Original Article

Nutritional status and dietary intake pattern among under-5 children of ethnic minorities living in Chittagong Hill Tracts, Bangladesh: Influence on socioeconomic and dietary factors on chronic malnutrition

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Abstract

Background: Present study retrospectively investigated the nutritional status and nutrient intake pattern of under-5 (U5) children of ethnic minorities living in three districts of Chittagong hill tracts (CHTs) of Bangladesh. **Materials and Methods:** In 2022, data of 232 children (aged 1-5 years) under 505 male-headed households of three hilly districts were extracted from the Nutrition, Health, and Demographic Survey (NHDS, 2013), rearranged and analyzed to determine which socioeconomic/dietary factors are associated with the prevalence of malnutrition among U5 ethnic children. NHDS was a cross-sectional survey, under the framework of the integrated multipurpose Sample (IMS) design, conducted among Bangladeshi people of all ages including ethnic minorities living in three districts (e.g., Rangamati, Khagrachori, and Bandarban) of CHTs. 'WHO (2006) child growth standard' was used to assess U5 nutritional status, 24-hour dietary recall for 'Nutrient intake' assessment, and all data were analyzed employing statistical software packages. **Results:** Most of the fathers/mothers were in the 26-35 age groups while respectively 56.1% and 34.1% fathers and mothers had formal education. Majority (47.4%) of the fathers were farmers, and mothers (69.8%) were house makers with a mean income of 9956.7±459.0 and 2612.8±149.1 BDT, respectively. The overall prevalence of stunting, wasting, and underweight were respectively 28.5%, 20.3%, and 24.6%, with no gender differences (P>0.05). Nutrient analysis indicates the majority of U5 children's (especially 1-3 years) diet were deficient in calcium and vitamin A, who met 58.0% of recommended dietary allowances (RDA) for both nutrients. However, RDA fulfillment of protein, iron, and vitamin C were much higher than the recommended level. Multiple logistic regression outlined that the father's illiteracy (aOR=4.9), and income ≤7000 BDT (aOR=3.4), <4 dietary diversity score/DDS (aOR=4.1), <1650 Kcal intake/day (aOR=2.9), and calcium intake ≤250 mg/day (aOR=2.6) were significantly associated with the prevalence of stunting. **Conclusion:** Higher prevalence of chronic malnutrition was observed among U5-children living in CHTs, Bangladesh. Majority of U5 children's diet deficient in energy, calcium, and vitamin A, especially in the 1-3 years.

Keywords: Under-5 children; Ethnic minorities; Chittagong Hill Tracts; Nutrient intake, Stunting; Chronic malnutrition

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Introduction

There are about forty-five different tribal groups spread across Bangladesh. The proportion of the tribal population in the 64 districts varies; together, they constitute about 1% of the total population of the country (about 12 million according to the1991 census). Of them, 56% resided in Rangamati, 48.9% in Kagrachari, and 48% in Bandarban district of the Chittagong Hill Tracts (CHTs) of Bangladesh. The CHTs, the hilly forested south-eastern region of Bangladesh is the traditional homeland of the Jummas, a group of 12 different indigenous peoples (Chakma, Marma, Tripura, Tanchangya, Mro, Lushai, Pangkhua, Bawm, Chak, Khumi, Khyang, and the Rakhine). The tribal groups belong to different ethnic-lingual communities, profess diverse faith,

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have unique cultures different from mainstream plain-land Bengali people, and are at different levels of development (economically and educationally). All of them are descendants of different sects of Mongoloid families and moved into the region between the 14th to mid-16th centuries. Most of them inhabit in hard to reach areas such as hilly terrains or forest areas where access is generally tricky. Moreover, many of these tribal groups are also characterized by slow/low growth rates compared to the mainstream population. The Chakmas, Tripuras, Marmas, and Mros are the four major ethnic groups in the region, besides the Bengali people who also recently inhabited the regions.[1]

