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Contributing Factors of Length of Suffering Periods for Unintentional Childhood Injury of Children: A Study of Tertiary Hospital Data in Bangladesh

M. K. Hossain[1], M. N. I. Mondal[2], M. N. Haque[3], M. R. Islam[4] and M. A. Rahman[5]

ABSTRACT

Background: *Childhood injury is a growing public health problem in developing countries like Bangladesh. Unintentional injuries (UIs) include road traffic injuries (RTIs), falls, burn, cut, drowning, animal injury, machine injury, poisoning and injuries by blunt objects that occur without intent of harm (BHIS, 2016). Information on length of hospital stay periods and magnitudes of social burden of unintentional injuries (UIs) in Bangladeshi children is not adequate.*

Objectives: *This study aimed to determine average length of suffering periods of children (in days) and also to explore the most influential factors for UIs with socio-demographic characteristics.*

Methods: *For this study, 822 children of aged <18 years who were hospitalized to the pediatric emergency wards of a government and non-government hospital in Rajshahi City, Bangladesh, were chosen. Convenience sampling was used to choose the injured children as well as their parents. The outcomes included duration of suffering periods for UIs. Bivariate analysis and Multiple Classification Analysis (MCA) were employed for fulfilling the objectives of this study.*

Results: *The majority of children were suffered to 8-15 days among them due to RTI and injury due to fall comprising 12.30% and 14.80% respectively for their childhood unintentional injury (UI). The result of χ^2 test statistic has expressed statistically significant association between duration of suffering periods for UIs of children with type of UIs. The MCA analysis results indicated that the grand mean for the length of suffering periods were 5.98 days. Any damage of organs (38.80%) and type of UIs (23.80%) were the strong influential factors for contributing duration of suffering periods. The duration of suffering to hospital stay was significantly longer for children with burn injuries compared with other injuries. The longest length of suffering due to burn injury was 16.97 days. The average duration of sufferings due to RTI and injury due to fall were 5.92 days and 5.68 days respectively.*

Conclusion: *Unintentional childhood injuries with RTI, injury due to fall and burn injuries were associated with a longer hospital stay for treatment compared with other injuries. To reduce this suffering on families, an effective UIs prevention programme should be developed.*

Key words*: Unintentional injury (UI), Duration of suffering periods, Road traffic injury (RTI), fall injury, Drowning and Burn injury.*

1. INTRODUCTION

In 2002, 1.2million people died as a result of RTI, and it was the 11th leading cause of death. In addition to the huge death toll, 20–50 million people are injured or disabled every year due to road traffic accidents (Penden *et al*., 2004). Future projections suggest that the global RTI-related death toll will grow by approximately 66% between 2000 and 2020, and in many developing countries, it will be much higher than the global estimate (Kopits *et al*., 2005).In Bangladesh, approximately 12,000 people died due to RTI each year, and the annual cost of road traffic accidents is estimated to be approximately BDT 45 billion (US$ 76 million) (Rahman *et al.*, 2004). The stay of hospital during treatment period or length of suffering periods due to RTIs were 5.70 days on an average (Odero *et al*., 2003).

Annually, about 4.7 million deaths are due to injury, and these account for about 8.5% of the global disease burden (GBD, 2015). Falls are the second leading cause of unintentional injury deaths, and the 13th leading cause of global years lived with disability (GBD, 2015; WHO, 2014). Between 2005–2015, global deaths due to fall increased by about 21%, and a major contributor was population growth and aging (GBD, 2015). In Bangladesh, falls among children aged <18 years, women and elderly were more frequent within the home environment. In contrast, men and adolescents spend more time outside the home, and this can explain the higher incidence of falls outside the home environment (Fayyaz *et al*., 2015). Bangladesh, a lower-middle income country in the South Asia, has a high burden of disability as a result of injury, including falls (PID, 2016). World Health Organization (WHO) estimated that 372,000 deaths occurred from drowning in 2012, which has made it the world's third leading unintentional injury killer (WHO, 2016). Injuries claim over 5 million lives, with more than 90% of those occurring in low- and middle-income countries (LMICS) (WHO, 2002; WHO, 2014). Unintentional injuries (UIs) such as drowning, road traffic injuries (RTIs), falls and burns account for 72% of all injury deaths among them drowning, one of the leading causes of unintentional injuries across the world, accounted for more than 300,000 deaths in 2016 (GHDE, 2018). In Bangladesh, while childhood deaths due to communicable infectious diseases were on a decline in the past decade, deaths due to injuries in the same age group were increasing. The paper *Epidemiology of Drowning in Bangladesh: An Update*-showed those children 1 to 5 years of age were 13 to 16 times more likely to be involved in a drowning (or near-drowning) event than infants or older children. Individuals from lower

socio-economic profiles were at more risk of drowning than their rich counterparts. Males also sustained more near-drowning events than females (WHO, 2016). The great burden of drowning in childhood, and especially concentrated in early childhood where drowning makes up almost three quarters of all injury (BHIS, 2016).

In developing countries, burns are considered to be a complicated healthcare problem as care requires specialized staff and medical technologies that are expensive and not always readily available (Lari *et al*., 2002). In *Epidemiology of Burns in Rural Bangladesh: An Update*, showed that burn injuries and suicides were three to six times more common in females than in males in the rural population of Bangladesh. Children 1 to 4 years of age were four times more likely to sustain burn injuries as compared to infants (Siran *et al.,* 2017). Some studies have also shown that adolescents and younger adults are at even higher risk of suffering from burn injuries in LMIC, compared to children (Sharma *et al*., 2011). The duration of hospital stay was significantly longer for patients with burn injury compared with patients with other injuries or illnesses. The longest hospital stay due to burn injury was 17.34 days, found for children aged 1 to 4 years (Mashrekya *et al*., 2008).

For prioritizing unintentional childhood injury preventive measures, the magnitude of the social burden and suffering of stay hospital at the time of treatment of children must be addressed. However, Bangladesh has few data about UIs, hospital bed occupancy and duration of hospital stay. This study was designed to assess the average hospital stay of injured children at tertiary level hospitals in Bangladesh, and also to explore the average time stay (in days) based on socio-demographic characteristics of UIs children.

2. DATA AND METHODOLOGY

This study focuses on unintentional childhood injuries that occur regularly throughout Bangladesh. Parents and caregivers within families strive to minimize such injuries to ensure the healthy growth and development of future generations. To achieve the objectives of this research, we gathered data from injured children, and the children were identified from registered medical hospitals for children who were admitted during a specific period for the treatment of injuries. Rajshahi, situated in the western part of Bangladesh, serves as the divisional headquarters of Rajshahi Division and

is an administrative district. It is one of the seven metropolitan cities in Bangladesh and is home to numerous private and government hospitals, notably Rajshahi Medical College Hospital (RMCH), a tertiary-level public hospital, as well as private institutions such as Islami Bank Hospital (private), Islami Bank Medical College andHospital (private), Barind Medical College Hospital, Child Hospital (private), Chest-disease Hospital, Sadar Hospital operated by the government, and Christian missionary hospital (NGO).

For the sake of convenience, this research study collected information about injured children through interviews with their parents, and relatives, or direct interviews with children themselves. These interviews were conducted in the hospital wards where injured children were admitted for treatment.

2.1. *Data Collection*

The data were collected for this study encompassed various aspects related to childhood injuries, including types of Injury: Information regarding the nature and type of injuries sustained by the children. Length of Suffering Period: The duration for which the child experienced pain or discomfort due to the injury along with their socio-economic characteristics of both parents and children.

2.2. *Sample Selection*: We employed a purposive sampling method to select individuals for this study. Data were collected from randomly selected four (04) hospitals (two public and two private hospitals) located in the Rajshahi City area of Bangladesh. A total of 822 children were interviewed as part of this research, representing a diverse cross-section of the population seeking treatment in the selected hospitals.

2.3. *Variables Considered for Multiple Classification Analysis (MCA)*

The MCA is applied to evaluate the contribution of several socio-demographic and health related variables on childhood unintentional injury. For the sake of making this analysis more reliable, prominent and understandable, it is indispensable to get an idea about the conditions of the selected predictor variables and the outcome variables. In this section, one variable is considered as outcome variable which is continuous in nature and all of the selected predictor variables are categorical variables. The results of MCA were made using the tertiary hospital data through the statistical software SPSS-7.5 version.

2.4. *Measurement of Explanatory and Outcome Variables*

The specific objective is to identify the contribution of selected socio-demographic and injury related variables on the length of suffering periods for childhood UIs. Therefore, there is needed a multivariate technique which can evaluate these effects in order to know the intensity of the influences of the various factors. In this case, Multiple Classification Analysis (MCA) has been employed to investigate the depth of various socio-demographic and type of UIs variables on duration of hospital stay of children for UIs treatment. MCA examines the relationships between several predictor variables and a single dependent variable, which can also determine the effects of each predictor before and after adjustment for its inter-correlations with other predictors in the analysis. It also provides more information about the bivariate and multivariate relationships between the predictors and the outcome variable. In this study, some selected socio-demographic variables were considered such as type of UIs, sex of children, age of children, parents' occupation, damage of organs and family income and the outcome variable was duration of suffering from childhood unintentional injury (UI) (in days). This was measured by asking how many days children were under treatment for their UIs.

2.5. *Model Validation Technique*

The cross validity prediction power (CVPP), ρ_{cv}^2, is applied to assess the soundness of the fitted model and it is defined by

$$\rho_{cv}^2 = 1 - \frac{(n-1)(n-2)(n+1)}{n(n-k-1)(n-k-2)}(1-R^2);$$ Where, n is the number of classes, k is the number

of explanatory variables of the model and the cross-validated R is the correlation between observed and predicted values of the dependent variable (Stevens, 1996). The shrinkage coefficient of the model is the positive value of (ρ_{cv}^2 -R^2); where ρ_{cv}^2 is CVPP & R^2 is the coefficient of determination of the model. The CVPP and the shrinkage coefficient of the model are presented at the bottom of Table 2.

3. RESULTS

The results indicate that children suffering period ≤7 days, 8-15 days, 16-21days and 22+ days are 24.70%, 34.80%, 18.60% and 21.90% respectively. The majority of children (34.80% out of 100%), among them road traffic injury and injury due to fall holds 12.30% and 14.80% respectively suffered 8-15daysfor their childhood injury. The result of χ^2 test statistic has statistically significant (ρ<0.001) association between length of suffering period of children and type of unintentional childhood injuries (Table 1).

Table 1. Bivariate Distribution and Association between Length of Suffering Period of Children and Type of UIs using Hospital Data at Rajshahi city in Bangladesh**.**

Variables	Length of suffering period from unintentional injury (%)				Total		Significant at 5% level ($\rho \leq 0.05$)
	≤ 7 days	8-15 days	16-21 days	22+ days	(%)Number	95% CI	
Type of unintentional childhood injury							
Road trafficking	8.80	12.30	5.00	9.50	35.50(292)	(32.80-38.30)	$\rho<0.001$
Fallen	8.00	14.80	7.90	6.90	37.70(310)	(34.90-40.60)	
Burn	0.20	1.20	1.80	1.70	5.00 (41)	(3.80-6.30)	
Others	7.70	6.40	3.90	3.90	21.80(179)	(19.30-24.20)	
Total	24.70	34.80	18.60	21.90	100 (822)		

3.1 *Contributing Factors of Length of Suffering Period to Unintentional Injury (UI) of Children*

Socio-demographic and injury related variables may influence on length of suffering period for injury of children. To investigate the mean duration of childhood UI, the well-known MCA has been employed and the results of MCA are shown in Table 2 which contains unadjusted and adjusted predicted mean duration of injury period with their correlation ratio η^2 (unadjusted) and β^2 (adjusted) by socio-demographic, health and injury related factors. Moreover, grand mean, proportion of variance (R^2) and significance of the model has been mentioned in this Table 2. From the results, it was revealed that the significance of the model at $\rho<0.001$, i.e., this model is highly significant. The proportion of variance explained by MCA is $R^2 = 0.230$ which indicates that 23% variation on length of suffering period for UIs of children by the selected socio-demographic variables. The value of R^2 is medium on account of some interrelation among the explanatory variables or some other factors which may influence the unadjusted and adjusted mean duration of suffering for UIs. Again, the grand mean of this model is 5.98 days which means that children has been suffering from injury to less than one week on an average. Moreover, the smallest shrinkage coefficient (0.0142) of the model obtained from CVPP indicating the better fit of the model.

From Table 2, it was identified that the effect on damage of organs by the unintentional childhood injuries had been found to be the first strongest influential factor for explaining the variation on duration of suffering from childhood injury among all other selected socio-demographic variables. It was depicted from the result that damage of organs had strong association ($\eta^2 = 0.406$) with

length of suffering period from injury of children. It was also revealed that the effect of organ damaged of child caring remains low after adjusting for the effect of all other selected variables in the model $\beta^2 = 0.388$ (adjusted) which implied that the effect of organ damaged of children contributed to 38.80% on duration of suffering from childhood injury. Again, the adjusted mean duration of suffering from childhood injury were 3.38 days and 13.00 days for the children whose did not damage of organs and having damaged of organs of children respectively. It was observed from the results that the mean duration of suffering from childhood injury increased with having damaged of organs of the children. So, the result was noticed that everyone should take care of their children from any kind of childhood injury.

Type of unintentional childhood injury had found to be the second strongest influential factor for explaining the variability of duration of suffering from injury among the included variables. The proportion of variance explained for type of unintentional childhood injury was $\eta^2 = 0.256$ (unadjusted) and $\beta^2 = 0.238$ (adjusted) respectively. It was clear that the effect of type of unintentional childhood injury contributed to 23.80% on duration of suffering from childhood injury which remains high after adjusting the effect of all other variables in this model. The adjusted mean duration of suffering from childhood injury was 5.92, 5.68, 16.97 and 4.08 days for those children who belong to type of unintentional childhood injury with road trafficking, injury due to fallen, burn, and other types of injury respectively. It implies that the mean duration of suffering from childhood injury is very high for those children with burn injury but it is lower to other type of injury. Generally, burn injury is more pathetic and time consuming to treatment and cure than other type of childhood injury.

Income of family is an essential socio-economic factor for the wellbeing of human life with increase of individuals' income. Family income of children had found to be the third strongest influential factor for explaining the variation on duration of suffering from childhood injury among all other selected variables. The proportion of variance explained for income of the family is $\eta^2 = 0.091$ and $\beta^2 = 0.068$ respectively which indicates that the effect of family income contributes 6.7% (after adjusted) on duration of suffering from injury of children. It was also observed that the adjusted mean duration of suffering from injury were 6.13, 6.60 and 4.16 days for the children whose family income were ≤10000Tk, 10001-15000 Tk and 15001Tk + respectively. That means-duration of suffering for injury was increased in the lower income family.

The effect of parents' occupation had found to be the fourth (fathers) and fifth (mothers) strongest influential factor for explaining the variation on duration of suffering from childhood injury among all included variables to the model. The proportion of variance is $\eta^2 = 0.084$ and $\beta^2 = 0.066$ explained for fathers' occupation and $\eta^2 = 0.058$ and $\beta^2 = 0.016$ explained for parents' occupation respectively. It is depicted from results that the effect of fathers' and mothers' occupation contributes to 6.6% and 1.6% on duration of suffering from injury respectively which remains high in fathers' occupation but low in mothers' occupation after adjusting the effect of all other variables. The adjusted mean duration of suffering from injury is 5.17 and 6.62 days for the children whose fathers' occupation are service and business, and agriculture and labour respectively. Again, the children whose mothers' occupation is housewife, service holders and others group with mean duration of 5.93, 6.01 and 6.74 days on average respectively. In case of low occupational parents' indicates that duration of suffering from injury is obviously higher than that of high occupational parents'.

Age of the children is the sixth strongest influential factor for explaining the variability of duration of suffering from morbidity as well as the proportion of variance explained for age of the children is $\eta^2 = 0.019$ and $\beta^2 = 0.035$ respectively. The effect of age of the children contributes 3.5% on duration of suffering from injury which remains high after adjusting the effect of all selected variables in this model. Again, the adjusted mean duration of suffering from childhood injury are 5.17 days and 6.16 days for the children who are belong to ≤5 years and 6+ years of their age respectively. It is clear that duration of suffering from morbidity is gradually increasing with increasing their age excepting aged 6+ years.

It is also found that sex of the children is the last strongest influential factor for explaining the variation on duration of suffering from injury and the proportion of variance explained for sex of the children is $\eta^2 = 0.019$ and $\beta^2 = 0.028$ which indicates that the adjusted effect of this variable contributes to 2.80% on duration of suffering from injury. Again, it is found that female children are suffering more (6.57 days on an average) from injury than that of male children (5.81 days on an average).

Table 2. Mean Length of Suffering Periods for Unintentional Injury (UI) of Children with some Selected Socio-demographic Variables using Hospital Data at Rajshahi City in Bangladesh.

Explanatory variables	N=822	Length of suffering periods for UIs	
		Predicted mean	Correlation ratio

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		Unadjusted	Adjusted	η^2 Unadjusted)	β^2 (Adjusted)
Type of injury					
Road traffic injury (RTI)	292	6.28	5.92		
Fallen	310	4.81	5.68	0.256	0.238
Burn	41	17.90	16.97		
Others	179	4.78	4.08		
Sex of children					
Male	647	5.87	5.81	0.019	0.028
Female	175	6.38	6.57		
Age of injured children					
≤5 years	150	5.54	5.17	0.019	0.035
6+ years	672	6.08	6.16		
Mother's occupation					
Housewife	730	6.08	5.93	0.058	0.016
Service holders	51	3.66	6.01		
Others	41	7.13	6.74		
Fathers occupation					
Service and Business	362	4.94	5.17	0.084	0.066
Agriculture and labour	460	6.79	6.62		
Monthly family income					
≤10000 Tk	510	6.36	6.13	0.091	0.068
10001-15000 Tk	201	6.41	6.60		
15001Tk and above	111	3.45	4.16		
Damage of organs					
No	600	3.26	3.38	0.406	0.388
Yes	222	13.32	13.00		
Model summary: Grand mean =5.98, Multiple R = 0.479, Multiple R^2 = 0.230, Significance of model, p<0.001, and the shrinkage coefficient of the model=0.0142.					

4. DISCUSSION

Childhood injury including road traffic injury (RTI) is one of the major causes of hospital admission in Bangladesh, and is responsible for one-fifth of injury-related hospital admissions in primary and secondary level hospitals (Mashreky *et a*l., 2010). Specialized hospitals are normally situated in larger cities, where living costs are higher. In addition, patients with more complex injuries normally attend tertiary level hospitals, resulting in longer hospital stays and higher costs. This study revealed that the effect of type of unintentional childhood injury contributed to 23.80% on duration of suffering from childhood injury. The grand mean was 5.98 days which means that children had been suffering from their unintentional childhood injury (UI) to less than one week on an average along with 5.92 days due to RTI consistent with other study of the average duration

of hospital stay was 5.70 days (Odero *et al*., 2003).The resulting that damage of organs had strong association with length of suffering period from injury of children and the effect of organ damaged of children contributed to 38.80% on duration of suffering from childhood injury. The mean duration of suffering from childhood injury was 13.00 days for the children who's having damaged of organs. This finding is consistent with many other studies in the world (Odero *et al.;* 1997; