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Malnutritional Status of 6-59 months Childs of Rural Families in Dinajpur Districts Bangladesh

Monika Khatun Sharna[1], Masuma Tunazzin Rim[2], Anusree Ghosh[3*], Anwara Akter Khatun[4], Uttam Kumar Majumder[5]

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ABSTRACT

The present status of malnutrition among the children of 6-59 months old was assessed from the rural families in selected areas of Dinajpur district. Anthropometric methods and the data were collected through a face-to-face interview using a semi-structured questionnaire. The prevalence of malnutrition was assessed using three indicators: stunting, under-weight, and wasting following the WHO guidelines and cut-off points. 165 children (6-59 months) and their household of three Upazila (Kaharole, Dinajpur Sadar and Birganj) in Dinajpur district were considered for study subjects. The prevalence of stunting, underweight, and wasting of 6-59 months old children in Dinajpur was 38.8%, 41.3%, and 12.1%, respectively. The mean height of male and female children were 82.99 cm and 84.15 cm. The mean weight of male and female children was 10.97 kg and 10.78 kg. Female children are more susceptible to malnutrition than male children. The main contributing factors for stunting and wasting children were religion, monthly income of the family, parent education, criteria of child's daily activity, and consumption of egg, cow milk, citrus fruits, leafy vegetables, other vegetables, rice, and pulses.

INTRODUCTION

In the Asian region, Bangladesh had one of the highest prevalence of malnutrition over the last two decades. Although Neonatal mortality, infant mortality, and under-5 mortalities have decreased, stunting, wasting, and underweight percentages of children are still very high compared globally. Children under the age of 5 years are at risk of malnutrition, especially those under 2 years of age more susceptible to undernutrition. Malnutrition is a condition that occurs when certain vital nutrients are deficient in a person's diet. The deficiency fails to meet the demands of the body, leading to effects on the growth, physical health, mood, behavior, and other functions of the body. Malnutrition has both short term and long-term consequences. The term malnutrition covers two broad groups of conditions. One is 'undernutrition'—which includes stunting (low height for age), wasting (low weight for height), underweight (low weight for age) and micronutrient deficiencies or insufficiencies (a lack of important vitamins and minerals) such as vitamin A deficiency, anemia and iron deficiency, iodine deficiency disorder (IDD), etc. The other is overweight, obesity and diet-related non-communicable diseases (such as heart disease, stroke, diabetes, and cancer). Children under 5 are also affected by macro and micronutrient deficiencies. Various factors influence malnutrition among children such as socio-demographic, environmental, reproductive, institutional, cultural, political, and regional factors (UNICEF-WHO-The World Bank, 2012). Malnutrition among children also depend on poor nutrition, inadequate food intake, inadequate breastfeeding of child, safe water. The growth of children greatly depend on food. Lack of food results in undernutrition, which can slow the growth of a child. Poor nutrition can also lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development, and reduced productivity which is irreversible. Good nutrition – an adequate, well-balanced diet combined with regular physical activity – is a cornerstone of good health. Healthy children are better in education, stronger, more productive, and more able to create opportunities to break the cycle of both poverty and hunger in a sustainable way (WHO, 2008). Malnutrition is alarming for developing countries including Bangladesh. It is due to improper knowledge about nutrition of food, ignorance, improper diet, illiteracy, lower family income, poverty, mother occupation, father occupation, densely populated area, sanitation, unhygienic environment, mother education about nutrition, family size, practice of breastfeeding, complete immunization is significant with nutritional status of children. An unhygienic environment and lack of sanitation lead to illness fever, diarrhea which can result in malnutrition. Low birth weight, low height, and weight of mothers who do not breastfeed also manipulate malnutrition. Food insecurity, particularly due to insufficient food access caused by high levels of poverty, as well as food price volatility, natural disasters, and limited land for cultivation. (Bosak *et al,* 2018).

It is necessary to increase the sincerity to find out the determinants of undernutrition and take efficient action to eliminate it in Low- and Middle-Income Countries (LMICs) like Bangladesh. Although various

[1] BRAC Health Programme, Manikganj, Bangladesh
[2] Department of Food Science and Engineering, Faculty of Engineering Sciences, German University Bangladesh, Dhaka, Bangladesh
[3] School of Education, Bangladesh Open University, Gazipur, Bangladesh
[4] Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh
[5] Statistics discipline, Khulna University, Khulna 9208, Bangladesh
[*] Corresponding author's e-mail: anusreeghosh62@gmail.com

NGO and government are working for malnutrition, lack of coordination to act on nutrition between and among government ministries, donors, different levels of government, and implementing bodies, such as nongovernmental organizations, at the local level (Chaparro *et al.*, 2014) make it difficult to eradicate malnutrition. This study aimed to explore the stunted, wasted, and underweight status of children (6-59 months old) in the study area in Dinajpur district, Bangladesh. The study's objective was to know the prevalence of nutrition and health status of children of the rural populations.

MATERIALS AND METHOD

The community-based cross-sectional study was conducted at different locations in the Dinajpur district of Bangladesh. The study area mainly covered Dinajpur Sadar, Kaharole, and Birganj upazila of Dinajpur district. Dinajpur is one of the extreme northern districts of Bangladesh. In Dinajpur, the poverty level is comparatively high compared with the national average. The study period was January 2017 to January 2018.

Sampling Design and Sample Size

The sample size was determined using the formula: $n = z^2pq / d^2$

Where,

n = required sample size

z = 90% of confident limits (1.645)

P= 0.36(The prevalence rate of stunting status of under five children in Bangladesh (BDHS, 2014).

d = Precision or error allowed in the study = 6.5% = 0.065

$n= Z^2 \times p(1-p)/m^2 = (1.645)2 \times 0.36 \times 0.64/ (0.065)^2 =147$

To find the adjusted sample size, allowing nonresponse rate of 20%, the adjusted sample size will be 147+20%=176. But in this study the children of under five families were found for data collection as sample 165.

Data Collection Instruments

A pre-coded and pre-tested questionnaire was administered to the respondents by asking questions. Both qualitative and quantitative data were collected by interviewing. The questionnaire was designed to collect a bulk of socio-economic, demographic characteristics, health, intake of food related questions.

