



Research Article

Effectors of income-child health gradient: Role of dietary diversity on child nutritional status in selected slums of Dhaka city

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ABSTRACT

Child dietary diversity (CDD) is an important nutritional outcome measuring the economic ability of a household to access a variety of foods during a determined period. Relating household income to CDD and child anthropometric failure, a cross-sectional study was conducted among 275 selected Dhaka city slum children of 6-12 years. Prevalence of stunting (18%), wasting (19.4%), and underweight (22%) among them were found similar to the current national figure. However, a sizable number of households showed increased DDS (>5), thereby indicating an increased household purchasing power (PP). Bivariate regression analysis showed that children from lower family income (≤ 6000 BDT) were 3 times more likely to be stunted as compared to children with greater family income [Unadjusted OR=3.097, 95% CI (1.578-6.077), $p=0.001$]. Furthermore, logistic regression showed that children who had <5 DDS were 2 times more likely to be stunted than children who had ≥ 5 DDS [Adjusted OR=2.127, 95% CI (1.051-4.305), $p=0.036$]. Therefore, an inverse association has been found between CDD and their anthropometric failure.

Introduction

Dietary diversity (DD) is usually assessed using simple tools such as the dietary diversity score (DDS), which counts the number of food groups consumed over a given reference period. Hence, DDS is a helpful evaluation index to assess and predict the adequacy of micronutrient consumption of children (FAO 2013), which is reported to be associated with malnutrition. Furthermore, low DD is found to be a predictor of child stunting in rural Bangladesh (Rah et al., 2016).

Bangladesh is now the 41st largest economy in the World's GDP ranking and 29th largest country by purchasing power parity (PPP) (CEBR,

2019). Nine percent of the population of Bangladesh resides in Dhaka city, but its contribution to GDP is 36% (Ahmed & Ahmed 2017), indicating a vast production activity here, which reduces the slum poverty in terms of income parity. On the other hand, the reflection of purchasing power is manifested by the huge availability of fruits, vegetables, and fishes in almost every rural and urban Bangladesh market. Dietary diversity, i.e., consumption of a higher and diverse number of food items from different food groups by urban slums-dwellers, is expected to be increased due to their increased purchasing power, which is a consequence of a

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strong Bangladesh economy. However, relevant studies in this regard are not available that specifically address a linkage between the slum household income, food consumption diversity, and nutritional status of children.

Since absence or low dietary diversity in slum dwellers' daily dietary is assumed to be one of the fundamental causes of malnutrition of their children as reported in several past studies, two questions arise: (1) Does increase income (a proxy of purchasing power) of slum dwellers increase their consumption of diverse foods? and (2) Does improve CDD of slum children is positively associated with their nutritional status?

To answer these questions, the present study was conducted in a sample population of 275 children aged between 6-12 years living in 5 selected slums of Dhaka City by a cross-sectional data collection technique.

Objectives

The objectives of the study were:

- 1) To assess the current prevalence of malnutrition among the study children.
- 2) To determine individual dietary diversity score (DDS) of the children and their effectors.
- 3) To evaluate the association and its strength between household income, DDS of children, and their nutritional status.

Methods and Materials

Study design

A comparative observational study was conducted in a sample population of the children (6-12 years) living in 5 selected

slums of Dhaka City by a cross-sectional data collection technique.

Sample size and sampling

We have modeled sample size calculations for the household survey based on a percentage of children 6-12 years of age who are stunted (height for age) and living in urban slums. According to BDHS 2014 data, the range of stunting prevalence in urban areas varies from 21.7% to 37.7% among children of 6-59 months of age. A sample size of 275 mothers and caregivers of children aged <5 years was estimated based on a 95% confidence interval, a level of desired precision at 0.05, and with a 22% prevalence of stunting based on similar contexts (BDHS, 2014).