Optimum nutrition is the prime need for child's survival, health, and development as it reflects the overall health status. A child's nutritional status in terms of anthropometry and nutrient intake is a proximate determinant of proper growth and development. Well-nourished children have a better start in life, perform better in school, and grow into healthier adults. Both macronutrient and micronutrient deficiencies in early childhood affects mental development and learning ability later in life, thus malnourished children are at higher risk of morbidity and mortality. Furthermore, U5 are more susceptible to infection, undernourishment at earlier age of development links with infections; malnutrition-infection is a vicious cycle, affects overall physical, mental development, and learning ability as well. Childhood under nutrition is a major public health problem especially in low and middle income countries (LMICs).[2,3] Globally child malnutrition is responsible for about one-third of child deaths. Historically, tribal communities have lagged behind the general population regarding most socioeconomic aspects, and one such aspect is the nutritional status of children.[4] Studies reported about ethnic minorities of hilly zones of CHTs more than one decade's earlier.[5,6] Most National level health surveys[7,8] did not focus on these groups separately except for the earlier Nutrition, Health, Demographic Survey, Bangladesh (NHDS, Bangladesh), which reported on nutrition and health status of ethnic minorities of CHTs. However, under-five children of ethnic minorities was not reflected properly in this survey. Earlier studies[5,6] showed that CHT is one of the country's most disadvantaged and vulnerable regions due to a lack of economic opportunities and proper functioning of social services. Higher illiteracy rates, poor water, environment, and Sanitation, low health-seeking behavior, and higher unemployment rates make them underprivileged. Moreover, the rough terrain, remoteness of villages, scattered communities, the multiplicity of the language, poor or nonexistent road infrastructure, and various political issues associated with a protracted conflict have seriously impeded the region's economic development. Health, nutrition, and population services in CHT had multiple geographical, environmental, infrastructural, and institutional challenges. However, few recent studies indicate that the overall development of the CHTs, in Bangladesh, is somewhat promising, and the inhabitants' health, nutrition, and education status are improving, under-5 nutritional status is declining, especially in the Chakma community of Rangamati district, and overall stunting rates are declining than the national average.[9,10]

Recent researches revealed that increased prevalence of under nutrition among tribal children of India was not due to ethnicity rather than socio-economic variables.[11] Previous study[12] showed that under nutrition is still a significant public health problem among U5 tribal children and is associated with maternal literacy, socioeconomic condition, and morbidities. The leading underlying cause of under nutrition among tribal children of India is their poor socioeconomic conditions.[11,13] The main factors affecting these children's health and nutritional status are poverty, dependence on the forest, low-quality food inaccessible habituation, vegetarian diet, and non-availability of regular health service.[14] Debnath and Bhattacharjee (2016) found that a conditional inverse association between child malnutrition and women's empowerment in tribal communities.[15]

No national level survey, even though no individual research initiative was taken to focus on U5 tribal children's nutritional status during the last decade. Given the importance of the declining trend of U5 nutritional status among general population,[7,8] this study attempt to investigate nutritional situation of U5 tribal children retrospectively. As data regarding ethnic minorities, especially those under-five, are scanty, and a decade earlier, so is the importance of assessing the present nutrition situation among U5-ethnic children. This study attempted to extract data from the NHDS survey in Bangladesh to find out how socioeconomic and dietary variables are going to be associated with the prevalence of malnutrition among U5-children of ethnic minorities. On top of that, U5 nutritional status, determination of macro and micronutrient consumption, and quality of nutrient intake patterns of 3 hilly districts are still unavailable, these are not at the forefront of research.

Materials and Methods

Study population and sites: In 2022, socio-demographic, anthropometric, and dietary data were extracted from the previous Nutrition, Health, Demographic Survey, Bangladesh (NHDS, BD, 2013). Two hundred thirty-two (n=232) U5 ethnic children of 505 households from three hilly districts of CHTs were extracted from NHDS, BD and analyzed to determine which socioeconomic/dietary factors are associated with the prevalence of malnutrition among U5 ethnic children. To avoid counting households more than once and minimize recall bias, all households having under five years of children were selected for the study.

Study design and sampling: The study mentioned above was cross-sectional in nature, was under the framework of Integrated Multipurpose Sample (IMPS) design, developed based on the sampling frame of the 'Population and Housing Census, 2001'. This survey was carried out by the Institute of Nutrition and Food Science, University of Dhaka; sstandardized questionnaires were used for the data collection, and respondents (fathers/mothers/ household heads/spouses) were interviewed personally. A multistage cluster sampling technique was employed, and data were collected according to the probability proportional to size (PPS).

