Original Research Article

Minimum dietary diversity and anthropometric measures of nutritional status among children aged 6–23 months in rural Noakhali, Bangladesh.

Abstract

Background: Child under nutrition is a serious public health concern in a developing country like Bangladesh though significant improvement occurred in the last few decades. Dietary diversity is important for having balanced nutrition and in Bangladesh, only 39.6% of children aged 6–23 months receives the minimum acceptable diet. Therefore, the main aim of this study was to determine the association between the level of minimum dietary diversity practice and anthropometric measure (stunting) of nutritional status among children aged 6–23 months in rural Noakhali, Bangladesh.

Methods: A cross sectional study was undertaken in Noakhali, Bangladesh in April 2019. Data were collected by using a standard, structured and pretested questionnaire, bivariate and multivariate logistic regression was carried out to identify factors associated with minimum dietary diversity scores for children.

Result: Minimum dietary diversity (MDD) score were found to be 61%; 40% children were stunted and only 13.4% stunted children achieved MDD. Children's minimum dietary diversity is positively & strongly associated with the children nutritional indicator (stunting). In the multivariate analysis, children who had not achieved minimum dietary diversity had a higher risk for being stunted [adjusted Exp (B)= 0.012; 95% confidence interval (CI)=0.001–0.107, *P*=0.00] than the children who had achieved minimum dietary diversity. Similarly, mothers' education and household size were also positively associated with minimum dietary diversity which effects were minimized in multivariate analysis.

Conclusion: The consumption of minimum dietary diversity was found to be moderate & more efforts need to be done to achieve the recommended minimum dietary diversity intake for all children aged between 6 and 23 months to tackle severe and moderate stunting.

Keywords: Minimum dietary diversity, stunting, infant and young child feeding practice, food groups, acceptable diet.

Introduction

Despite of recent progress in reducing the incidence of child malnutrition in Bangladesh, there are large disparities exists across gender, geographical regions, ethnic and economic groups. Bangladesh has made strides in reducing the prevalence of stunting nationally, falling from 41 percent in 2011 to 36 percent in 2014 (Research et al. 2011; Abir et al. 2015). Stunting is highest in the Sylhet division at 50 percent and lowest in Khulna at 28 percent. Stunting is most prevalent among children 18–23 months, indicating that poor complementary feeding and hygiene and sanitation practices are likely contributors to stunting in that age group. Wasting is deemed "high" in Bangladesh at 14 percent of children under 5 years, according to the 2017 public health prevalence thresholds (NIPORT 2016). There is huge disparity in chronic under nutrition according to maternal education and wealth levels—18 percent of children whose mothers have secondary education are stunted, while the rate rises to 47 percent of children whose mothers had no formal education. Similarly, 19 percent of children in the highest wealth quintile are stunted, while 49 percent of children in the lowest wealth quintile are stunted (Abir et al. 2015). In addition, children are more likely to be stunted in rural communities (38 percent) as compared to children from urban communities (31 percent) (UNICEF 2013). Inadequate infant and young child feeding (IYCF) practices also contribute to the high prevalence of under nutrition. The exclusive breastfeeding prevalence has declined since the last DHS in 2011 (from 64 percent in 2011 to 55 percent in -2014) and exclusive breastfeeding at 4–5 months has also declined since 2011 to 32 percent. Only around half of infants are exclusively breastfed for the first 6 months and only 23 percent of breastfed children 6–23 months are receiving a minimum acceptable diet (Research et al. 2011; Abir et al. 2015).

Children in rural communities are more likely to receive optimal breastfeeding practices than children from urban communities, with 53 percent of rural vs. 45 percent of urban infants being put to the breast within 1 hour of birth and 26 percent of rural vs. 32 percent of urban infants receiving harmful pre-lacteal feeds (Abir et al. 2015). However, rural infants are more likely to receive suboptimal complementary feeding practices as compared to children from urban communities. For example, among breastfed infants, 25 percent of rural infants received adequate dietary diversity as compared to 32 percent of urban infants, and only 21 percent of rural infants as compared to 28 percent of urban infants received a minimally acceptable diet (adequate food groups and frequency of feeds) (Hasan et al. 2018).