The study samples were collected from randomly selected slums of Dhaka North City Corporation area (Ambagan of Farmgate Thana, Borkot slum of Mohammandpur Thana, and Laujhora of Rayer Bazar Thana) as well as from Dhaka South City Corporation area (Gendaria of Sutrapur Thana and Robidaspara of Wari Thana). Mothers or caregivers of the child from 55 households from each slum were selected by quota sampling method. Therefore, a total of 275 respondents were collected and sought their oral permissions for interviewing.

Development of study instrument (SI)

A semi-structured questionnaire was developed with specific and relevant questions for the interviewee and pretested in 10% of the similar sample from a different slum that is not included in the final count. Final SI was developed by incorporating the outcomes of the pretesting survey. For CDD, the list of 12 food groups was incorporated in the SI as

recommended by FAO (2013). The SI also contained socioeconomic, demographic, and anthropometric measurement formats.

Determination of DDS

If the children consumed any amount of food from 12 food groups (FAO 2013) on the previous day, it was scored as “1”; If not scored as “0”. Individual DDS for each child was then calculated by summing the number of food groups consumed during the 24-h recall period.

Data collection and data entry

Face-to-face interviews with the mother/caretaker of the children were conducted with the SI to collect socioeconomic and demographic variables. While height and weight were recorded using laboratory height and weight scales with a standard reference protocol. The dietary consumption of the children was determined by a 24-hour dietary recall method with a structured food frequency questionnaire. Collected data were coded for data entry in SPSS spreadsheet. Extensive scrutiny of the data was conducted for error identification. After data cleaning, the final sample size was found 250. All interviews and measurements were conducted between October 2015 to April 2017.

Data analysis

Bivariate and multivariate analyses were employed to examine the contribution of the household index of purchasing power on child health status using DDS as an intermediate outcome variable. So, HH income was an independent variable along with other sociodemographic and dietary variables. Statistical software like Excel was used for descriptive statistics, whereas SPSS was used for analytical statistics.

Results and Discussion

This frequency distribution of the socioeconomic and demographic variables of the studied children is presented in Table 1 and shows that majority of the children (52%) belonged to the 6-8 years age group. Characteristics of the households illustrate that most parents (63.6%) were illiterate while the overwhelming majority of them (83.2%) were found employed. In addition, the majority of the households (72.4%) showed a monthly family income of ≥ 6001 takas.

Table 1. Sociodemographic and economic features of the respondents.

Parameter	% (No.)
Age (years)	
6.0–8.0	52.0 (130)
8.1–10.0	21.6 (54)
10.1–12.0	26.4 (66)
Gender	
Boy	
Girl	48.4 (121)
Parity	
1-2 children	51.6 (129)
≥ 3	
Family Size	51.6 (129)
≤ 5 members	48.4 (121)
> 5 members	
Parent’s Education	56.8 (142)
Illiterate	
<SSC	43.2 (108)
SSC/ HSC	
Occupation	63.6 (159)
Employed	
Others	28.8 (72)
Monthly HH Income (Tk)*	7.6 (19)
Lower (≤ 6000)	
Above average (≥ 001)	83.2 (208)
	16.8 (42)
	27.6 (69)
	72.4 (181)

*Average income range of slum-dwellers is Tk.6000-10000 (Latif et. al., 2016)

The nutrition knowledge of their parents was judged to be relatively poor because the majority of the parent gave incorrect answers to the nutrition knowledge questions asked to them (Table 2). However, they showed relatively good knowledge about foods assumed for body building and disease protection. On the other hand, the families showed a cereals-based dietary consumption behavior (99.6% of HH consumed cereals every day), whereas only 10.4% of families consumed flesh meat, milk, and milk product every day. Furthermore, only 4.4% of families consumed fruits every day (data not shown), indicating less divergence in food consumption at the household level. However, this behavior at the household level did not affect the dietary consumption of the children as revealed from the DDS of the children, which showed that the

majority of them belonged to the medium dietary diversity category (Table 3), indicating preferential parental care of their food intake.