The main 'study protocol' was approved by the Faculty of Biological Science's ethical review committees, University of Dhaka. Both oral and written consent were obtained from each participant. According to the Helsinki Declaration, confidentiality was ensured during and after data collection.

Measures

Outcome variable: Using world health organization (WHO)16 child growth standards, the prevalence of childhood malnutrition of the ethnic U5-children was assessed using three malnutrition classifications (stunting, wasting, and underweight). Thus, outcome variables were the prevalence or the percentage (%) of malnutrition among U5-children.

Independent variables: Different socio-demographic (ethnicity, parents' ages, education, occupation, and income) and dietary intake variables [nutrients like calorie (Kcal), protein (g), calcium (mg), Iron (mg), vitamin C (mg), and vitamin A (μg)].

Anthropometric assessment

Child Growth Standard (WHO, 2006)16 for height and weight measurements of the 232 children were used to assess the nutritional status of U5 ethnic children. Three standard indices of physical growth of NHSH standard that describe the nutritional status of children are height-for-age-Z-scores (HAZ/stunting), weight-for-height-Z-scores (WHZ/wasting), and weight-for-age-Z-scores (WAZ/underweight). Height-for-age is a measure of linear growth, a condition reflecting the cumulative effect of chronic malnutrition, probable failure to receive adequate nutrition over a long period in a population, and does not vary appreciably according to the season of data collection, may be caused by recurrent and chronic illness. A child below -2SD height-for-age from the WHO reference population's median is considered short for his/her age. Similarly, weight-for-height-Z-scores measure acute malnutrition, and weight-for-age-Z-scores are a composite of both acute and chronic malnutrition. If the child is <-3SD from the reference median, then the child is considered to be severely stunted/wasted/underweighted. A child between -2SD and -3SD is considered to be moderately stunted/wasted/ underweighted.

Dietary assessment

Dietary intake were assessed using the 24-hour dietary recall method and food frequency questionnaire (FFQ). Different foods consumed by the ethnic children were converted to the quantity (g) of nutrients taken with the use of food conversion tables (FCTs).17 Consumption equivalent of different nutrients (Per capita per day) were computed using syntax of statistical software package (SPSS version 26).

Dietary diversity score: Food eaten by the children was classified into the following eleven food groups: (1) Cereals, (2) Legumes and nuts, (3) Green leafy vegetables/GLVs, (4) Non-leafy and other vegetables, (5) Fruits (6) Fish (7) Flesh foods (8) Eggs (9) Dairy products (10) Oils and fats, and (11) Miscellaneous. A 24-hour dietary diversity score (DDS) was calculated by counting the number of food groups received in the last 24 hours by the children before the survey. A DDS of <5 is considered the minimum dietary diversity for children required to meet the daily energy and nutrient requirements. Children receiving foods from ≥5 groups are considered to have adequate dietary diversity.

Statistical Analysis

Anthropometric data were analyzed by Anthro (version 3.2.2, 2011, WHO)18, and socioeconomic and dietary data were analyzed using statistical software packages (SPSS Inc, Chicago, IL, USA, version 26.0) and Microsoft Excel. Normality tests (Shapiro–Wilk goodness-of-fit) for all data were performed before analysis. After extracting and cleaning the data, bivariate analyses (chi-square tests) were done to examine possible associations between malnutrition scores and socioeconomic and dietary intake variables. P-value <0.05 was set as significance. A variance inflation factor (VIF) test with an estimated mean VIF of <2 indicates multicollinearity within the tolerance limit. In the multiple logistic regressions (MLRs), the outcome variables (Stunting, wasting, and underweight) were dichotomized as (1) for 'malnourished (<-2SD)' and (0) for 'Normal status (≥-2SD)'. Relative odds ratios and 95% confidence intervals (CIs) were obtained to identify potential 'determinants' associated with the 'malnutrition scores' among U5-children. Socioeconomic and dietary covariates found statistically significant (P<0.05) in bivariate analyses were introduced in the 'multivariable analysis' by 'Backward-Stepwise Elimination.' Hosmer-Lemeshaw goodness-of-fit and Nagelkarke-pseudo-R2 of the models were observed.

