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Drowning of Under 18 Children in Bangladesh: Analysis of Risk Factors Using MICS 2006 Data

Farzana Chowdhury[1] and Jahida Gulshan[2]*

[1]*Department of Business Administration, Northern University Bangladesh, Dhaka-1209, Bangladesh*

[2]*Institute of Statistical Research and Training, Dhaka University, Dhaka-1000, Bangladesh*

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Abstract

In Bangladesh, drowning is the single leading cause of death among children aged 1 to 17 years. With a view of measuring the drowning of under 18 children in Bangladesh, this paper attempts to analyze different factors responsible for drowning by using the MICS 2006 data. Bivariate analysis is employed to examine the factors related to drowning and logistic regression model is used to determine the contribution of different significant factors to drowning. This study found that divisions, residing in flood prone area or riverbank and wealth index have significant association with drowning. Children residing in flood prone area and riverbank have greater risk of drowning as compared to their counterparts.

Keywords: Drowning, risk factor, Chi-square test of association, logistic regression model, odds ratio.

I. Introduction

Drowning refers to an event in which a child's airway is submerged in liquid, leading to impairment to breathing. The outcome can be fatal or nonfatal, with some nonfatal drowning events leading to significant neurological damage.[1] According to an estimate of World Health Organization (WHO) in 2004, almost 3,88, 000 people die every year from drowning and it is the third leading cause of unintentional injury death worldwide, accounting for 7% of all injury related deaths.[2] In the eastern and southeastern regions of the world, more children die annually from drowning than from any other diseases[3].

In flood-prone Bangladesh, drowning is the single leading cause of death among children aged 1-17.[4] Almost 17,000 children die from drowning each year in Bangladesh implying over 46 each day.[5] In Bangladesh, generally drowning peaks in the 1 to 4 age group and then rapidly declines as age increases.[6] Besides ponds, rivers, canals and drainage ditches drowning occurs even in household water containers such as tubs, buckets, water drums, etc.[4] Heavy monsoon rains and flood increases numbers of deaths from drowning.[6]

Very few studies have focused on child drowning in Bangladesh. The only large scale survey on health and injury of Bangladeshi people was conducted in 2003 where drowning was found to be the greatest danger for children aged 1-9 years, with the death rate declining as the children grow older.[6] The highest incidence (86.3 per 100,000 children years) was in children aged 1 to 4 years.[7] Only the fatal cases of drowning (not involving water transport) were, however, measured in the above-mentioned survey.

An observational study explored the incidence and some potential risk factors of drowning associated deaths in Matlab area of Bangladesh during 1985 to 2000. An analysis of seasonal variation revealed that in Matlab, most deaths due to drowning occurred during the monsoon season.[8] Another study reveals that age of mother, parity, sex of child, mother's education and size of the dwelling space (used as an indicator of socio economic status) have significant impact in increasing or lowering the child mortality associated with drowning in Matlab area of Bangladesh.[9] However, dwelling space is not always proportional and in urban settings, it costs more to live. Moreover, wealth index was available for the current study and hence wealth index was chosen as the indicator of socio-economic status.

The Multiple Indicator Cluster Survey (MICS, 2006) collected cross sectional information on different types of child injury including drowning of under 18 children along with socio-economic and other information on respective households. Number of children drowned in different households in previous one-year of the day of the survey was recorded. The data included all drowning cases including fatal and nonfatal drowning. The objective of the present study is to identify the risk factors that are potential to increase the number of cases of drowning of under 18 children in Bangladesh using MICS data. Identification of individual factors are expected to help to identify those who may be particularly vulnerable and provide information that policy makers can use to target programs at those in greater needs.

II. Data and Variables

Multiple Indicator Cluster Survey (MICS-2006) data has been used for the present study. MICS Bangladesh is the only household survey providing disaggregated data up to district level on a large number of socio-economic indicators. The survey was funded by UNICEF, Bangladesh and carried out by the Bangladesh Bureau of Statistics in partnership with UNICEF.

The field data was collected by Mitra and Associates. The sample for the Bangladesh Multiple Indicator Cluster Survey (MICS) was designed to provide estimates on a large number of indicators on children and women at the national level, for urban and rural areas, and for all 6 Divisions, 64 Districts, urban slums of two City Corporations (Dhaka and Chittagong), and tribal areas. Within each region, 26 census enumeration areas were selected with probability proportional to size. Of the 68,247 households selected and

*Author for correspondence. *e-mail*: gulshan@isrt.ac.bd

tested for the sample, 67,540 were occupied. After a household listing was carried out, a systematic sample of 35 households was drawn from each enumeration area. 62,463 households were covered in the survey from 1,950 enumeration area and household response rate was almost 93%.

In this study, drowning of any children under 18 in last one year is considered as the dependent variable (yes = 1). Independent variables selected are: area (categorized as non-urban and urban), division (with categories: Barisal, Chittagong, Khulna, Rajshahi, Sylhet, Dhaka), residing in flood prone area (yes, no), residing at riverbank (yes, no), living in house with insecure door (yes, no) and wealth index (ranked as poor, middle, rich).