The impact of poor IYCF practices on undernutrition is exacerbated by a lack of access to improved sanitation facilities, which increases the risk of illness and infections that can impair nutrition and growth. Only 45 percent of households have an improved latrine and, although most households have a handwashing station (96 percent), only 21 percent of rural households and 48 percent of urban households have both water and soap for handwashing (UNICEF 2013).

Malnutrition and disease are interred linked with each other. Malnutrition in children is consequence of range of factors, which are often related to poor food quality, insufficient food intake, and severe and repeated infectious disease. Child nutrition status assessment not only serves as a means for survival of children but also provides an indirect measurement of the quality of life of an entire population (Ayaya et al. 2004). Nutritional assessment by anthropometric measurement is an important technique for identifying individuals, groups or communities whose growth is not keeping up with the expected pattern (STATISTICS 2005).

The World Health Organization (WHO) has established guidelines with respect to Infant and Young Child Feeding (IYCF) practices for children aged 6–23 months by considering Minimum Dietary Diversity (MDD) as one of the core eight indicators (Organization 2005). *"Minimum Dietary Diversity is the consumption of four or more food groups from the seven food groups for higher dietary quality and to meet daily energy and nutrient requirements of the seven recommended food groups namely: grains, roots and tubers; legumes and nuts; dairy products; flesh foods (meat, fish, poultry and organ meats); eggs; vitamin-A rich fruits and vegetables; other fruits and vegetables'' (Senarath and Dibley 2012).* This cut–off point was used due to its association with a better-quality diet both for breastfed and non-breastfed children (Daelmans, Dewey, and Arimond 2009). *"Consumption of foods from at least four food groups on the previous day would mean that in most populations the child had a high likelihood of consuming at least one animal-source food and at least one fruit or vegetable that day, in addition to a staple food (grain, root or tuber)'' (Senarath and Dibley 2012).*

Dietary Diversity (DD) is a major factor for all people to meet the requirements for essential nutrients. Improved feeding practices by provision of adequately diversified food can lead to improved intake of energy and nutrients, which leads to better nutritional status. In contrary, inappropriate feeding practice is one of the reasons for under nutrition in many developing countries where diets are mostly based on starchy staples (staple foods) and seasonal fruits

and vegetables with few or no animal products (Organization 2005).The main aim of this study was to determine the association between the level of minimum dietary diversity practice and anthropometric measures of nutritional status among children aged 6–23 months in Dhormopur Union of Sadar Upazilla, Noakhali, Bangladesh.

Methods and materials

Study design and participants

The study design was cross-sectional in nature. The components of the study were anthropometric, dietary, and socio-demographic characteristics. This study was conducted from 6th Murch to 28th April 2019. This small-scale nutrition survey was carried out in those families which had 6-23 months children at Dhormopur Union of Sadar Upazilla, Noakhali. The study area was selected randomly among the clusters of unions and the selection of households were also random.

A total of 110 children aged 6-23 months were included in the study based on availability and response of the household. Study tools were predesigned and pretested questionnaire, and modified infant and young children feeding practices questionnaire. Minimum dietary diversity and minimum acceptable diet of the children were taken by interviewing from the respondents.

Sample Size Calculation

The sample size was calculated assuming the rate of achieving minimum dietary diversity of children age between 6-23 months as 50%, precision level at 0.1, confident limits 90%. According to Cochran equation (Israel 1992) the sample size calculation was as follows:

$$n_o = \frac{z^2(1-P)P}{d^2}$$

$$= \frac{(1.96)^2 X(1-0.50)X0.50}{(0.1)^2}$$

$$= 96$$

After adding 10% non-respondent rate the final sample size was 106, however, finally information of 110 children was collected.

Measurement of dietary diversity

We measured dietary diversity in terms of dietary diversity scores (DDS), a common indicator that counts the number of food groups consumed over a certain period. Dietary diversity scores are categorical measures of the number of different food groups consumed. Minimum dietary diversity score for Infant & children (age 6-23 Months) which is used to calculate individual's dietary diversity score of household members. The present study also estimated the Minimum dietary Diversity Score for infant & children based on FAO guidelines (FAO, 2016). These dietary diversity score consist of a simple count of food groups that an infant & children has consumed over the preceding 24 hours recall period and MDD for infant & children were calculated by aggregating 7 food groups: (i) All cereals and tubers, (ii) Pulses, nuts and cereals, (iii) Milk and dairy products, (iv) Meat, fish and marine fish, (v) Eggs, (vi) Vitamin A rich dark green vegetables & Other Vitamin A rich vegetables & fruits, (vii) Other Fruits &Vegetables (FAO 2016).