Results

Table 1 depicts that most of the U5-children belonged to the Chakma tribe (42.7%), followed by the Marma (34.9%) and the Tripura (11.6%). Most fathers (56.5%) and mothers (58.1%) belonged to the 26-35 age groups. Formal education got 56.1% of fathers and 34.1% of mothers, whereas 29.3% of husbands and 47.8% wife of households were illiterate. Most (47.4%) of the fathers were involved in agriculture, and mothers (69.8%) in household works. The mean income was 9956.7±459.0 BDT for fathers and 1612.8±149.1 for mothers.

Table No. 1: Parents' Socio-demographic profile of the ethnic children

Socio-demography (n=232)	Household head n (%)	Spouse n (%)
Ethnicity		
Chakma	99 (42.7)	
Marma	81 (34.9)	
Tripura	27 (11.6)	
Othersa	25 (10.8)	
Parent's age (y)		
≤25	15 (6.4)	61 (26.2)
26-35	131 (56.5)	135 (58.1)
36-45	66 (28.4)	22 (9.4)
≥45.1	20 (8.7)	14 (6.3)
Education		
Formal	130 (56.0)	80 (34.5)
1-5 y	32 (13.8)	27 (11.6)
6-8	34 (14.7)	20 (8.6)
9-10	36 (15.5)	26 (11.2)
≥11	28 (12.1)	07 (3.1)
Informal	102 (44.0)	153 (65.9)
lliterate	68 (29.3)	110 (47.4)
Can sign/read only	34 (14.7)	42 (18.1)
Occupation		
Agriculture	110 (47.4)	12 (5.2)
Household-works	01 (0.4)	162 (69.8)
Business	20 (8.6)	03 (1.3)
Services	42 (18.2)	08 (3.4)
Othersb	59 (25.4)	47 (20.3)
Income (BDT)		Spouse's Income (BDT)
≤7000	150 (64.7)	≤1000 BDT 73 (31.3)
7001-14500	67 (28.9)	1001-3000 53 (23.0)
≥14501	15 (6.5)	≥3001 106 (45.7)
Mean ±SD	9956.7± 459.0	2612.8± 149.1

aTanchanga=11, Bam=14; bEarth cutting/Rickshapuller/NGO workers/jobless.

Table 2 illustrates that only 15 children were in the 7-12 months age group, and the rest (n=217) were 13-60 months older. Half of them were girls (n=117) and boys (n=115). It also showed that 27.4% and 29.5% of girls and boys were stunted, respectively; 20.6% of girls and 19.4% of boys were wasted; and 28.2% of girls and 20.8% of boys were underweighted (HAZ/WHZ/WAZ <-2SD). Severe stunting (<-3SD) was 10.3% for both boys and girls, severe wasting/severe acute malnutrition/SAM was 3.4% for girls and 4.3% for boys, and severe underweight was 9.4% and 7.8% for girls and boys, respectively. No significant differences in malnutrition (for all scores) were observed between boys and girls.

Table No 2. Age groups and Nutritional status of under-5 children of ethnic minorities

Malnutrition (z-score classification)	Girl (n=117) n (%)	Boy (n=115) n (%)	Total (N=232) N (%)	*P-value
Under-5 age groups (months)				
7-12	12 (10.3)	03 (2.6)	15 (6.5)	
13-36	59 (50.4)	63 (54.8)	122 (52.6)	
37-60	46 (39.3)	49 (42.6)	95 (40.9)	
Total	117 (50.4)	115 (49.6)	232 (100)	P>0.05
Height for age (stunting)				
Severe (<-3SD)	12 (10.3)	12 (10.4)	24 (10.3)	
Moderate (<-2SD to ≥ -3SD)	20 (17.1)	22 (19.1)	42 (18.2)	
Total (<-2SD)	32 (27.4)	34 (29.5)	66 (28.5)	P>0.05
Normal (≥-2SD)	85 (72.6)	81 (70.5)	166 (71.5)	
Weight for Height (wasting)				
Severe acute malnutrition/SAM (<-3SD)	04 (3.4)	05 (4.3)	09 (3.9)	
Moderate acute malnutrition/MAM (<-2SD to ≥ -3SD)	20 (17.0)	18 (15.1)	38 (16.4)	
Total (<-2SD)	24 (20.6)	23 (19.4)	47 (20.3)	P>0.05
Normal (≥-2SD)	93 (79.4)	92 (80.0)	185 (79.7)	
Weight for age (underweight)				
Severe (<-3SD)	11 (9.4)	09 (7.8)	20 (8.6)	
Moderate (<-2SD to ≥ -3SD)	22 (18.8)	15 (13.0)	37 (15.9)	
Total (<-2SD)	33 (28.2)	24 (20.8)	57 (24.6)	P>0.05
Normal (≥-2SD)	84 (71.8)	91(79.2)	175 (75.4)	