III. Methodology of the Study

Frequency tables are employed to describe the data. To determine the possible socio- demographic characteristics of households related to drowning of under 18 children contingency table is constructed. Chi-square test of association is applied to examine the association of household characteristics with drowning status of children.

In studies with a dichotomous dependent variable, a binomial logistic regression model, often called logistic regression model, is a common choice, which estimates the effects of a set of explanatory variables on the dependent variable. In this study, the dependent variable, drowning (of any children under 18 in last one year), is a dichotomous variable where drowning = 1 for drowned and 0 for not drowned children. Hence, to model the relationship of the socio demographic factors and drowning, a binomial logistic regression model[10] is fitted.

Let the dependent variable be Y, with categories 0 and 1 and the independent variables are $X_1, X_2, \ldots\ldots\ldots, X_k$.

The probability being modeled is denoted by

$$P(Y=1|X_1, X_2, \ldots, X_k) = \frac{e^{(\alpha+\beta_1 X_1+\beta_2 X_2+\ldots\ldots,\beta_k X_k)}}{1+e^{(\alpha+\beta_1 X_1+\beta_2 X_2+\ldots\ldots,\beta_k X_k)}}$$

where $\alpha, \beta_1, \beta_2, \ldots, \beta_k$ are the parameters.

The authors used SPSS (version 16) for analyzing the data.

IV. Results

Using MICS 2006 data, the study demonstrates the drowning status experienced by different households and also the risk factors for this event. Significant demographic and socio economic factors responsible for drowning of under 18 children in last one year have been identified.

Table 4.1. Frequency distribution table for drowning of any under 18 children in last one year from the day of survey

Drowning	Percent
No	99.3
Yes	0.7
Total	100.0

The percentage of children drowned is presented in Table 4.1. The table shows that 7 in every 1000 households experienced drowning of at least one child under 18 in last one year at the time of the survey.

Table 4.2 is the contingency table constructed to show the pattern of the relationship among dependent variable and the independent ones. The findings are illustrated after the table.

Table 4.2. Table for drowning of under 18 children by potential risk factors

Risk Factors		Did any under 18 children get drowned	
		No (row %)	Yes (row %)
Area* **	Urban	99.2	0.8
	Non-urban	99.5	0.5
Division* **	Barisal	98.8	1.2
	Chittagong	99.5	0.5
	Khulna	99.2	0.8
	Rajshahi	99.4	0.6
	Sylhet	99.4	0.6
	Dhaka	99.3	0.7
Flood prone area **	Yes	99.1	0.9
	No	99.3	0.7
Riverbank **	Yes	98.9	1.1
	No	99.4	0.6
Insecure door* **	Yes	98.9	1.1
	No	99.4	0.6
Wealth index* **	Poor	99.2	0.8
	Middle	99.2	0.8
	Rich	99.8	0.2

** p value < 0.05 , *** p value < 0.01

Table 4.2 describes the percentage distribution of respondents according to the response variable and the independent variables. Most of the drowning cases were occurred in urban area (0.8%) and highest numbers of respondents were from Barisa61l division (1.2%) and the lowest number was from Chittagong (0.5%). Poor and middle income households (0.8%) are more vulnerable than rich people (0.2%). About 0.9 percent of the respondents are from flood-prone area and 1.1 percent resides at riverbank. Among them 1.1 percent lived in a house with insecure door. It might be noted that according to Bangladesh Health and Injury Survey (BHIS 2005), ponds, ditches, lakes, rivers are the common places of childhood drowning in Bangladesh. 'Basically children aged 1 to 4 years are the most vulnerable groups, account for almost half of all drowning. Nevertheless, the incidence of drowning at these ages occur not only in ponds or rivers at distances from their residences; even in most of the cases, those take place in buckets, tubs, drums and other uncovered water containers kept inside the home and in the house yard. In these cases, carelessness of mothers or other caretakers and also the lack of adequate supervision on children are responsible for the occurrences of the incidence of drowning. However, the MICS data do not contain sufficient information on the place of incidence and hence it was not possible to explore that event more using this data. Most of the events of child drowning took place in urban area. The highest number of drowning was reported in Barisal division, followed by Rajshahi, Chittagong and Sylhet divisions respectively. Prevalence rate shows that children of flood prone area, riverbank and households with insecure doors have greater risk of drowning as compared to their counterparts.

Chi-square test of independence recommended that the variables, area, division, riverbank, insecure door living in Flood prone area and wealth index have significant association with drowning. Using these variables, we fitted a binomial logistic regression model where the dependent variable was drowning taking value '1' if any child drowned in last one year and '0' otherwise. The results are summarized in table 4.3.

Table 4.3 presents the results of the logistic regression analysis. Children from Barisal are at highest and Sylhet are at lowest risk of drowning compared to the children of Dhaka division (RC). The results exhibit that the drowning of children is 1.610 times more likely to occur in Barisal but in Sylhet, the risk of being drowned is almost 0.674 times lower for the children than that of their counterparts (Dhaka-RC).