Variables Used for this Study

Dependent and independent variables were selected first, before performing any statistical analysis.

Independent Variables

1. Age of children
2. Gender of children
3. Child breast feeding status
4. Educational level of mother
5. Educational level of father
6. Religion of family
7. Father occupation
8. Mother occupation
9. Monthly income of family
10. Total number of children of the family
11. Number of children under 5 years of age

Dependent Variables

1. Height-for-age Z-scores
2. Weight-for-age Z-scores
3. Weight-for-height Z-scores

Assessment of Nutritional Status

There are several ways to assess the nutritional status of children.

Stunting

Stunting referred to low height-for-age. A child who is stunted or chronically malnourished often appears to be normally proportioned but is actually shorter than normal for his/her age. Due to poor diets or recurrent infections Children who suffer from growth retardation tend to be at greater risk for illness and death. The effects of stunting are largely irreversible and generally occurs before age two.

Wasting

Wasting, or low weight for height, is a sturdy predictor of mortality among children under five. Wasting indicates current or acute malnutrition resulting from failure to gain weight or actual weight loss (Cogill,2003). It is the result of insufficient food intake or a high incidence of infectious diseases, especially diarrhea. It impairs the execution of the immune system and can lead to enlarged harshness and duration of and vulnerability to infectious diseases and an increased risk for death.

Underweight

Underweight means below a weight considered normal or desirable. A person may become underweight due to metabolism, drug use, lack of food (frequently due to poverty), eating disorder, or illness (both physical and mental), genetics, etc.

Anthropometric Indices

Anthropometric indices are an essential part of the interpretation of anthropometric measurements (WHO,1986). Indices are formed from two or more raw anthropometric measurements. Various types of anthropometric indices are:

Weight for Age Z - Scores (WAZ)

According to UNICEF, Moderate and severe - below minus two standard deviations from median weight for age of reference population; severe - below minus three standard deviations from median weight for age of reference population. W/A is commonly used for monitoring growth and to assess changes in the magnitude of malnutrition over time. Weight for age composite measure of height-for-age and weight-for-height, making interpretation difficult. Weight for age reflects body mass relative to age.

The reference standards (NCHS Cut-off point) of height and weight data are given below:
Severe (WAZ =< -3.00 SD)
Moderate (-2.99 =<WAZ =< -2.00)
Not underweighted (WAZ > -2.00 SD)

Weight-for-Height Z – Scores (WHZ)
According to WHO, is defined as a weight-for-age between -3 and -2 z-scores below the median of the WHO child growth standards. It can be due to a low weight-for-height (wasting) or a low height-for-age (stunting) or to a combination of both. Weight for height is a sensitive index of current nutritional status. The reference standards (NCHS Cut-off point) of height and weight data are given below:
Severe (WHZ =< -3.00 SD)
Moderate (-2.99 =<WHZ =< -2.00)
Not wasted (WHZ > -2.00 SD)

Height-for-Age Z –Scores (HAZ)
Children are defined as stunted if their height-for-age is more than two standard deviations below the WHO Child Growth Standards median (WHO, 2018). Low H/A relative to a child of the same sex and age in the reference population are referred to as "shortness". It cannot measure short term changes in malnutrition. Stunting is a slowing of skeletal growth and of stature, defined by Waterlow, et. al. (1977) as "the end result of a reduced rate of linear growth". It results from long time inadequate food intake and increased morbidity and is generally found in developing countries where economic conditions are poor. The reference standards (NCHS Cut-off point) of height and weight data are given below:
Severe (HAZ =< -3.00 SD)
Moderate (-2.99 =<HAZ =< -2.00 SD)
Not stunted (HAZ> -2.00 SD)

Formula for Calculating Z-Scores
Weight for age z= Observed weight at age X – Standard weight at age X/Standard deviation of weight at age X
Height for age= Observed height at height X – Standard height at age X/Standard deviation of height at age X
Weight for height =Observed weight at height X-Standard height at height X/Standard deviation of weight at height X

Software Used and Statistical Analysis for the Study
For socio-economic, demographic, health and food preferences data analysis, general statistical software SPSS22.0 was used. For identifying risk factors associated with child health and nutrition ANTHRO software was used to calculate Z-scores. For the chi-square test we used a custom table. The overall software used for data entry, data analysis, graphical representation and writing reports were SPSS 22.0, ANTHRO, MS WORD, MS-EXCEL etc. Descriptive measures, like, means, variances, proportions, standard error of mean were calculated. To test the significance of the association between two categorical variables Chi-square (X2)-test was used.

Logistic (binary) Regression
Binary logistic regression estimates the probability that a characteristic is present (e.g., estimate probability of 'success") given the values of explanatory variables, in this case a single categorical variable; π =Pr (Y=1/X=x).

Single Level Binary Logistic Regression
Let Y be a dichotomous dependent variable, say nutritional status taking values 0 and 1 and suppose that Y=I if a child is malnourished and Y=0 otherwise. Also let X be an independent variable. Then the form of the logistic regression model is

$$P = p(Y = 1/X) = \frac{e^{\beta_0+\beta_1 X}}{1+e^{\beta_0+\beta_1 X}}$$

$$\text{and, } 1-P = p(Y = 0/X) = \frac{1}{1+e^{\beta_0+\beta_1 X}}$$

Then a transformation of P known as the logic transformation and is defined as

$$g(x)= \text{logit } P= \log\left[\frac{P}{1-P}\right] = \beta_0 + \beta_1 X$$

The importance of this transformation is that g(x) has many of the desirable properties of a linear regression model. The logic, g(x) is linear in its parameters, may be continuous, and may range from -∞ to + ∞ depending on the range of x. For more than one independent variable the model can be generalized as

$$g(x) = \text{logit}(P_{ij}) = \beta_{0j} + \sum_{l=1}^{K} \beta_l X_{ijl}$$

Model Fit
To determine the factors associated with the response variables (e.g., stunning, wasting, and underweight) the cox's logistic regression model (single level) was fitted and the odds ratio of occurring an event was calculated for different independent variables using SPSS 22.0. All the independent variables found significant at the bi-variate analysis were considered but only the significant variables in regression analysis were retained in the final regression model. The possibility of multicollinearity and confounding was also explored. Interaction effects were tested and reported in the result section where found.

RESULTS AND DISCUSSION

Findings
The findings from the study are described below. The status of malnutrition noted in the table and graph are of the time period 2017 to 2018:

Food Intake
Table 1 determined the distribution of food intake frequencies of children (6-59 months) in a week of selected households on a categorical scale. This table indicated that 57.6% of children were breastfeeding and

42.4% children were not breastfed. 61.8% of children consumed meat sometimes or never, 33.9% consumed meat 2-4 days, 4.2% consumed 5-7 times per week. Regarding fish, 29.7% consumed sometimes or never, 47.3% consumed 2-4 times per week, 23% consumed 5-7 times per week. 35.8% of children sometimes or never, 32.7% children 2-4 times per week, 31.5% children 5-7 times per week consumed egg. Cow milk was consumed 2-4 times per week by 6.7 % children, 5-7 times per week by 23% children and 70.3% children consumed sometimes or never. In the case of citrus fruits, 47.9% children sometimes or never, 40% children 2-4 times per week, 12.1% children 5-7 times per week were consumed. 49.7% children sometimes or never, 33.9% children 2-4 times per week, 16.4% children 5-7 times per week consumed color fruits. Results implied that 56.4% children 2-4 times per week, 21.2% children 5-7 times per week and 22.4% children sometimes or never consumed leafy vegetables. Besides, color vegetables were consumed by 35.2% children sometimes or never, 2-4 times per week by 42.4% children, 5-7 times per week by 22.4% children.14.5% children sometimes or never, 67.9% children 2-4 times per week, 17.6% children 5-7 times per week consumed other vegetables. Most of the children, 94.5% were consumed rice bread and 5.5% children were not consumed. In case of pulses, 47.3% children sometimes or never, 33.9% children 2-4 times per week, 18.8% children 5-7 times per week consumed pulses. 23.1% children sometimes or never 47.3% children 2-4 times per week, 29.1% children 5-7 times per week consumed cake, biscuits etc.

Table 1: Percentage distribution of food intake frequencies of children per week of selected rural families having children (aged 6-59 months old) in Dinajpur district

Variables	Categories	No	%
Current breastfeeding of child	Yes	95	57.6
	No	70	42.4
	Subtotal	165	100.0
Meat consumption	Sometimes/never	102	61.8
	2-4 times/week	56	33.9
	5-7 times/week	7	4.2
	Subtotal	165	100.0
Fish consumption	Sometimes/never	49	29.7
	2-4 times/week	78	47.3
	5-7 times/week	38	23.0
	Subtotal	165	100.0
Egg consumption	Sometimes/never	59	35.8
	2-4 times/week	54	32.7
	5-7 times/week	52	31.5
	Subtotal	165	100.0
Cowmilk consumption	Sometimes/never	116	70.3
	2-4 times/week	11	6.7
	5-7 times/week	38	23.0
	Subtotal	165	100.0
Citrus fruit consumption	Sometimes/never	79	47.9
	2-4 times/week	66	40.0
	5-7 times/week	20	12.1
	Subtotal	165	100.0
Color fruit consumption	Sometimes/never	82	49.7
	2-4 times/week	56	33.9
	5-7 times/week	27	16.4
	Subtotal	165	100.0
Leafy vegetables consumption	Sometimes/never	37	22.4
	2-4 times/week	93	56.4
	5-7 times/week	35	21.2
	Subtotal	165	100.0

Color vegetables consumption	Sometimes/never	58	35.2
	2-4 times/week	70	42.4
	5-7 times/week	37	22.4
	Subtotal	165	100.0
Other vegetables consumption	Sometimes/never	24	14.5
	2-4 times/week	112	67.9
	5-7 times/week	29	17.6
	Subtotal	165	100.0
Rice, bread consumption	Yes	156	94.5
	No	9	5.5
	Subtotal	165	100
Pulse consumption	Sometimes/never	78	47.3
	2-4 times/week	56	33.9
	5-7 times/week	31	18.8
	Subtotal	165	100.0
Cake, biscuits consumption	Sometimes/never	39	23.6
	2-4 times/week	78	47.3
	5-7 times/week	48	29.1
	Subtotal	165	100

Nutritional Status of Children Under –Five of Selected Rural Families and Identification of Causal Factors

Table 2 showed that the average height of boys and girls were 82.99 cm and 84.16 cm. The average weight of boys and girls were 10.97 kg and 10.78 kg weight were significant. It indicated the average height of female children were higher than male children. But the average weight of male and female children was almost the same. The average weight for age for boy and girl were -1.53 SD and -1.66 SD. It showed that the value was greater than -2 SD which indicated normal underweight. The average height for age for boy and girl was -1.64 SD and -1.71 SD which were greater than -2 SD and also showed normal stunting status. The average weight for height of boy and girl was height -.67 SD and -.75 SD that were also greater than – 2 SD which showed normal wasting. Results of average z-scores also indicated that the prevalence of stunting, wasting and underweight children for female was higher than male children.

Table 2: Mean, Standard deviation and Standard error of mean of anthropometric indicators of 6-59 months old children of selected rural families by gender, 2017-18.

Gender		**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Height(cm)	Boy	82	82.9906	13.25411	1.46367
	Girl	83	84.1566	11.74473	1.28915
P value (t-test)	**.114**				
Weight(kg)	Boy	82	10.9721	3.10307	.34268
	Girl	83	10.7867	2.40962	.26449
P value (t-test)	**.006**				
Weight for age	Boy	82	-1.5356	1.10017	.12149
	Girl	83	-1.6698	1.12128	.12308
P value (t-test)	**.646**				
Height for age	Boy	82	-1.6483	1.29220	.14270
	Girl	83	-1.7187	1.44628	.15875
P value (t-test)	**.470**				
Weight for height	Boy	82	-.6723	1.20067	.13259
	Girl	83	-.7504	1.19436	.13110
P value (t-test)	**.921**				

Table 3: Mean, Standard deviation and Standard error of mean of anthropometric indicators according to age category of 6-59 months old children of selected rural families by gender, 2017-18.