*Proportion test

Table 3 represents the mean (g/person/day) food items consumed by under-5 children for three meals each day of a week. U5 ate the bulk of rice (86.3 g) and little amount of other carbohydrates (1.38 g) 3-times every day of a week, followed by non-leafy vegetables (49.9 g) for five days in 3 meals, leafy vegetables (8.4 g) for four days. However, a remarkable amount of fish (15.6 g), fruits (9.9 g), and little amount of milk (1.70 g) were also taken by U5 children for only two days a week. Meat (4.27 g) and eggs (2.9 g) were taken only one day a week. The mean DDS of each day was 5±1, while >5 DDS for only two days of the week was observed.

Table No. 3: Mean foods (g/person/day) consumed by U5 children for three meals in a day on a week

Food groups	Food items	g/person /day Mean± SD	Mean day in a week for 3 meals on each day	Mean day (Approx)	DDS Score Per day		
			Moring	Noon	Night		
1.Cereals	Rice	86.3±7.8	6.9	6.9	6.9	6.9 (7)	
	Maize	0.04±0.1	1.2	1.8	1.6	1.5 (2)	
	Wheat	0.99±0.1	4.3	3.5	5.3	4.4 (4)	1
	Sugar	0.35±0.0	6.9	6.9	6.9	6.9 (7)	
2.Legumes/nuts	Pulses	1.02±0.1	1.4	1.5	1.5	1.5 (2)*	-
3.GLVs	Green leafy vegetable	8.4±1.1	3.3	4.1	3.8	(4)	1
4.Other vegetables	Non-leafy vegetables	49.9±3.6	4.9	5.02	4.9	4.9 (5)	1
5.Fruits	Fruits	9.9±0.9	1.8	2.1	1.9	1.9 (2)*	-
6 Fish	Fish	15.6±2.1	1.9	1.9	1.8	1.9 (2)*	-
7 Flesh foods	Meat	4.27±.05	1.1	1.5	1.3	1.3 (1)	-
8 Eggs	Egg	2.9±0.2	1.3	1.4	1.3	1.3 (1)	-
9 Dairy products	Milk	1.70±0.1	1.7	1.5	1.8	1.7 (2)*	-
10 Oils/fats	Oil/fat	1.5±0.1	4.9	4.9	4.9	4.9 (5)	1
11 Miscellaneous	Snacks etc.	1.54±0.2	3.9	3.9	3.9	3.9 (4)	1
	Total	191.57±4.9					5 ±1

*DDS >5 for only two days of the week was observed.

Nutrient analysis and comparison with RDA indicates calcium and vitamin A deficiency, especially for the 1-3 year age group who met approximately 58.6% of the Recommended Dietary Allowances (RDA) for both nutrients. However, for all age groups, RDA fulfillment of protein, iron, and vitamin C was much higher than the recommended level (>100%) except for the iron intake of children of 7-12 months, which met only 42.4% RDA. Calorie intake somewhat met 88-99% of RDA for all age groups (Table 4).