Anthropometric measurements

The children's anthropometric status was determined using the World Health Organization Growth standards Z- scores (Turck et al. 2013).

Height: Children were measured in a standing position, using a free-standing height/length stadiometer. Before taking the reading, the survey enumerators ensured that the child was bare feet and that the heels, buttocks, shoulders, and the back of the head touched the stadiometer. Height was measured to the nearest 0.1 mm. Each of the measurements were taken twice and an average taken to ensure accuracy.

Weight: Children were weighed on a weight Machine. Children were weighed with minimum clothing, after emptying the bladder and without shoes. All the scales were calibrated by measuring a known weight to ensure that the correct measurement was achieved. Each of the measurements were taken twice and an average taken to ensure accuracy.

Children with a Z- score of less than −2SD for height- for- age were categorized as being stunted & -2 to 1SD were categorized as normal (Gibson 2005).

The Statistical Model

To analyze the relationship between anthropometric measures of nutritional status among children aged 6–23 months and the level of minimum dietary diversity practice in Dhormopur

Union of Sadar Upazilla, Noakhali, the following analytical procedure develops through Young Children Minimum Dietary Diversity (IYCF MDD) as the variables of interest.

The regression model is specifically constructed to assess the link between children nutritional status (stunting) and minimum dietary diversity score, excluding all other covariates. For the analytical procedure, Logistic regression will be employed. Furthermore, this model was extended for multivariate analysis to estimate the effect of children nutritional status (stunting) and minimum dietary diversity score. The equation 1.1 examined the effect of children nutritional status (stunting) and minimum dietary diversity score by controlling other covariates. The following regression models are formulated.

$$\text{Children NS}_{ij} = \alpha_0 + \alpha_1 DS_i + \varepsilon_{ij} \ldots\ldots\ldots\ldots (1)$$

where Children NS_i is the children nutritional status (stunting), DS_i is Minimum Dietary Diversity Score for children, which represent children's minimum dietary diversity of household i. ε_i is a random error term, and α_0 and α_1 are coefficients to be estimated. We are particularly interested in the estimate for α_1. To control of such other factors, in extended model specifications, we add additional explanatory variables.

Multivariate regression models with all available covariates are constructed to examine the change in the effect of children nutritional status (stunting) as follows:

$$\text{Children NS}_{ij} = \alpha_0 + \alpha_1 DS_i + \alpha_2 ME_i + \alpha_3 HS_{ii} + \varepsilon_{ij} \ldots\ldots\ldots\ldots\ldots (1.1)$$

where Children NS_i is the children nutritional status (stunting), DS_i is Minimum Dietary Diversity Score for children, ME_i is the mother education status, HS_i, is the socio-demographic characteristics such as Household size that may also influence children nutrition status (stunting), all referring to household $_i$. α_0, α_1, α_2 and α_3 are coefficients to be estimated, and ε_i is a random error term.

Ethical Considerations: Ethical approval was obtained from the Committee of Research cell, Faculty of Sciences, Noakhali Science & Technology University. The survey was done upon the approval of Dhormopur union Chairman, Sadar Upazilla, Noakhali and all the procedures were collaborated with the respective authorities. The survey objectives were shared to the respondents and household heads for their consent and upon their consent the study was carried out.

Results

General information

Table 1 shows that 34.5% children were aged 6-12 months, 50% male and 50% female, only 39.1% of mother's were secondary or more educated and 67.3% household had ≥6 family members.

Table 1: General information of the participating members assessed through nominal and ordinal variables.

Variable	Percentage (%)	N
Age groups		
6-12 months	34.5	38
13-18 months	32.7	36
More than 18 months	32.7	36
Sex		
Male	50	55
Female	50	55
Mother's education		
Uneducated	9.1	10
Primary completed	58.1	57
Secondary completed or more	39.1	43
Household size		
≤ 6 members	67.3	74
> 6 members	32.7	36

Descriptive statistics

The study shows that the average height for age z score are -1.6307 ± 1.75342 standard deviation, average height and weight were respectively 73.7221 ± 6.74260 standard deviation and 8.8864 ± 1.67532 standard deviation.