Age in months	**6-12**				**13-24**				**25 and above**			
Gender	**Boy**		**Girl**		**Boy**		**Girl**		**Boy**		**Girl**	
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Height(cm)	67.25	1.13	63.71	1.02	76.87	1.55	74.19	1.12	92.17	1.31	90.56	1.08
Weight(kg)	7.47	0.30	7.81	0.42	9.52	0.51	8.78	0.26	13.04	0.31	11.93	0.27
Weight for age	-1.25	0.29	-0.39	0.52	-1.89	0.36	-1.71	0.23	-1.55	0.12	-1.82	0.14
Height for age	-1.35	0.29	-2.04	0.63	-1.93	0.35	-1.98	0.37	-1.69	0.19	-1.58	0.18
Weight for height	-0.51	0.37	1.68	0.39	-.83	0.41	-0.68	0.18	-0.69	0.11	-1.09	0.13

Table 3 demonstrated the mean and standard error of mean of the anthropometric indices according to age category of selected surveyed children of 6-59 months old. For children aged 6-12 months old, the mean of height of boy and girl were 67.25 cm and 63.71 cm. For children aged 13-24 months old, the mean of height of boy and girl were 76.87 cm and 74.19 cm. For children aged 25 and above months old, the mean of height of boy and girl were 92.17 cm and 90.56 cm. It clearly indicated that for each group of age the average height of male is higher than female. The average weight of male and female children were 7.47 kg and 7.81 kg for aged 6-12 months old, 9.52 kg and 8.78 for aged 13-24 months old, 13.04 kg and 11.93 kg for aged 25 and above months old children. Results indicated that weight of boy and girl was almost same at the age of 6-12 months old, but weight of male was higher than female for remaining two group. The mean z-scores value of weight for age for boy (-1.25 SD) and girl (-.39 SD) for aged 6-12 months old, boy (-1.89 SD) and girl (-1.71 SD) for 13-24 months old, boy (-1.55 SD) and girl (-1.82 SD) which were greater than -2SD that indicates normal underweight of children for each group. The mean z-scores value of height for age for boy (-1.35 SD) and girl (-2.04 SD) for aged 6-12 months old, boy (-1.93 SD) and girl (-1.98 SD) for 13-24 months old, boy (-1.69 SD) and girl (-1.58 SD) which were greater than -2SD that indicates normal underweight of children for each group. At age 6-12 months female were moderately stunted where male was normal. The remaining two group of age were normal. The mean z-scores value of weight for height for boy (-.51 SD) and girl (1.68 SD) for aged 6-12 months old, boy (-.83 SD) and girl (-.68 SD) for 13-24 months old, boy (-.69 SD) and girl (-1.09 SD) which were greater than -2SD that indicates normal wasting status of children for each group.

Among the 6-59 months old children of selected rural families. Among the children, 61.2% were not stunted, 22.4% were moderately stunted and 16.4% were severely stunted. Whereas 58.8% were not underweight, 35.2% were moderately uunderweight and 6.1% were severely underweight. Findings also shows that among them 87.9% of children were not wasted. 9.1% were moderately wasted, and 3% were severely wasted.

Table 4: Stunting status of children according to socio-demographic, economic and household charateristics of selected rural families having children (aged 6-59 months old) in Dinajpur district, 2017-2018.

Variables	**Categories**	**Stunting status**			
		Not Stunting		**Stunting**	
		No	**%**	**No**	**%**
Age of children in months	6-12	17	16.8	11	17.2
	13-24	18	17.8	18	28.1
	25 and above	66	65.3	35	54.7
	Subtotal	101	100.0	64	100.0
	Chi-square	**2.636NS**			
Gender	Male	51	50.5	31	48.4
	Female	50	49.5	33	51.6
	Subtotal	101	100.0	64	100.0
	Chi-square	**.066 NS**			

Religion	Muslim	79	78.2	58	90.6
	Hindu and others	22	21.8	6	9.4
	Subtotal	101	100.0	64	100.0
	Chi-square	**4.280***			
Type of family	Nuclear	79	78.2	43	67.2
	Joint	22	21.8	21	32.8
	Subtotal	101	100.0	64	100.0
	Chi-square	**2.474 NS**			
Father occupation	Farmer	35	34.7	22	34.4
	Day labour	38	37.6	26	40.6
	Service holder and other	28	27.7	16	25.0
	Subtotal	101	100.0	64	100.0
	Chi-square	**.201 NS**			
Mother occupation	Housewife	81	80.2	53	82.8
	Day labour	11	10.9	6	9.4
	Service holder and other	9	8.9	5	7.8
	Subtotal	101	100.0	64	100.0
	Chi-square	**.176 NS**			
Monthly income of family (Tk)	=<10000	58	57.4	27	42.2
	>10000	43	42.6	37	57.8
	Subtotal	101	100.0	64	100.0
	Chi-square	**3.642*** **			
Mother education	No formal education	29	28.7	9	14.1
	Primary	48	47.5	44	68.8
	Secondary and above	24	23.8	11	17.2
	subtotal	101	100.0	64	100.0
	Chi-square	**7.615***			
Father education	No formal education	32	31.7	20	31.2
	Primary	39	38.6	35	54.7
	Secondary and above	30	29.7	9	14.1
	Subtotal	101	100.0	64	100.0
	Chi-square	**6.314***			
Total number of children of family	1	41	40.6	27	42.2
	2-3 and above	60	59.4	37	57.8
	Subtotal	101	100.0	64	100.0
	Chi-square	**.041 NS**			
Number of children under 5 year	1	81	80.2	49	76.6
	2	20	19.8	15	23.4
	Subtotal	101	100.0	64	100.0
	Chi-square	**.310 NS**			
Criteria of child's daily activity	Very active	92	91.1	61	95.3
	Active several hours	9	8.9	3	4.7
	Subtotal	101	100.0	64	100.0
	Chi-square	**1.036 NS**			

*Note: Level of significance*p<0.05, **P<0.01, **P<0.10, NS = Not Significant*

Table 4 clearly shows the association with stunting status of children according to socio-demographic, economic and household characteristics of selected families. Results revealed that religion, monthly income of family mother education, father education had significant association with stunting status of children.

Table 5: Underweighting status of children according to socio-demographic, economic and household charateristics of selected rural families having children (aged 6-59 months old) in Dinajpur district, 2017-2018

Variables	Categories	Underweighting status			
		Not underweighted		Underweighted	
		No	%	No	%
Age of children in months	6-12	20	20.6	8	11.8
	13-24	18	18.6	18	26.5
	25 and above	59	60.8	42	61.8
	subtotal	97	100.0	68	100.0
	Chi-square	**3.000 NS**			
Gender	Male	53	54.6	29	42.6
	Female	44	45.4	39	57.4
	Subtotal	97	100.0	68	100.0
	Chi-square	**2.300 NS**			
Religion	Muslim	76	78.4	61	89.7
	Hindu and others	21	21.6	7	10.3
	subtotal	97	100.0	68	100.0
	Chi-square	**3.658*** **			
Type of family	Nuclear	71	73.2	51	75.0
	Joint	26	26.8	17	25.0
	Subtotal	97	100.0	68	100.0
	Chi-square	**.068 NS**			
Father occupation	Farmer	34	35.1	23	33.8
	Day labour	34	35.1	30	44.1
	Service holder and other	29	29.9	15	22.1
	subtotal	97	100.0	68	100.0
	Chi-square	**1.786 NS**			
Mother occupation	Housewife	76	78.4	58	85.3
	Day labour	13	13.4	4	5.9
	Service holder and other	8	8.2	6	8.8
	Subtotal	97	100.0	68	100.0
	Chi-square	**2.447 NS**			
Monthly income of family (Tk)	=<10000	52	53.6	33	48.5
	>10000	45	46.4	35	51.5
	subtotal	97	100.0	68	100.0
	Chi-square	**.413 NS**			
Mother education	No formal education	21	21.6	17	25.0
	Primary	53	54.6	39	57.4
	Secondary and above	23	23.7	12	17.6
	Subtotal	97	100.0	68	100.0
	Chi-square	**.941 NS**			
Father education	No formal education	33	34.0	19	27.9
	Primary	39	40.2	35	51.5
	Secondary and above	25	25.8	14	20.6
	Subtotal	97	100.0	68	100.0
	Chi-square	**2.055 NS**			

Total number of children of family	1	39	40.2	29	42.6
	2-3 and above	58	59.8	39	57.4
	Subtotal	97	100.0	68	100.0
	Chi-square	**.098 NS**			
Number of children under 5 year	1	75	77.3	55	80.9
	2	22	22.7	13	19.1
	Subtotal	97	100.0	68	100.0
	Chi-square	**.304 NS**			
Criteria of child's daily activity	Very active	91	93.8	62	91.2
	Active several hours	6	6.2	6	8.8
	Subtotal	97	100.0	68	100.0
	Chi-square	**.413 NS**			

*Note: Level of significance*p<0.05, **P<0.01, **P<0.10, NS = Not Significant*

Table 6: Wasting status of children according to socio-demographic, economic and household charateristics of selected rural families having children (aged 6-59 months old) in Dinajpur district, 2017-2018.

Variables	**Categories**	**Wasting status**			
		Not wasting		**Wasting**	
		No	**%**	**No**	**%**
Age of children in months	6-12	23	15.9	5	25.0
	13-24	32	22.1	4	20.0
	25 and above	90	62.1	11	55.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**1.043 NS**			
Gender	Male	73	50.3	9	45.0
	Female	72	49.7	11	55.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.201 NS**			
Religion	Muslim	120	82.8	17	85.0
	Hindu and others	25	17.2	3	15.0
	Subtotal	145	100.0	20	100.0
	Chi-square	.063 NS			
Type of family	Nuclear	108	74.5	14	70.0
	Joint	37	25.5	6	30.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.183 NS**			
Father occupation	Farmer	50	34.5	7	35.0
	Day labour	56	38.6	8	40.0
	Service holder and other	39	26.9	5	25.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.034 NS**			
Mother occupation	Housewife	119	82.1	15	75.0
	Day labour	14	9.7	3	15.0
	Service holder and other	12	8.3	2	10.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.657 NS**			

Monthly income of family (Tk)	=<10000	74	51.0	11	55.0
	>10000	71	49.0	9	45.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.111 NS**			
Mother education	No formal education	33	22.8	5	25.0
	Primary	80	55.2	12	60.0
	Secondary and above	32	22.1	3	15.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.526 NS**			
Father education	No formal education	45	31.0	7	35.0
	Primary	65	44.8	9	45.0
	Secondary and above	35	24.1	4	20.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.215 NS**			
Total number of children of family	1	59	40.7	9	45.0
	2-3 and above	86	59.3	11	55.0
	subtotal	145	100.0	20	100.0
	Chi-square	**.135 NS**			
Number of children under 5 year	1	115	79.3	15	75.0
	2	30	20.7	5	25.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.195 NS**			
Criteria of child's daily activity	Very active	137	94.5	16	80.0
	Active several hours	8	5.5	4	20.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**5.467***			

*Note: Level of significance*p<0.05**P<0.01, **P<0.10,, NS = Not Significant*

Table 6 clearly showed the association with stunting status of children according to socio –demographic, economic and household characteristics of selected rural families. Results revealed that criteria of child's daily activity had significant association with stunting status of children.

Table 7: Stunting status of children according to food intake frequencies of children per week of selected rural families having children (aged 6-59 months old) in Dinajpur district, 2017-2018.

Variables	**Categories**	**Stunting status**			
		Not Stunting		**Stunting**	
		No	**%**	**No**	**%**
Do you breastfeed your child	Yes	54	53.5	41	64.1
	No	47	46.5	23	35.9
	Subtotal	101	100.0	64	100.0
	Chi-square	**1.801 NS**			
Meat consumption	Sometimes/never	61	60.4	41	64.1
	2-4 times/week	36	35.6	20	31.2
	5-7 times/week	4	4.0	3	4.7
	Subtotal	101	100.0	64	100.0
	Chi-square	**.357 NS**			