Table No. 4: Intake of different nutrients and RDA fulfillment by different age groups

Nutrients	Energy and nutrient fulfillment by u5 children (n=232)				
	Age (y) Group	Mean ± SD	Reference RDA	% of RDA met	Distribution (%) of children by RDA fulfillment RDA n (%)
Energy (Kcal/day)	7-12 months	891 ± 92.0	800-900	99.0	< RDA 09 (60.0) ≥ RDA 06 (40.0)
	1-3	1101 ± 78.0	1240	88.8	< RDA 98 (59.8) ≥ RDA 66 (40.2)
	4-5	1677 ± 99.0	1690	99.2	< RDA 67 (56.3) ≥ RDA 52 (43.7)
Protein (g/day)	7-12 months	23 ± 3.0	13-14	164.3	< RDA 06 (40.0) ≥ RDA 09 (60.0)
	1-3 y	38 ± 7.0	22	172.7	< RDA 38 (23.2) ≥ RDA 126 (76.8)
	4-5	59 ± 33.0	30	196.6	< RDA 13 (10.9) ≥ RDA 106 (89.1)
Calcium (mg/day)	7-12 months	269 ± 90.0	400	67.3	< RDA 12 (80.0) ≥ RDA 03 (20.0)
	1-3 y	293 ± 94.0	500	58.6	< RDA 122 (74.4) ≥ RDA 42 (25.6)
	4-5	424 ± 44.0	600	70.6	< RDA 90 (75.6) ≥ RDA 29 (24.4)
Iron (mg/day)	7-12 months	3.94 ± 0.78	9.3	42.4	< RDA 13 (86.7) ≥ RDA 02 (13.3)
	1-3 y	7.24 ± 2.6	5.8	124.8	< RDA 78 (47.9) ≥ RDA 86 (52.1)
	4-5	13.36 ± 1.5	6.3	212.0	< RDA 37 (31.1) ≥ RDA 82 (68.9)
Vitamin A (µg RE/day)	7-12 months	401 ± 93.5	400	100.3	< RDA 06 (40.0) ≥ RDA 09 (60.0)
	1-3 y	239 ± 49.0	400	59.8	< RDA 118 (72.0) ≥ RDA 46 (28.0)
	4-5	344 ± 23.0	450	76.4	< RDA 80 (67.2) ≥ RDA 39 (32.8)
Vitamin C (mg/day)	7-12 months	34 ± 6.0	30	113.3	< RDA 07 (46.7) ≥ RDA 08 (53.3)
	1-3 y	29 ± 6.0	30	96.7	< RDA 96 (58.5) ≥ RDA 68 (41.5)
	4-5	54 ± 9.0	30	180.0	< RDA 39 (32.8) ≥ RDA 80 (67.2)

No associations of socio-demography and dietary variables with wasting and underweight were observed in bivariate analyses except for the calorie intake (≤1650 kcal/day) showed significant negative co-relation with wasting. However, socio-demography and dietary factors are reportedly associated with the prevalence of stunting among U5-children (P<0.05) (Table 5).

Table No. 5: Unadjusted model shows socioeconomic and dietary factors associated with Stunting, wasting and underweight among under-five children of ethnic minorities

	Total (n=232) (n %)	Unadjusted Odds ratio (UOR) (95% CI)		
Characteristics		Stunting (HAZ)	Wasting (WHZ)	Underweight (WAZ)
Socio-demography		<-2 SD	<-2 SD	<-2 SD
Household head's education	(years)			
Illiterate/can sign name/read or write	102 (43.9)	4.43 (2.37-8.28)**	1.6 (.35-1.21)	1.54 (.94-2.63)
1-12R	130 (56.1)			
Head's Income (BDT)				
≤7000	150 (64.7)	3.0 (1.49-6.1)*	1.2 (.63-2.14)	1.22 (.69-2.13)
>7001R	82 (35.3)			
Spouse's education (years)				
Illiterate/can sign name/read or write	153 (65.9)	2.98 (1.64-5.40)**	1.6 (.35-1.21)	.897 (.52-1.5)
1-10 R	80 (34.1)			
Spouse's Income				
≤3000	126 (54.3)	2.0 (1.1-3.7)*	1.8 (.475-1.50)	1.11(.65-1.89)
>3001 R	106 (45.7)			
Dietary		<-2 SD	<-2 SD	<-2 SD
Dietary Diversity Scores/DDS				
2-3	128 (55.2)	5.1(2.53-10.1)**	1.6 (.35-1.12)	1.24 (.73-2.11)
4-5R	104 (44.8)			
aNutrients intake/day				
Calorie (Kcal)				
≤1650	185 (79.7)	3.8 (1.4-10.2)*	5.2* (1.8-15.0)	1.6 (.81-3.2)
>1650 R	47 (20.3)			
Calcium (mg)				
≤250	124 (53.4)	2.2 (1.1-4.4)*	1.2 (.63-2.4)	1.0 (.55-1.85)
251-500	42 (18.1)	.82 (.29-2.25)	.90 (.37-2.2)	.513 (.22-1.19)
>500 R	66 (28.4)			
Vitamin A (IU)				
≤250	126 (54.3)	1.99 (.99-3.9)*	1.4 (.70-2.8)	1.15 (.63-2.1)
251-500	40 (17.2)	.531 (.17-1.60)	2.2 (.93-5.3)#	.70 (.30-1.63)
>500 R	66 (28.4)			