Table 2: Children anthropometric status

	Mean	±Std. Deviation	Minimum	Maximum
Children anthropometric status				
Age (months)	15.5218	5.17000	6	24
Height (cm)	73.7221	6.74260	58.00	90.00
Weight (kg)	8.8864	1.67532	5.50	15.00
MUAC (mm)	139.3500	19.54547	16.00	190.00
HAZ (Stunted)	-1.6307	1.75342	-7.76	2.96

Nutritional status of the child according to Height for Age z score (HAZ)

From the data analysis, we found that, out of 100, 40% were stunted and 60% children were normal. Stunting is a chronic malnutrition results from long time deprivation of enough nutrition which affect future work capacity and trigger to continue intergenerational poverty cycle and finally affect national economy.

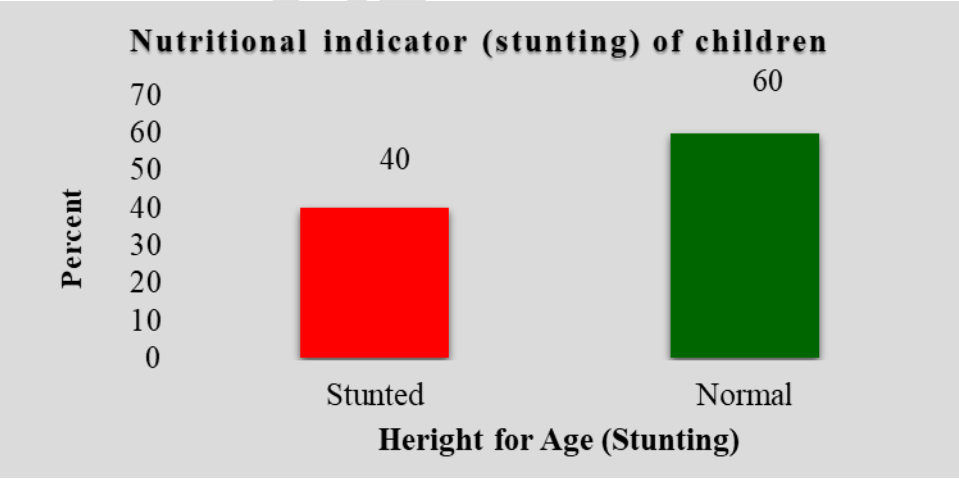

Figure 1: Nutritional indicators of children (6-23 months)

Minimum dietary diversity indicator of infant and young child feeding practices

From the study we found that, 61% children achieved minimum dietary diversity means that they consume more than four food groups above mentioned and 39% children did not achieve minimum dietary diversity.

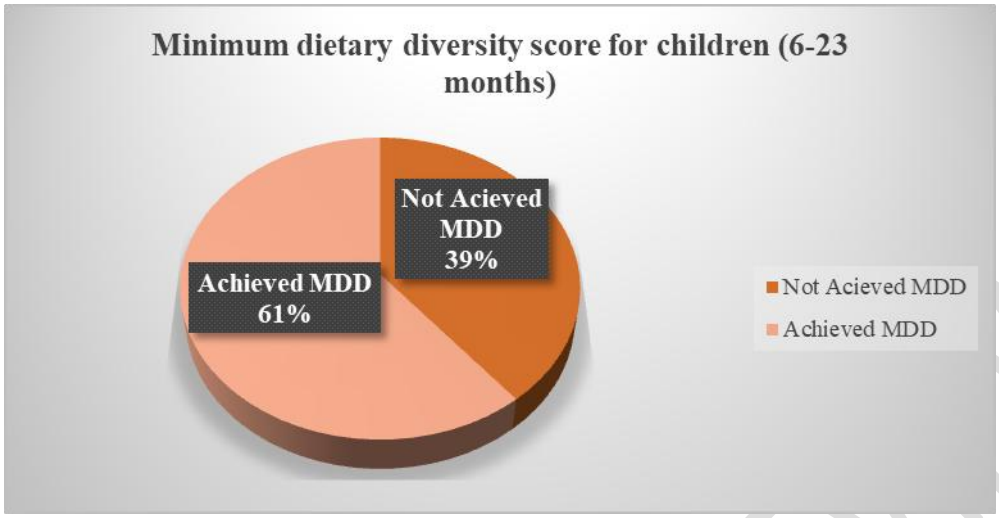

Figure 2: Minimum dietary score for children (6-23 months)

