mother, profession of parents, family type and size were not significant.

**Table 2:Mean household food security (HFS) across socio-demographic and other characteristics in rural areas of Bangladesh.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Deteminants** | **n** | **Mean HFS (sd)** | **P values from (Kruskal Wallis tests)** | **P values from (Mann-Whitney test)** |
| **Age of mother** |  |  |  |  |
| 30 | 124 | 35.02 (3.51) |  | 0.563 |
| > 30 | 183 | 35.29 (3.76) |  |  |
| **Education of father** |  |  |  |  |
| Primary | 54 | 33.4 (3.92) | 0.000**\*\*** |  |
| Secondary | 142 | 35.2 (3.42) |  |  |
| Higher secondary and above | 96 | 36.54 (3.23) |  |  |
| **Education of mother** |  |  |  |  |
| Primary | 52 | 33.73 (3.53) | 0.000**\*\*** |  |
| Secondary | 184 | 34.85 (3.44) |  |  |
| Higher secondary and above | 67 | 37.3 (3.50) |  |  |
| **Profession of father** |  |  |  |  |
| Job | 79 | 35.2 (3.16) | 0.172 |  |
| Business | 70 | 35.89 (3.15) |  |  |
| Foreigner | 45 | 36.09 (3.94) |  |  |
| Day labor | 95 | 34.93 (3.70) |  |  |
| **Profession of mother** |  |  |  |  |
| Homemaker | 283 | 35.08 (3.63) |  | 0.084 |
| Job | 24 | 36.42 (3.84) |  |  |
| **Family income** |  |  |  |  |
| 15000 | 95 | 34.59 (3.99) | 0.022**\*** |  |
| 15001-30000 | 141 | 35.28 (3.47) |  |  |
| >30000 | 71 | 36 (3.01) |  |  |
| **Family member** |  |  |  |  |
| 4 | 138 | 35.31 (3.67) |  | 0.763 |
| > 4 | 169 | 35.08 (3.66) |  |  |
| **Type of family** |  |  |  |  |
| Nuclear | 252 | 35.12 (3.47) |  | 0.340 |
| Joint | 55 | 35.45 (4.45) |  |  |
| **Domestic animal rearing** |  |  |  |  |
| Yes | 188 | 34.82 (3.36) |  | 0.006**\*** |
| No | 119 | 35.75 (4.03) |  |  |
| **Microcredit loan taking** |  |  |  |  |
| Yes | 51 | 33.43 (2.66) |  | 0.000**\*\*\*** |
| No | 139 | 35.27 (3.39) |  |  |
| **Knowledge about energy by eating egg & drinking milk** |  |  |  |  |
| Yes | 276 | 35.42 (3.51) |  | 0.004\*\* |
| No | 31 | 33.03 (4.23) |  |  |
| **Knowledge about eating egg by adult people** |  |  |  |  |
| Yes | 160 | 36.38 (3.72) |  | 0.000\*\*\* |
| No | 147 | 33.9 (3.13) |  |  |
| **BMI of mother** |  |  |  |  |
| Underweight | 22 | 34.32 (2.84) |  | 0.015\* |
| Normal | 197 | 34.98 (3.6) |  |  |
| Overweight | 64 | 35.86 (3.69) |  |  |
| Obese | 22 | 36.41 (4.36) |  |  |
| **Children DD score** |  |  |  |  |
| Inadequate DD ( 4) | 52 | 34.54 (3.76) |  | 0.043\* |
| Adequate DD ( 4) | 204 | 35.55 (3.56) |  |  |
| **Household DD score** |  |  |  |  |
| Low DD ( 3) | 8 | 29.5 (3.55) | 0.000\*\*\* |  |
| Medium DD (4 to 6) | 100 | 34.07 (3.27) |  |  |
| High DD (7) | 199 | 35.97 (3.51) |  |  |