*Nutrients like Protein, Iron, and vitamin C were not significant at bivariate analysis. RReference category; *P<0.05 **P<0.001, #P=.07

Notably, socioeconomic factors like the father's education and income are significantly associated with the prevalence of stunting among U5-children in both unadjusted (Table 5) and adjusted (AOR) models (Table 6). father's illiteracy (P=.000) and income ≤7000 BDT (P=.003) are respectively 4.9 and 3.4-times more likely to be associated with the prevalence of stunting among U5-children. Moreover, lower DDS (2-3 score), calorie and calcium intake (≤250 mg/day) are respectively 4.1, 2.9, and 2.6 times more likely to be associated with the prevalence of stunting among U5-children also noticed (P<0.05).

Table No. 6: Socioeconomic and dietary factors associated with the stunting among U5-children

Characteristics	Beta Coefficient	Standard Error	P-value	Adjusted Odds ratio (AOR)	95% CI Lower	95% CI Upper
Socio-demography						
Father education						
Illiterate/can sign name/read or write	1.590	.363	.000	4.905	2.408	9.991
1-12R						
Father's income						
≤7000	1.235	.413	.003	3.439	1.531	7.721
>7001R						
Dietary intake/day						
DDS						
2-3	1.413	.389	.000	4.108	1.917	8.801
4-5R						
Calorie (Kcal/day)						
≤1650	1.074	.558	.05	2.927	.981	8.736
>1650R						
Calcium (mg/day)						
≤250	.944	.426	.027	2.570	1.116	5.918
251-500	-.154	.580	.790	.857	.275	2.673
>500 R						

Hosmer-Lemeshaw goodness-of-fit (Chi-square=11.03, P=.138), Overall Classification table=78.8%, -2LL (log-likelihood) =203.1, Nagelkerke-R-Square=.368, Model co-efficient=67.658, degree of freedom (degree of freedom/ df) =06, P=.000, RReference category.

Discussion

Present study retrospectively investigated how dietary nutrient intake and socioeconomic factors influenced the nutritional status of U5-children of ethnically minor children living in three hilly South-eastern districts of Bangladesh. Prevalence of stunting (HAZ), wasting (WHZ), and underweight (WAZ) were respectively 28.5%, 20.3%, and 24.6%. However, the prevalence of stunting for other tribal children (Santal, Garo, Oraon, and Hajong) of northern part of Bangladesh reported very high (42%)19 than this study and national average[7,8]. Furthermore, a higher prevalence of stunting but a lower prevalence of wasting and underweight in the Bandarban district of CHTs than the present study was also reported.[10] On the other hand, severe acute malnutrition (SAM) of U5-children of this study was remarkably higher (20.3%) than the tribal children of Northern areas (13.0%),[19] and also from two previous Bangladesh Demographic and Health surveys (BDHS).[7,8] Furthermore, demographic health surveys/ DHS of other countries are reported lower wasting and underweight from this study.[20] However, earlier studies revealed that all nutritional indices among the preschool children of Indian scheduled tribes were higher than this study.[12,13, 21-25]

Factors of Childhood stunting are multifaceted, and malnutrition among tribal children is more complicated as a result of a nexus of multiple factors,[26] are significantly associated with both macro and micro-level socioeconomic determinants, and several children and maternal-related factors.[20, 27-30]