Relationship between children nutritional indicator (stunting) & minimum dietary diversity score of children

In this section, we established correlational aspect to understand the relation between children nutritional indicator (stunting) & minimum dietary diversity score of children. The children's nutritional status of the study households is significantly described by the children's minimum dietary diversity score because the Pearson Chi-square (p-value) significance level is .000 (p< .001) for of the children's nutritional status indicator. The accessed information is summarized into table 3.

Table 3: Prevalence of IYCF practices and nutritional status among children age 6-23 months.

Children Nutritional indicator (Stunting)	Minimum Dietary Diversity score for children		Pearson Chi-square p-value (sign. level)
	Achieved MDD [N (%)]	Not achieved MDD [N (%)]	
Stunted	9 (13.4)	35 (81.4)	50.406 (.000)
Normal	58 (86.6)	8 (18.6)	

The study shows that, the percentage of stunted children who achieved MDD were 13.4%, and 81.4% stunted children did not achieve MDD. On the other hand, 86.6% normal children achieved MDD and 18.6% normal children not achieved MDD. However, stunting prevalence was higher in children who didn't achieve MDD. It may be due to low family income, lack of mother's nutritional knowledge.

This mean that the children's nutritional status (stunting) is greatly influenced with children minimum dietary diversity score. There are a strong association between children's minimum dietary diversity and nutritional status (stunting) observed and significant difference exist between the categories of minimum dietary diversity level and stunting because the Chi-square p-value's significance level < .01 which mean that with increase in consumption of food groups the nutritional status (stunting) is improved for the respective children.

Association between children nutritional indicator (stunting) with minimum dietary diversity score of children

Table 4 provides result of logistic regression analysis (bivariate & multivariate) on models (children nutritional status [stunting]) where how minimum dietary diversity level affects household's children nutritional status (stunting) [model equations were discussed in Methods section].

Table 4: Association between children nutritional indicator (stunting) with minimum dietary diversity score of children

Minimum dietary diversity score of children (MDD)	**Height for age (stunting) (Stunted/Normal)**	
	Bivariate logistic regression (OR)	Multivariate logistic regression (OR)
Not achieved	0.035***	.012***
Achieved	1	1
SE	.531	1.11
Wald	39.549	15.809
Mother's education		
Uneducated	.019***	.008***

Primary completed	.055**	.012***
Secondary completed or more	1	1
SE	.656	1.184
Wald	19.662	13.843
Household size		
less or equal 6 members	6.57***	.059
> 6 members	1	1
SE	.449	.783
Wald	17.593	.356

***Significant at <0.05 level, ** Significant at <0.1 level

From the table it can be stated that the children nutritional status (stunting) is positively and strongly correlates with minimum dietary diversity score. This should not surprise in subsistence-oriented households, where children's growth is accelerated by foods consumed in the household. If we consider the Exponentiated (B) value, then it is possible to infer that children who had not achieved minimum dietary diversity had a higher risk for being stunted [Exp (B)=.035; 95% confidence interval (CI)= .013–.100, *P*=0.00] than the children who had achieved minimum dietary diversity.

Table 4 also describes the association of children's nutritional status (stunting) and minimum dietary diversity after controlling the effect of other significant explanatory variables. The explanatory variables which effects are minimized includes mother education status and household size which showed a significant effect in bivariate analysis. The result shows that even after controlling the effects of other variables- the association between children's nutritional status (stunting) and minimum dietary diversity is strong. In the multivariate analysis, children who had not achieved minimum dietary diversity had a higher risk for being stunted [adjusted Exp (B)=.012; 95% confidence interval (CI)= .001–.107, *P*=0.00] than the children who had achieved minimum dietary diversity. Similarly, mothers' education and household size were also positively associated with minimum dietary diversity child feeding practice which effects are minimized in multivariate analysis. Comparing the estimates suggests that consuming one additional food group would have a larger positive effect on children nutritional status than reducing the household size. The estimated marginal effects for minimum dietary diversity are positive in both models, but lower than those in

multivariate analysis. Comparison between bivariate & multivariate analysis suggests that the children's minimum dietary diversity score has a greater influence on children's nutritional status (stunting) than all other covariates which were included to control those models.