Table 4.3. Binomial logistic regression model for drowning of under 18 children

Risk Factors		Coefficient	Standard error of coefficient	Odds ratio	95% CI for odds ratio
Constant		-6.082	0.239	.002	
Division	Barisal**	0.477	0.151	1.610	(1.197, 2.167)
	Chittagong **	-0.362	0.158	0.696	(0.511, 0.949)
	Khulna	0.156	0.146	1.169	(0.878, 1.557)
	Rajshahi	-0.140	0.134	0.869	(0.668, 1.131)
	Sylhet	-0.394	0.242	0.674	(0.420, 1.084)
	Dhaka (RC)				
Flood prone area	Yes	0.620	0.377	1.860	(0.888, 3.892)
	No (RC)				
River bank	Yes ***	1.025	0.285	2.786	(1.593, 4.872)
	No (RC)				
Wealth index	Poor	0.240	0.378	1.272	(0.606, 2.668)
	Middle	0.915	0.266	2.498	(1.483, 4.206)
	Rich (RC)				
Area × River**		-0.724	0.322	0.485	(0.258, 0.911)
Flood × River**		-0.745	0.355	0.475	(0.237, 0.952)
Area × Wealth	Non-urban × Poor *	1.046	0.565	2.845	(0.940, 8.608)
	Non- urban × Middle	0.296	0.493	1.344	(0.512, 5.532)

RC = Reference Category, * p value < 0.10, **p value < 0.05, *** p value < 0.01

Drowning of children is 1.3 times more likely to occur in poor families and 2.5 times more likely to occur in middle income families as compared to rich ones. The risk of being drowned is almost twice for the children of flood prone area as compared to their counterparts. Similarly the children residing riverbanks are 2.8 times more likely to be drowned than the children of other areas. Area and insecure door though have been found significant in contingency table analysis, turned out to be insignificant in logistic regression analysis. Nevertheless, area is insignificant but the interaction of area with two other variables (riverbank and wealth index) was significant in the logistic regression model. The interaction of area and wealth index indicates that the non-urban children of poor and middle income families are 2.845 and 1.334 times more likely to be drowned as compared to rich children of urban area. Parallel ficant impact has been obtained from the interaction of riverbank and flood prone area.

V. Conclusion

Drowning is the second principal cause of injury related mortality among children worldwide.[11] where 90% of the

children drowning deaths occur in low and middle-income countries.[12] Still with the towering rates of drowning, inadequate research has been performed on causes and prevention strategies particularly to the unique hazards in low and middle income countries.[13] Substantial amount of research and program is needed to explore the nature of the problem and develop suitable interventions for the most vulnerable groups.

As drowning is the single leading cause of death among children aged 1-17 years in Bangladesh, there is a clear necessity for research that identifies risk factors for drowning in Bangladesh in order to find out the most vulnerable group for drowning and to help choosing effective interventions. [13, 14, 15] The goal of this article was to contribute to the body of knowledge on childhood drowning in Bangladesh. Contingency table analysis and logistic regression analysis had been performed to explore the type of association among drowning and the potential risk factors.

The study demonstrates that division, wealth index, residing in flood prone area or at riverbank has significant association with drowning. Among six divisions, only Sylhet was significantly lower than Dhaka in experiencing child drowning. In the study wealth index (used as an alternative of socioeconomic status) is found to be significantly associated with child drowning. That is, children from poor and middle families are at higher risk to drown as compared to their counterparts. The study also confirmed the belief that the risk of drowning is higher for children of flood prone area or children residing at riverbanks. Some of the combined factors have also made impact on this issue like children residing in non-urban area specially who live the riverbanks and flood prone area have greater risk of being drowned. Moreover, poor children of rural areas have great chance of occurring this event.

The report of BHIS 2005 reveals an estimate of the type specific injury mortality rate (per 100,000) for both under 18 male and female children and it is 28.6%. Among them for infants the rate is 20%, for children aged 1-4 is 91%, for children aged 5-9 is 60%, for children aged 10-14 is 14% and for children aged 15-17 is 5%. From these results we obtain that the children aged 1 to 4 are the most vulnerable groups having highest drowning rate and the rates falling rapidly as the age increases. Since most the incidents of drowning at these ages occur in open water inside the home, a very useful way to decline the rate of drowning at these presumably particular ages should be raising the awareness of mothers and other caregivers about their children and in this context raising awareness is more rational than any other preventive measures. They should be more concern about not keeping the water uncovered. Since open water is a high risk area for drowning for the safety of children fences or door gates must be provided around the water sources nearby and devise ways to decrease the access to these. However the settlement of water safety rules is also important. Since the analysis exhibits that the children of non-urban area are more vulnerable, so different strategies should be taken to check this occurrence. Some NGO's have targeted programs like providing training of swimming to young children because for children over five years of age swimming is a necessary life skill for survival and can be considered as the public health cure for the epidemic drowning in children after age four. Media can play an important role by encouraging the parents in both rural and urban areas to ensure not only the learning of swimming of their children but also to create awareness among the mother and other caregivers about the safety of their children from water. However, implementation of awareness program is more rational as a recommendation. The issues those are pertinent with reducing the number of casualties may include keeping children safe so that they are not exposed to open water unattended. In short, an organized effort will definitely reduce the incidence of drowning in Bangladesh in the long run.

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