Multiple logistic regression showed that (Table 6) father's illiteracy (P=.000) and income ≤7000 BDT (P=.003) are respectively 4.9 and 3.4 times more likely to be associated with the prevalence of stunting among U5-children. Study[31] reported that fathers/male involvement in buying food for their children and providing money for transport to young child clinics were associated with the normal nutritional status of under-five children. A significant association between male occupation and economic status was also noticed in the Indian tribal population.[32] The present study shows much higher income of the ethnic population than reported earlier[5,6] and agrees with recent studies[10], which showed higher income of ethnic minorities than settlers. Large body of literature[7, 12, 14, 15, 20, 25,30, 33, 34] on tribal population reported economically poorer households had a more significant association with malnutrition especially stunting, than the richer ones. Furthermore, a recent study worked on the data of Bangladesh demographic and health survey (BDHS, 2014), implied that fathers' engagement in agricultural work and residence in Chittagong and Sylhet were associated with severe stunting among Bengali under-5 children.[25]

Parental education[14,34] found to be the most important determinants of child stunting, so as in the tribal population.[12,22,25] However, mother's literacy and income showed no effect on U5 malnutrition in the multivariable model despite being associated with the unadjusted/ bivariate model, and consistent with other studies.[12,25] In this study, both Parents of the tribal U5 children were illiterate; mothers were more illiterate than fathers, and nearly 47.4% of tribal fathers (only 5.2% of mothers) were occupied as agricultural labourers like other Indian tribes.[12, 33]

The consumption patterns of children reflected the eating patterns of their families. Acute food insecurity in tribal households is due to the loss of their traditional dependence on forest livelihood and the state's deepening agrarian crisis. Furthermore, nutrient analysis implies the vast majority of U5 children's diet was deficit in calcium and vitamin A, however, calorie intake reported to be much higher than Banderbon's U5-children.[10] Multivariable analysis revealed that (Table 6) <4 DDS (aOR=4.1), <1650 Kcal intake/day (aOR=2.9), and calcium intake ≤ 250 mg/ day (aOR=2.6) were significantly associated with the prevalence of stunting. U5-children of this study consumed a pretty good amount of non-leafy vegetables (49.9 g), leafy vegetables (8.4 g), fish (15.6 g), fruits (9.9 g), and meat (4.27 g) with a mean DDS/day <4. However, the adjusted model showed that children <4 DDS/day have a 4.1 times more risk of being stunted than children with 4-5 DDS/day, consistent with a recent study.[2] More than half of the under-5 children of this study had lower (2-3) dietary diversity scores as ice (86.3 g) predominated in their diets, and the rest of them (44.8%) had DDS/day 4-5, reported to be better off than other tribal children of India.[13] Moreover, consumption frequencies (per day of the week) and amount of other food groups (especially protein, milk/milk products) were extremely low among U5 tribal children of this study. Similarly, the diet of the Bhumia tribe of India was a deficit of all nutrients except for the calcium[27], and also consistent with the amount of food consumed by other Indian tribes.[13] Twara et al. (2017) reported that all nutrients (Calorie, protein, vitamins, and minerals) consumed by the children of both the Gond and Kharwar tribes of India were significantly lower than RDA.[35]

Conclusion

Majority of U5 children's diet was deficit in calcium and vitamin A, and lower calorie intake, less dietary diversity was associated with stunting. Father's illiteracy and income also had influence on chronic nutrition. To address malnutrition, multisectoral nutrition policies targeting poor households of ethnic minorities are required, especially severe acute malnutrition/SAM. Malnourished children living in the least well-off households headed by mothers should also be taken into consideration.

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Declaration of interest statement
Authors declared none

Limitations

The cross-sectional design limits the possibility of determining causal relationships. Moreover, morbidity patterns (diarrhea preceding week), birth weight, and birth order of the ethnic children were not able to assess. Furthermore, data on the mother's age at birth, postnatal and antenatal care of mothers, and seasonal impact on the prevalence of stunting among ethnic children were not addressed. Strengths of the study include the use of a large representative sample size with a standardized questionnaire.

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