Discussion

Lack of dietary diversity is one of the severe problems among poor population in the resource limited countries. Their diets are monotonous and often include little or no animal products with few fresh fruits and vegetables. The diets consumed tend to be low in several micronutrients and the micronutrients they contain are often in a form that is not easily bioavailable, thus resulting in malnutrition. The effects of malnutrition on human performance, health and survival have been the subject of extensive research for several decades and studies showed that malnutrition affects physical growth. In this study, only 61% of the children aged 6-23 months had fed on four or more than four food groups meeting the minimum dietary diversity. This finding is like a study done in Sri-lanka (Khanal et al. 2014), however, it is much higher than the reported national 2011 DHS (Costello et al. 2018) and some other national studies (Dangura and Gebremedhin 2017; Mekbib et al. 2014). In this study only 86.6% normal children achieved MDD and 81.4% children who are stunted not achieved MDD. Only 39.1% mothers completed their secondary education and 9.1% mother's uneducated. Furthermore, it is higher than other studies done in Ghana (Saaka et al. 2016), east Delhi, India (Khan et al. 2012). Since this study was done at the rural center – the village of Bangladesh, mothers' might not have easy access to information or media and health services about dietary diversity and child feeding practices.

It might also be due to the difference in the study design and setting. However, this study and the above-mentioned studies were cross-sectional, most of them were community-based studies done in rural areas. In community-based studies, the overall estimate of optimum dietary diversity could be lower than health facility studies, which we noticed in these studies (Aemro et al. 2013; Fekadu et al. 2015). Moreover, differences in countries setting, the self-reported measurement and recall method could also influence the estimated minimum dietary diversity score.

The age of a child between 6 and 23 months is the critical windows of opportunity to prevent childhood malnutrition and is a period of growth faltering and malnutrition since children need more energy and nutrient dense foods to grow and develop. There will be frequent childhood illness like diarrheal diseases and infections as well as high nutrient requirement in

addition to breast milk to sustain normal development (Rao et al. 2011). Moreover, nutritional deficiencies during this period can lead to impaired cognitive development, growth retardation, smaller adult stature, and a consequence of compromised educational achievement and low economic productivity which become impossible to reverse later in life (Arimond and Ruel 2004). Therefore, during this period, proper infant and young child feeding practice; that is, appropriate, safe, adequate and frequent child feeding is important for the optimal growth of a child, better health and development (Dwyer et al. 2010).

Conclusion

Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods and is an also a proxy for nutrients adequacy of the diet of individuals. The study pinpointed the effect of dietary quality on one of the anthropometric indices (stunting) of children 6-23 months of age and the result reflects that a handful of children did not receive minimum dietary diversity. Hence, it is important to take proper actions and proper infant and young child feeding practices are pivotal to tackle nutritional problems and to prevent irreversible consequences among children.

Key messages

- Child under nutrition is a public health problem in developing country and the impact is more severe among children age 6-23 months.
- A dietary imbalance or a disregard for the nutritional needs of children during early childhood can affect their growth from the age of 6 months.
- In Bangladesh, only 39.6% of children age 6–23 months receives the minimum acceptable diet.
- Stunting is most prevalent among children 18–23 months, indicating that poor complementary feeding and hygiene and sanitation practices.
- In the multivariate analysis, children who had not achieved minimum dietary diversity had a higher risk for being stunted [adjusted Exp (B)=.012; 95% confidence interval (CI)= .001–.107, *P*=0.00] than the children who had achieved minimum dietary diversity.
- In this study, only 61% of the children aged 6-23 months had fed on four or more than four food groups meeting the minimum dietary diversity.

Data availability

Data will be available upon request

Ethics declarations

Ethical approval was obtained from the Committee of Research cell, Faculty of Sciences, Noakhali Science & Technology University.

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