Micronutrients (minerals and vitamins) are crucial for the growth spurt of young children. Since DDS is an index of the adequacy of these nutrients, the mean DDS of the children (mean DDS= 4.44 ± 0.97, Table 3) has been considered the cut-off of DDS for nutrient consumption adequacy. For simplicity of calculation, DDS<5 has been taken as inadequate child dietary diversity after a modification of Swindale and Bilinsky (2006) categorization.

The findings in Table 3 showed that the majority of the children (53.6%) have a DDS of <5, which indicates that these children are not getting adequate nutrients from their usual diet required for body growth. However, no significant (p=0.971) difference in DDS was noticed between boys and girls (Table 3).

Table 2. Frequency distribution of parents by their nutritional knowledge.

Nutrition Knowledge Questions	Correct Answer % (n)	Incorrect Answer % (n)
1. Which food gives you energy?	10.0 (25)	90.0 (225)
2. Which food builds your body?	44.8 (112)	55.2 (138)
3. Which food protects you from disease?	48.0 (120)	52.0 (130)

Table 3. Frequency distribution of children by their individual dietary diversity score.

6-12 years Children	Category of Child Dietary Diversity Score (Child DDS)*				p-value	Mean DDS
	Low % (n)	Medium % (n)	High % (n)	Total % (n)		
Boys	22.3 (27)	66.9 (81)	10.8 (13)	48.4 (121)	0.971	4.44±0.97
Girls	31.0 (40)	58.1 (75)	10.9 (14)	51.6 (129)		
Total	26.8 (67)	62.4 (156)	10.8 (27)	100.0 (250)		

*Source: Swindale & Bilinsky 2006; consumption of ≤3 food groups-Low Dietary Diversity consumption of between 4 - 5 food groups - Medium Dietary Diversity consumption of ≥6 food groups - High Dietary Diversity.

When child DDS is cross-tabled with its socioeconomic and demographic effectors, the family income only showed a significant association with the increased child DDS (Table 4). Therefore, it implies that as income increases, the DDS of the children increases simultaneously at a 1% level of significance (Chi-square =11.50, p=0.003).

Results from anthropometric measurements of the children (Table 5) revealed that a good percentage of them were suffering from moderate to severe malnutrition. Prevalence

of stunting (18.0%), wasting (19.4%) and underweight (22.0%) among them showed dissimilarities with the current national statistics (BDHS 2017; 31% stunting, 8% wasting, and 22% underweight). Stunting is found to be 42% lower, wasting 142% higher, and underweight remained similar.

Comparing with other findings revealed that malnutrition figures showed considerable discrepancies. Using BDHS data of 2014, Das and Gulshan (2017) showed that among urban children aged 0-59 months, 30.5% are stunted,

Table 4. Socioeconomic and demographic effectors of DDS*.

Variables	<5 DDS [n=134]	≥ 5 DDS [n=116]	p value
Age (years)			
6.0-8.0	53.0 (71)	50.9 (59)	0.786
8.1-10.0	22.4 (30)	20.7 (24)	
10.1-12.0	24.6 (33)	28.4 (33)	
Parity			
1-2 children	53.0 (71)	50.0 (58)	0.638
≥ 3 children			
Family size			
≤ 5 members	56.0 (75)	57.8 (67)	0.776
> 5 members	44.0 (59)	44.2 (49)	
Parent's education			
Illiterate	67.2 (90)	59.5 (69)	0.414
<SSC	25.4 (34)	32.8 (38)	
SSC to HSC	7.5 (10)	7.8 (09)	
Parent's occupation			
Employed	19.4 (26)	13.8 (16)	0.237
Others	80.6 (108)	86.2 (100)	
HH monthly income (Tk.)			
Low (≤ 6000)	34.4 (46)	19.8 (23)	0.003
Above average (≥6001)	65.6 (88)	80.2 (93)	

*Results are presented as a percentage distribution of children along with no. of children in parentheses.

