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Prevalence and determinants of diarrhea among under-five children in Bangladesh: A Nationwide survey

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Abstract
Dehydration from diarrhea one of the contributing causes of childhood morbidity and mortality problems despite of the administration of oral rehydration therapy (ORT) in the low and middle income countries like Bangladesh. Therefore, the national data of the prevalence of diarrhea in children is crucial to understand the severity and likelihood of future episode of diarrhea. The present study aimed to identify the major factors in which prevalence of diarrhea acutely exists. Data and necessary information of 485 women were extracted from 6384 women from the Bangladesh Demographic and Health Survey (BDHS), 2014 whose children had experienced an episode of diarrhea. Bivariate analysis and multivariable logistic regression have applied to identify the significant socio-demographic determinants associated with diarrhea. The prevalence of diarrhea was 7.6% (95% CI: 6.9-8.3%). Maternal lower educational status, occupation of spouse, poorer socioeconomic positions of families were significantly associated with the status of diarrhea in children under five years old. The odds of diarrhea in children was higher among the families where father were businessman (OR: 1.4, 95% CI: 1.01-1.98), children living in the poorer socio-economic status (OR: 1.53, 95% CI: 1.12-2.43). We found that of diarrhea in children under the age of five is substantial in Bangladesh, with the highest prevalence occurring in the families of lower socioeconomic status. These findings underline that proper public health interventions are crucial to reduce the burden of diarrhea among disadvantage groups.

Keywords: diarrhea, children, bivariate analysis, logistic regression, odds ratio

1. Introduction
Diarrhea is commonly perceived when one individual emit stools three or more times in a single day. It is a leading cause of preventable death, especially among children under five years old in many developing countries. It causes variety of bacterial, viral and protozoan pathogens excreted in the faces of humans [1]. The familiar causative agents are enterotoxigenic *Escherichia coli* (ETEC), Shigella, Salmonella, Vibrio cholera, norovirus and campylobacter [2, 3]. From the noted viruses' rotavirus consider as the most common [4].
Diarrheal disease can be recognized by four clinical features, each reflecting the basic underlying pathology and altered physiology. These clinical features are acute watery diarrhea, acute bloody diarrhea, persistent diarrhea and diarrhea with severe malnutrition of which 50% of worldwide cases of the condition present with watery diarrhea [1]. Annually, at least 1,500 million cases of diarrhea occur in children under the age of five years with an estimated 4 million children deaths due to diarrhea [1, 5, 6].
According to the World Health Organization (WHO) and UNICEF, about 2 billion cases of diarrheal disease worldwide every year, from this huge number 1.9 million children younger than 5 years of age suffer from diarrhea each year and amounts to 18% of all the deaths and more than 5000 children are dying every day that are mainly in developing countries [7].
In Bangladesh, one third of the total child death burden is due to diarrhea and every year, a rural child suffers on average from 4.6 cases of diarrhea, from which about 230,000 children die [8].
Food poisoning, insufficient safe drinking water, sanitation and hygiene factors are considered to be the principal reasons for diarrheal disease. But most of the studies have mentioned that the source of enter pathogens was either water or food and most mortality related to diarrhea occurs in under developed countries and the highest rates of diarrhea occur among malnourished children [9]. Diarrhea is one of the key factors that contribute significantly to high child morbidity and mortality in the developing countries [10]. There is a significant association between diarrhea morbidity and access to water and sanitation facilities, hygiene practices, flies infestation and the regular consumption of street food [11].
In the context of Bangladesh, the appropriate policy regarding diarrheal disease management should be undertaken in turn it will help the attainment of MDGs. This research mainly focuses on determining the differentials pattern of diarrhea according to Socio-demographic variables and find out the most important factors.

2. Materials and Methods
2.1 Source of data
The study had been used a representative set of cross-sectional data extracted from the Bangladesh Demographic and Health Survey (BDHS), 2014 [12]. The survey was carried out under the authority of National Institute of Population Research and Training (NIPORT) of Ministry of Health and Family Welfare, Bangladesh. It was designed to produce representative results for whole country, for both urban and rural areas separately, and for each of the six administrative divisions of country. Primary Sampling Units (PSU) for the survey was based on enumeration areas (EAs) from the population census 2011.

2.2 Sample size selection
Data collection took place over a six-month period from June

to November 2014, but data processing commenced on July 24, 2014 and ended on November 20, 2014 and total of 17,863 respondents were interviewed. Among of these only 485 respondents were included in this study based on the experienced an episode of diarrhea in the last two weeks before the survey.