Fish consumption	Sometimes/never	33	32.7	16	25.0
	2-4 times/week	48	47.5	30	46.9
	5-7 times/week	20	19.8	18	28.1
	Subtotal	101	100.0	64	100.0
	Chi-square	**1.959 NS**			
Egg consumption	Sometimes/never	28	27.7	31	48.4
	2-4 times/week	38	37.6	16	25.0
	5-7 times/week	35	34.7	17	26.6
	Subtotal	101	100.0	64	100.0
	Chi-square	**7.423***			
Cow milk consumption	Sometimes/never	65	64.4	51	79.7
	2-4 times/week	10	9.9	1	1.6
	5-7 times/week	26	25.7	12	18.8
	Subtotal	101	100.0	64	100.0
	Chi-square	**6.227***			
Citrus fruit consumption	Sometimes/never	41	40.6	38	59.4
	2-4 times/week	44	43.6	22	34.4
	5-7 times/week	16	15.8	4	6.2
	Subtotal	101	100.0	64	100.0
	Chi-square	**6.687***			
Color fruit consumption	Sometimes/never	49	48.5	33	51.6
	2-4 times/week	33	32.7	23	35.9
	5-7 times/week	19	18.8	8	12.5
	Subtotal	101	100.0	64	100.0
	Chi-square	**1.150 NS**			
Leafy vegetables consumption	Sometimes/never	22	21.8	15	23.4
	2-4 times/week	58	57.4	35	54.7
	5-7 times/week	21	20.8	14	21.9
	Subtotal	101	100.0	64	100.0
	Chi-square	**.122 NS**			
Color vegetables consumption	Sometimes/never	38	37.6	20	31.2
	2-4 times/week	39	38.6	31	48.4
	5-7 times/week	24	23.8	13	20.3
	Subtotal	101	100.0	64	100.0
	Chi-square	**1.552 NS**			
Other vegetables consumption	Sometimes/never	17	16.8	7	10.9
	2-4 times/week	65	64.4	47	73.4
	5-7 times/week	19	18.8	10	15.6
	Subtotal	101	100.0	64	100.0
	Chi-square	**1.638 NS**			
Rice, bread consumption	Yes	97	93.1	62	96.9
	No	7	6.9	2	3.1
	Subtotal	101	100	64	100
	Chi-square	**1.100 NS**			
Pulse consumption	Sometimes/never	49	48.5	29	45.3
	2-4 times/week	34	33.7	22	34.4
	5-7 times/week	18	17.8	13	20.3
	Subtotal	101	100.0	64	100.0

	Chi-square	**.220 NS**			
Cake, biscuits consumption	Sometimes/never	26	25.7	13	20.3
	2-4 times/ week	46	45.5	32	50
	5-7 times/week	29	28.7	19	29.7
	Subtotal	101	100	64	100
	Chi-square	**.666 NS**			

*Note: Level of significance*p<0.05, **P<0.01, **P<0.10, NS = Not Significant*

Table 7 clearly revealed the association with stunting status of children according to food intake frequencies of children per week of selected rural families. Results indicated that consumption of egg, cow milk, citrus fruit per week had significant association with stunting status of children.

Table 8: Underweight status of children according to food intake of children per week of selected rural families having children (aged 6-59 months old) in Dinajpur district, 2017-2018.

Variables	**Categories**	**Underweighting status**			
		Not Underweighted		**Underweighted**	
		No	**%**	**No**	**%**
Do you breastfeed your child	Yes	57	58.8	38	55.9
	No	40	41.2	30	44.1
	Subtotal	97	100.0	68	100.0
	Chi-square	**.136 NS**			
Meat consumption	Sometimes/never	64	66.0	38	55.9
	2-4 times/week	31	32.0	25	36.8
	5-7 times/week	2	2.1	5	7.4
	Subtotal	97	100.0	68	100.0
	Chi-square	**3.569 NS**			
Fish consumption	Sometimes/never	29	29.9	20	29.4
	2-4 times/week	45	46.4	33	48.5
	5-7 times/week	23	23.7	15	22.1
	Subtotal	97	100.0	68	100.0
	Chi-square	**.089 NS**			
Egg consumption	Sometimes/never	33	34.0	26	38.2
	2-4 times/week	34	35.1	20	29.4
	5-7 times/week	30	30.9	22	32.4
	Subtotal	97	100.0	68	100.0
	Chi-square	**.613 NS**			
Cow milk consumption	Sometimes/never	69	71.1	47	69.1
	2-4 times/week	7	7.2	4	5.9
	5-7 times/week	21	21.6	17	25.0
	Subtotal	97	100.0	68	100.0
	Chi-square	**.325 NS**			
Citrus fruit consumption	Sometimes/never	46	47.4	33	48.5
	2-4 times/week	39	40.2	27	39.7
	5-7 times/week	12	12.4	8	11.8
	Subtotal	97	100.0	68	100.0
	Chi-square	**.025 NS**			

Color fruit consumption	Sometimes/never	48	49.5	34	50.0
	2-4 times/week	33	34.0	23	33.8
	5-7 times/week	16	16.5	11	16.2
	Subtotal	97	100.0	68	100.0
	Chi-square	**.005 NS**			
Leafy vegetables consumption	Sometimes/never	24	24.7	13	19.1
	2-4 times/week	52	53.6	41	60.3
	5-7 times/week	21	21.6	14	20.6
	Subtotal	97	100.0	68	100.0
	Chi-square	**.902 NS**			
Color vegetables consumption	Sometimes/never	34	35.1	24	35.3
	2-4 times/week	42	43.3	28	41.2
	5-7 times/week	21	21.6	16	23.5
	Subtotal	97	100.0	68	100.0
	Chi-square	**.106 NS**			
Other vegetables consumption	Sometimes/never	14	14.4	10	14.7
	2-4 times/week	65	67.0	47	69.1
	5-7 times/week	18	18.6	11	16.2
	Subtotal	97	100.0	68	100.0
	Chi-square	**.157 NS**			
Rice, bread consumption	Yes	90	92.8	66	97.1
	No	7	7.2	2	2.9
	Subtotal	97	100	68	100
	Chi-square	**1.417 NS**			
Pulse consumption	Sometimes/never	46	47.4	32	47.1
	2-4 times/week	35	36.1	21	30.9
	5-7 times/week	16	16.5	15	22.1
	Subtotal	97	100.0	68	100.0
	Chi-square	**.978 NS**			
Cake, biscuits consumption	Sometimes/never	26	26.8	13	19.1
	2-4 times/week	41	42.3	37	54.4
		30	30.9	18	26.5
	Subtotal	97	100	68	100
	Chi-square	**2.519 NS**			

*Note: Level of significance*p<0.05, **P<0.01, **P<0.10, NS = Not Significant*

Table 9: Wasting status of children according to food intake of children per week of selected rural families having children (aged 6-59 months old) in Dinajpur district, 2017-2018.