13.1% are wasted, and 26.6% are underweight. On the other hand, using BDHS data of 2013, a recent study showed that 50% of <5 children in slums are stunted, and 43% are underweight, whereas, for non-slums, these rates are 33% and 26%, respectively (Ahsan et al., 2017). These discrepancies are probably due to variations in data collection time and technique.

When the malnutrition level of the children is cross-tabled with their socioeconomic and demographic effectors, the children of '6-8 years' age group were found more stunted (p=0.012) and underweighted (p=0.000) than other age groups (Table 6).

Moreover, having fewer children (parity <3 children) was found irreversibly associated with stunting (p=0.026) and underweight (p=0.043). None of the other socioeconomic and demographic variables affect the malnutrition situation of the children studied, thereby pointing to the notion that these variables are not immediate effectors of the growth spurt for them compared to their age range.

On the other hand, the association between CDD and child malnutrition when were tested (Table 7), it was observed that stunting had a significant association with their DDS. This finding indicates that low diversity in food intake caused a micronutrient inadequacy (FAO 2013) among the children and produced a chronic anthropometric failure in the long run.

To reduce the confounding factors related to the outcome and predictor variables, multiple logistic regression was performed, though not all predictor variables fit into the multiple logistic (Adjusted) model (Table 8).

Table 8 shows that children who showed dietary diversity score <5 were 2-times more likely to be stunted than children who had ≥5 DDS. It reflects “Inadequate dietary diversity” as a strong predictor of stunting in them (Adjusted OR=2.13, p=0.036). The majority of the children (62.4%, Table 3) showed medium DDS (consumption of 4-5 food groups), and a sizable number of them (10.8%) showed DDS (≥6 food groups), which is a sign of improvement towards nutrient adequacy in slum children and their improved CDD.

Table 5. Prevalence of malnutrition by percentages of Z-score in slum children.

Category by Z-score	Stunting			Wasting			Underweight		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Severe (<-3 SD)	2.5	0.8	1.6	2.3	3.1	3.2	0.8	3.9	2.4
Malnourish (<-2 SD)	15.7	17.0	16.4	17.4	16.1	16.2	19.0	20.1	19.6
Normal (≥ ±2 SD)	81.8	82.2	82.0	80.3	80.8	80.6	80.2	76.0	78.0
No. of Children	121	129	250	86	99	185*	121	129	250

*Age group, 10.1 to 12.0 years (n=65), were not included in the analysis because of their non-suitability in wasting Z-score.

Table 6. Socioeconomic effectors of malnutrition by Z-score.

Effector variables	Stunting		Underweight		Wasting	
	% (n)	p value*	% n	p value*	% n	p value*
Age (years)						
6.0-8.0	57.8 (26)		80.0 (44)		83.3 (30)	0.062
8.1-10.0	6.7 (03)	0.012	9.1 (05)	0.000	16.7 (6)	
10.1-12.0	35.6 (16)		10.9 (06)		-	
Parity						
1-2 children	66.7 (30)	0.026	63.6 (35)	0.043	58.3 (21)	0.496
≥ 3 children	33.3 (15)		36.4 (20)		41.7 (15)	
Family size						
≤ 5 members	44.4 (20)	0.065	50.9 (28)	0.381	50.0 (18)	0.269
> 5 members	55.6 (25)		49.1 (27)		50.0 (18)	
Parent's education						
Illiterate	60.0 (27)	0.780	65.5 (36)	0.969	63.9 (23)	0.643
<SSC	33.3 (15)		27.3 (15)		25.0 (09)	
SSC to HSC	6.7 (03)		7.3 (04)		11.1 (04)	
Parent's occupation						
Employed	91.1 (41)	0.117	80.6 (29)	0.643	83.6 (43)	0.922
Others	8.9 (04)		19.4 (07)		16.4 (09)	
HH income (Tk.)						
Low (≤ 6000) Above average (≥6001)	27.6 (69)	0.432	27.6 (69)	0.839	27.6 (69)	0.733
	72.4 (181)		72.4 (181)		72.4 (181)	

*Significance level, p<0.05

Table 7. Association between child DDS and malnutrition prevalence.