**SD Standad deviation; \* Significant at P <0.05; \*\* Significant at P<0.01; \*\*\* Significant at P < 0.001**

**3.3 Correlation between HFS with household DD and children DD**

Table 3 represents the spearman’s rank correlation between HFS with household dietary diversity (HDD) and children dietary diversity (CDD). It was observed that HFS was significantly positively correlated with HDD and CDD.

|  |  |  |  |
| --- | --- | --- | --- |
|  | HFS | HDD | CDD |
| HFS | 1 |  |  |
| HDD | 0.32**\*\*\*** | 1 |  |
| CDD | 0.20**\*\*** | 0.55**\*\*\*** | 1 |

**\*\* Significant at P<0.01; \*\*\* Significant at P < 0.001**

**Chapter 4: Discussion**

The study was conducted in Boalkhali, Chakaria and RaipuraUpazila from Chottogrm, Coxbazar and Narsingdi district of Bangladesh. A total of 307 households data were collected. This study purpose was to determine the food security with associated factors. Parental education, family income, livestock rearing, knowledge about nutrition, and BMI of mother were significantly associated with HFS.

In case of parental education was significantly associated with HFS. A similar result was found different authors (Makombe*et al*., 2010; Idrisa*et al*., 2008; Kundu et all 2021).Our result demonstrated that family income and HFS were significantly associated. The family with lower income had lower mean HFS and higher income people had higher mean HFS. Another study reported that family income inversely related with HFS which result consistent with our result (Kundu et al., 2021, Alam. 2018).

Livestock is an indicator of the social and economic standing of a farmer. Livestock ownership hasa positive effect on food security. We thus expect households with livestock to bemore food secure than those without these assetsResource-endowed farmers can sell their livestock during food shortages. They can also getmilk, milk products and meat from their livestock or sell them for cash. Livestockcontributes draft power and helps the household meet subsistence, income andnutritional requirements (BogaleandShimelis, 2009; Gebre 2012;Mitiku*et al*., 2012). We found that livestock rearing has a significant relation with HFS.

Dietary diversity is a promising indicator for food security.In this study, HFS was significantly positively correlated with HDD and CDD. An inverse correlation was found between household food insecurity access scale(HFIAS) and dietary diversity (r = −0.450; p < 0.01) was observed. Therefore, dietary diversity is a promising indicator for food security(Faber, 2009).Our study result revealed that HFS was significantly positively correlated with CDD. Household food insecurity affects children's diet diversity (Chandrasekhar, 2017).

**Strengths and Limitations**

This is the first study of HFS with household of livestock rearing. Using a 24-hour recall period for food consumption may have reduced the likelihood of recall bias compared to a longer recall period.

This study is not free from limitations. This study conducted in the community based; therefore, the generalizability of the results is limited. No information was gathered on the sizes or quantities of food consumed by households from each food group. While a basic dietary diversity score may be a relatively precise predictor of nutritional sufficiency, recent research reveals that a score based on minimal portion size requirements increases the associations between the score and nutrient sufficiency. Similarly, giving the seven-day recall to families multiple times could reduce potential misclassifications associated with one-time events; such as marriages or funerals that might have been recorded in a single recall. Given the lack of variety in the rural Bangladeshi diet, the inclusion of fewer items may have nonetheless enabled us to capture much of the variability found in the diet when compared to situations where variation may be higher.

**Conclusion and Recommendations**

The results of the study indicate that HFS is associated to rural households' socioeconomic condition. The findings clearly demonstrated the importance of parental education, occupation, monthly family income, livestock ownership and rearing in rural households in achieving the necessary dietary diversity and, as a result, enhanced nutrient intake.

Despite the shortcomings, these findings suggest that the current dietary diversity score could be a useful tool for assessing food security in rural Bangladesh, particularly in situations where rapid assessments are required in the aftermath of disasters or where lengthy questionnaires are impossible to administer. Future research should look into the relationship between the dietary diversity score and nutritional status indicators. Regarding the seasonal nature of food availability in Bangladesh and articles focus on the impact of season on dietary diversification, the score should be examined for uniformity of usefulness across seasons.

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