Variables	**Categories**	**Wasting status**			
		Not wasting		**wasting**	
		No	**%**	**No**	**%**
Do you breastfeed your child	Yes	84	57.9	11	55.0
	No	61	42.1	9	45.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.062 NS**			
Meat consumption	Sometimes/never	91	62.8	11	55.0
	2-4 times/week	49	33.8	7	35.0
	5-7 times/week	5	3.4	2	10.0

	Subtotal	145	100.0	20	100.0
	Chi-square	**1.957 NS**			
Fish consumption	Sometimes/never	42	29.0	7	35.0
	2-4 times/week	69	47.6	9	45.0
	5-7 times/week	34	23.4	4	20.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.331 NS**			
Egg consumption	Sometimes/never	54	37.2	5	25.0
	2-4 times/week	45	31.0	9	45.0
	5-7 times/week	46	31.7	6	30.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**1.801**			
Cow milk consumption	Sometimes/never	103	71.0	13	65.0
	2-4 times/week	8	5.5	3	15.0
	5-7 times/week	34	23.4	4	20.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**2.552 NS**			
Citrus fruit consumption	Sometimes/never	69	47.6	10	50.0
	2-4 times/week	58	40.0	8	40.0
	5-7 times/week	18	12.4	2	10.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**.106 NS**			
Color fruit consumption	Sometimes/never	70	48.3	12	60.0
	2-4 times/week	49	33.8	7	35.0
	5-7 times/week	26	17.9	1	5.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**2.290 NS**			
Leafy vegetables consumption	Sometimes/never	32	22.1	5	25.0
	2-4 times/week	78	53.8	15	75.0
	5-7 times/week	35	24.1	0	.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**6.297***			
Color vegetables consumption	Sometimes/never	48	33.1	10	50.0
	2-4 times/week	62	42.8	8	40.0
	5-7 times/week	35	24.1	2	10.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**3.026NS**			
Other vegetables consumption	Sometimes/never	19	13.1	5	25.0
	2-4 times/week	97	66.9	15	75.0
	5-7 times/week	29	20.0	0	.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**5.880*****			
Rice, bread	Yes	139	95.9	17	85
	No	6	4.1	3	15
	Subtotal	145	100	20	100
	Chi-square	**4.021*****			

Pulse consumption	Sometimes/never	66	45.5	12	60.0
	2-4 times/week	54	37.2	2	10.0
	5-7 times/week	25	17.2	6	30.0
	Subtotal	145	100.0	20	100.0
	Chi-square	**6.146***			
Cake, biscuits consumption	Sometimes/never	32	22.1	7	35.0
	2-4 times/week	69	47.6	9	45.0
	5-7 times/week	44	30.3	4	20
	Subtotal	145	100	20	100
	Chi-square	**1.915 NS**			

*Note: Level of significance*p<0.05, **P<0.01, **P<0.10, NS = Not Significant*

Table 9 showed the association with children's wasting status according to children's food intake frequencies per week of selected families. Results revealed that consumption of leafy vegetables, other vegetables, rice, bread, pulses per week had significant association with wasting status of children.

Binary logistic regression analysis was performed to identify the factors affecting the stunting status of the rural children in the study area in Dinajpur. For this analysis, we merged two categories of stunting i.e., severe and moderate as stunted (code1) and other category remained as not stunted (code 0). Various socio-demographic and economic variables such as gender, religion, type of family, father occupation, mother occupation, monthly income of family, mother education, father education, age of children was inserted in the binary logistic regression model as independent categories.

Table 10: Results of binary logistic regression analysis of significant studied variables for stunting of children aged 6-59 months old of selected rural families according to socio-demographic, economic and household characteristics in selected areas Dinajpur district, 2017-18.

Variables	Level	B	S.E	DF	P value	Odds ratio (OR)	95% C.I. for OR	
							Lower	Upper
Type of family	Nuclear	-.776	.401	1	.053	.460	.210	1.011
	Joint (RC)	-	-	-	-	1.00	-	-
Monthly income of family	=<10000	0.224	.180	1	.003	1.251	0.879	1.780
	>10000 (RC)	-	-	-	-	1.00	-	-
Father education	No formal education	1.739	.514	1	.001	5.691	2.080	15.572
	Primary	1.700	.573	1	.003	5.472	1.782	16.807
	Secondary and above (RC)	-	-	-	-	1.00	-	-

*Note: RC-Reference category; Level of significance*p<0.05, **P<0.01*

Table 10 showed the significant studied variables for stunting status of selected rural families children aged 6-59 months old at study area in Dinajpur district. The variables like type of family, monthly income of family and father education were statistically significant variables with stunting status of children. Result shows that children of nuclear families were .460 times lower risk of being stunting then joint families. It means the risk of stunting number decreases among children with the increase the family members. The families having monthly income <= 10,000 (TK) had 1.250 times higher risk of being stunted than monthly income of family more than 10,000 (TK). It implied risk of stunting status reduced among children with the increase of their monthly income.

Children stunting status increased in 5.69 and 5.47 times for the No formal and Primary educated fathers respectively compared to the children of Secondary and above level educated fathers. It indicated that risk of stunted children reduced with the increase of their father's education.

Table 11: Results of binary logistic regression analysis of significant studied variables for stunting of children aged 6-59 months old of selected rural families according to food consumption frequencies of children in selected areas of Dinajpur district, 2017-18.