2.3 Predictor variables

This study includes six explanatory variables with categories shown in the parenthesis, viz. respondents education (1=no education, 2=primary, 3=secondary, 4=higher), husband occupation (1=agriculture, 2=business, 3=service, 4=unemployment), living condition (1=poor, 2=middle, 3=rich), preceding birth interval (1= ≤24 month, 2=25-36 month, 3= ≥37 month), religion (1=Islam, 2=Hinduism, 3=others) and sources of drinking water (1=tap, 2=tube-well, 3=pond, 4=others).

2.4 Statistical Methods

Prevalence of diarrhea have estimated by the number of children had episode of diarrhea before two weeks of the survey out of total children. Frequency distribution have used to report categorical variables and descriptive statistics for the continuous variables. In this study, data have been used for univariate analysis to describe the variables in a list, for bivariate analysis to determine the associations among the variables and for binary logistic regression analysis to determine the relative risk of the independent variables to the dependent variables. To examine the relationship between still had diarrhea and socio-demographic characteristics of the respondents, both quantitative and qualitative statistics were applied in this study. For statistical analyses, still had diarrhea was made a binary response. Bivariate analysis (chi-square test) was used to determine the association between still had diarrhea and socio-demographic factors. The binary logistic regression model

$$Y = \frac{e^{X\beta}}{1 + e^{X\beta}}$$

$$\text{where}, X = (X_1, X_{2,} \ldots, X_6)', \beta = (\beta_1, \beta_{2,} \ldots, \beta_6).$$

In logistic regression analysis, still had diarrhea (Y) is treated as the dependent variable and other variables are selected as independent variables (X_i, i = 1, 2, …, 6). In this model, the dependent variable (Y) is defined as

$$Y = \begin{cases} 1, & \text{children are affected by diarrhoea;} \\ 0, & \text{children are not affected by diarrhoea.} \end{cases}$$

The multicollinearity in this regression analysis was checked by examining the standard error (SE) for the regression coefficient (β). However, there is no exact method to detect the multicollinearity problem in logistic regression analysis. In this study, the magnitude of SE was used to detect the multicollinearity problem. If the magnitude of SE lies between 0.001 and 0.5, it can be considered that there is no evidence of multicollinearity [13]. Statistical significance was accepted at p-value < 0.05. The results of regression analysis are presented by odds ratios (OR) with a 95% confidence interval (CI) for easy understanding of the effect of the corresponding factor. Statistical Package for Social Sciences (SPSS) version 20.0 was used for statistical analysis.

3. Results

The frequency distribution of the child still has diarrhea or not by some selected socio-demographic and economic characteristics of the respondents. Results disclosed that about (7.6%) of the total infant had diarrhea. Most of the respondents were not educated (35.8%) and business (49.2%). About 42% of the children's living standard below satisfactory level (poor) and about less than half of them (44%) born with less than three years' interval (≤ 36 month). Most of the respondents used Tube-well (89.7%) and very few (2.8%) used pond as a source of daily used water in Table 1.

Table 1: Percentage distribution of the women whose children were experienced an episode of diarrhea in the last two weeks before the survey and some selected socio-demographic independent variable.

Factors		Frequency	Percentage (%)
Had diarrhea recently	No	5899	92.4
	Yes	485	7.6
Respondents education	No education	2288	35.8
	Primary	2004	31.4
	Secondary	1714	26.8
	Higher	378	5.9
Husband occupation	Agriculture	1741	27.3
	Business	3144	49.2
	Service	1310	20.5
	Unemployed/retired	189	3.0
Living conditions	Poor	2682	42.0
	Middle	1187	18.6
	Rich	2515	39.4
Preceding Birth Interval (in month)	≤24	852	18.9
	25-36	1131	25.1
	≥37	2524	56.0
Religion	Islam	5816	91.1
	Hinduism	539	8.4
	Others	29	0.5
Source of drinking water	Tap	467	7.3
	Tube well	5726	89.7
	Pond	180	2.8
	Others	11	0.2

The determination of association between dependent variable (still had diarrhea before last two weeks of the survey) and independent variables, chi-square ($\chi 2$) test analysis was used. The $\chi 2$ test results in Table-2 shown that child mothers education, fathers occupation and their living condition were significantly associated ($p<0.05$) with the prevalence of diarrhea of child.

Table 2: Distributions of selected socio-demographic variables on the basis of child's still had diarrhea in last two weeks before the survey.