Category	DDS (<5)	DDS (≥5)	p value
	% (n)	% (n)	
Stunting	66.7 (30)	33.3 (15)	0.05
Underweight	61.8 (34)	38.2 (21)	0.17
Wasting	58.3 (21)	41.7 (15)	0.72

*Significance level, p<0.05

<6 months in our analysis because, at this time, the child usually is breastfeeding.

Table 8. Logistic regression analysis of stunting risk factors in 250 slum children¹.

Predictor Variable	SE	Wald χ^2 value	β	Expo - β	Odds Ratio	Confidence Interval (95%)	p-value
Model 1 Children age (yrs.)							
6.0–8.0	0.327	0.747	0.327	1.387	1.38	0.660-2.915	0.388
8.1–10.0	0.669	6.355	1.686	5.398	5.39	1.455 -20.023	0.012*
10.1–12.0 (r) ²							
DDS score							
<5	0.360	4.399	0.755	2.127	2.127	1.051 - 4.305	0.036*
≥ 5 (r) ²							
Model 2 Monthly income							
(Tk.) ³ ≤ 6000	0.403	0.640	0.322	1.380	1.380	0.627-3.037	0.424
≥ 6001 (r) ²							

*P<0.05; ¹Adjusted Logistic Regression model: Hosmer-Lemeshaw goodness-off-fit=9.428, p=0.307, Model summary (-2LL/Log-likelihood ratio =217.447, Nagelkerke R-Square=0.115.), Model-coefficient (Chi-square=18.249, degree-of-freedom=5, p=0.003); ²r = reference category; ³Unadjusted OR=3.097, 95% CI (1.578-6.077), p=0.001

Using the National Surveillance Project data in 2003–2005, an earlier study revealed that reduced dietary diversity is a strong predictor of stunting in rural Bangladesh (Rah et al., 2016). But reports evaluating DDS as a predictor of stunting in urban slum children is very scanty. A recent prospective cohort study (Islam et al., 2018) revealed no significant association between DDS and stunting of children (AOR= 0.93; CI= 0.74-1.16; p= 0.505) after following them from birth to 24 months of age. Our results in this regard are significant because they revealed a long-term dietary adequacy situation enjoyed by the children. Moreover, we did not include infants

The bivariate analysis showed that children of lower family income (≤ 6000 Tk.) were found 3 times more likely to be stunted as compared to children with greater family income [Unadjusted Odds ratio 3.097, 95% CI (1.578-6.077), p=0.001]. However, income doesn't remain in the normal logistic regression model (Model 1) as it is not found significant in the Chi-square test (Table 6). But after controlling children's age, parity, and DDS score for income, a conditional logistic regression model (Model 2) fitted income as a predictor variable for stunting and showed insignificant correlation (Table 8). This finding is not in agreement with other results found in the

literature. For example, by measuring the determinants of malnutrition among urban slum children in Bangladesh, Fakir and Khan (2015) showed that per capita income significantly improves child health, but household assets do not. In contrast, a key covariate for stunting of urban children is wealth index poorest (OR = 2.892, p-value < 0.001) was reported by Das and Gulshan (2017).

Nevertheless, our study revealed that family monthly income is a significant effector of CDD (Table 5) but insignificantly associated with child stunting (Table 8), thereby pointing to the notion that it is not an immediate effectors of stunting whereas CDD is. The results also revealed a linkage of family income to diverse dietary consumption of children and their nutritional status.

Conclusions

While the causal effect on income-child health gradient has been questioned by several authors (Budiman and Damayanti, 2018; Govindaraj et al., 2018; Glewwe, 1999), arguably a significant portion (if not all) of income's role on child health operates through various other factors. Thus, the present study essentially established that CDD, i.e., adequacy in micronutrients (minerals and vitamins) consumption, could be an operational linkage to reduce the income-child health gradient.

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