Variables	Level	B	S.E	DF	P value	Odds ratio (OR)	95% C.I. for OR	
							Lower	Upper
Fish consumption	Sometimes/ never	1.058	.536	1	.020	2.880	1.007	8.236

	2-4 times/week	.437	.375	1	.358	1.548	.742	2.228
	5-7times/week (RC)	-	-	-	-	1.00	-	-
Egg consumption	Sometimes/ never	1.019	.475	1	.032	2.772	1.092	7.036
	2-4 times/week	.062	.484	1	.497	1.064	.412	2.747
	5-7times/week (RC)					1.00		
Cow milk consumption	Sometimes/ never	.397		1	.247	1.487	.651	3.396
	2-4 times/week	.818	.615	1	.048	2.265	.678	2.023
	5-7times/week (RC)	-	-	-	-	1.00	-	-

*Note: RC-Reference category; Level of significance*p<0.05, **P<0.01*

In table 11 we used different food consumption habits such as meat, fish, egg, cow milk, citrus fruits, color fruits and other, leafy vegetables, color vegetables, other vegetables, rice, pulses consumption per week to find out the stunting status of children using binary logistic regression model. For this analysis, we merged two categories of stunting i.e., severe and moderate as stunted (code1) and other category remained as not stunted (code 0).

Table 11 showed the result of binary logistic regression analysis of significant studied variables for stunting of selected rural families children aged 6-59 months old at study area in Dinajpur district. The variables like fish consumption, egg consumption and cow milk consumption were found statistically significant with stunting status of children. Children who consumed fish sometimes/never were 2.280 times higher risk of being stunted than who consumed 5-7 times/week. It implied the risk of stunting reduced among children with the increase of fish consumption. Children who consumed egg sometimes/never per week were 2.722 times higher risk of being stunted than who consumed 5-7 times/week. It implied the risk of stunting reduced among children with the increase of egg consumption also. Children who consumed cow milk 2-4 times/week were 2.265 times higher risk of being stunted than who consumed 5-7 times/week. That means the risk of stunting number reduced among children with the increase of cow milk consumption the child age under five.

DISCUSSION

Majumdar et. al. (2011) has conducted a similar study Socioeconomic and Demographic Determinants: Malnutrition of 6-59 Months Old Rural Santal Children and Food Security Status of Their Families in Dinajpur during 2011-12. That study found that factor showing significant role of hunger families are age of HH head, occupation of housewife, earning family members, monthly family income and child breastfeeding status. The currents study supports the statements. Islam and Biswas (2015) stated the same. ng children under the age of five. In rural areas, stunting prevalence rate was found to be more than six times higher than in urban areas. Income inequality was also a significant predictor of stunting. Similarly, the level of mother's education is strongly related to stunting: the higher the level of mothers' education, the lower the prevalence rate of stunting among children under five. Since wealth or income is a strong predictor of place of residence (urban/rural) as well as mothers' level of education. Hoque *et al.* (2016) conducted a survey on nutritional Status among under-5 Children of a selected slum in Dhaka city. Regarding Anthropometric assessment according to weight for height Z-score, 39% were wasted moderately and 13% were severely wasted and height for age Z-score, showed 47% of children were stunted moderately and 14% children were severely stunted. According to weight for age Z- score, 46% of children were moderately underweight and 16% children were severely underweight. Mustafa *et al.* (2017) surveyed of nutritional Status of Children of Under-5, attending a District Hospital – A Secondary Level Care Hospital at Gazipur District Hospital. Their findings reflects that the rural children are more unfortunate. A study conducted by Roy Roy *et al.* (2015) found that breastfeeding practice and monthly family income were significantly associated with wasting, stunting and underweight. Children who were not exclusively breast fed had higher rate of moderate wasting (59.5%), stunting (70.5%) and underweight (74.6%). Children with illiterate father were found to have more odd value of having wasting, stunting and underweight compared to literate father. Furthermore, early age (6-24 month) of children is more susceptible for malnutrition as compared to the age (25-59 months) of children. Bosak *et al.* (2018) reviewed the contribution of the non-government organizations in Bangladesh studying the malnutrition status in Dinajpur. Analyses determined that only 21.2% households were food secured, while 78.8% households were insecure. Among the insecure families about 19.4% households were insecure in food without hunger, 20.6% households were food insecure with moderate hunger and 38.8% families were insecure in food with severe hunger. Overall, 59.4% farmers' families were hunger and rest of them was not hunger (40.6%). But food insecurity level as well as hunger families were more prevalent among the families of landless farmers compared to marginal and small groups. Only 3.6% families give rich foods to the female child. Binary logistic regression analysis found that total land of the family, total family members and monthly family income were the significant contributing factors for determining hunger and not-hunger families. According to Rahman *et al.* (2017) family income, maintain proper diet during pregnancy period, proper

diet maintains for children have negative significant effect on child malnutrition. Debnath *et al.* (2017) accompanied a survey on malnutrition and morbidity profile of under Five in a rural area of Bangladesh. They found that about one-third (33.5%) of the children were stunted in Height for Age Z score. While 23.3% were moderately wasted and 6.5% were severely wasted in Weight for Height Z score. Severely underweight was 8.6%, 20.6% were moderately underweight and 70.8% of the children's weight was within the normal limit for their age. In MUAC measurement, about one-fourth (21.8%) were moderate acute malnutrition (MAM) and 1.1% were severe acute malnutrition (SAM). Most prevalent disease (45.0%) was the diarrhoeal disease with respiratory tract infection was 32.0% and pneumonia was 18.0%.

CONCLUSION

Although the stunting, underweight, and wasting status of children have decreased in the past few years, the percentage rate is still high in Bangladesh and is a serious problem for our country. In the study area, the prevalence of underweight children (41.3%) was comparatively higher than stunted children (38.8%) and wasted children (12.1%). Results showed that the prevalence of stunting and underweight status were higher than the national level of Bangladesh, which is very concerning. The female children were more stunted, underweighted and wasted than male children. Religion, the family's monthly income, the mother's education, and the father's education were considerably dependent on the stunting status of the children. But wasting status of children was associated with criteria of child daily activity. Egg, cow milk, and citrus fruit consumption was also dependent on the stunting status of children. But leafy vegetables, other vegetables, rice bread, and pulse consumption depended on children's wasting status. The type of family, Monthly income of the family, and the father's education were major determinants of the stunting status of children. Consumption of fish, cow milk, and egg were also the most important determinants of the stunting status of children. It is necessary to increase awareness about child nutrition and the quantity of food consumed. Educating presents by training about the nutrition of child, nutrition of food and diet chart of children. Persuading father and mother to regularly measure the height and weight of children will improve the situation. Government and NGOs should pay concentration to the nutrition status of rural children in relation to underweight and stunting.

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