Factors		Had diarrhea recently						P-value
		Yes		No		Total		
		N	%	N	%	N	%	
Respondents education	No education	181	37.3	2107	35.7	2288	35.8	0.028*
	Primary	172	35.5	1832	31.1	2004	31.4	
	Secondary	113	23.3	1601	27.1	1714	26.8	
	Higher	19	3.9	359	6.1	378	5.9	
Husband occupation	Agriculture	140	28.9	1601	27.1	1741	27.3	0.015*
	Business	257	53.0	2887	48.9	3144	49.2	
	Service	72	14.8	1238	21.0	1310	20.5	
	Unemployed/retired	16	3.3	173	2.9	189	3.0	
Living conditions	Poor	235	48.5	2447	41.5	2682	42.0	0.007*
	Middle	88	18.1	1099	18.6	1187	18.6	
	Rich	162	33.4	2353	39.9	2515	39.4	
Preceding birth interval	≤24	69	19.2	783	18.9	852	18.9	0.108
	25-36	106	29.4	1025	24.7	1131	25.1	
	≥37	185	51.4	2339	56.4	2524	56.0	
Religion	Islam	443	91.3	5373	91.1	5816	91.1	0.812
	Hinduism	39	8.0	500	8.5	539	8.4	
	Others	3	0.6	26	0.4	29	0.5	
Source of drinking water	Tap	38	7.8	429	7.3	467	7.3	0.929
	Tube well	434	89.5	5292	89.7	5726	89.7	
	Pond	12	2.5	168	2.8	180	2.8	
	Others	1	0.2	10	0.2	11	0.2	

* Statistical significant at p<0.05

Thereafter, the logistic regression analysis was utilized to assess the net effects of independent variables on prevalence of child diarrhea. In this analysis, all the independent variables were coded in dummy coding scheme. Odds ratio (OR) had been used to compare different groups with 95% confidence interval (CI) presented in Table 3.

Table 3: Logistic regression analysis for the effects of socio-demographic variables on children still had diarrhea in last two weeks before the survey

Factors	Coefficient (β)	S.E. of estimates (β)	Significant (ρ)	OR	95% CI of OR	
					Lower	Upper
Respondents education						
No education			.426	1.000		
Primary	.164	.127	.196	1.179	.919	1.512
Secondary	.016	.171	.926	1.016	.726	1.421
Higher	-.315	.411	.444	.730	.326	1.635
Husband occupation						
Service			.234	1.000		
Agriculture	.274	.188	.145	1.316	.910	1.902
Business	.352	.171	.039	1.422	1.017	1.989
Unemployed	.306	.380	.420	1.358	.645	2.858
Living conditions						
Poor			.025	1.000		
Middle	-.185	.154	.228	.831	.615	1.123
Rich	-.416	.154	.007	.659	.487	.892
Preceding birth interval (in month)						
≤ 24			.215	1.000		
25-36	.136	.162	.403	1.145	.833	1.575
≥37	-.089	.148	.547	.915	.685	1.222
Source of drinking water						
Tube well			.455	1.000		
Tap	.307	.241	.202	1.360	.848	2.180
Pond	-.336	.351	.338	.715	.359	1.421
Others	-18.668	15113.227	.999	.000	.000	.

OR, Odds Ratio
CI, Confidence Interval
Significant at 5% level of significance (P<0.05)

Out of five independent variables, two, viz. child father's occupation and their living condition were identified as the significant predictors. Respondents whose husband were agriculture they had 1.316 times (OR=1.316, 95% CI=0.910-1.902) more prevalence of child diarrhea as compared to the respondents whose husband were service holders. Therefore, business and unemployed had also more prevalence child diarrhea than service holders. Again, respondents in rich living condition were 34.1% (OR=0.659, 95% CI = 0.487-0.892) less prevalence of child diarrhea as compared to the

children with poor living condition. Respondents in middle living condition were also less prevalence of child diarrhea than poor.

4. Discussion

Diarrhea is one of the most important causes of death among infants in developing countries like Bangladesh [14]. Sometimes diarrhea becomes epidemic diseases in rural areas in developing countries. A systematic review of the research suggested that such an association is more likely to occur in poor living condition. Parents educational qualifications is a vital factor in the study of children still has diarrhea. The prevalence of diarrhea was acute among the child whose mother was uneducated or primary educated. Some others previous studies also had demonstrated the similar result [14, 15].

Similarly, occupation of husband is one of the important determinant of children who still has diarrhea. As a developing country, most of the people's income is under satisfactory level. If the income is insufficient then obviously life style will be below satisfactory level and higher prevalence of diarrhea.

By supporting the previous study [15-17], it had concluded that higher percentage of diarrhea prevalence among the family with earning sources were day labor. Another major cause of diarrhea is the unawareness of drinking water. By supporting the previous many others studies, the present study revealed that safe water reduce the chance of having diarrhea [18, 19].

The strength of the study is that the sample size represents the national population for generating credible evidence. However, the determinants have to explain with cautious since this is a cross sectional study design, which may be a limitation for the interpretations of the findings in this study.

5. Conclusions

In our study, high prevalence of diarrhea is disclosed and reported in Bangladesh. The authors recommend that increasing the female education, living condition, community health facilities and the awareness of safe drinking water are also important to reduce the prevalence of diarrhea.

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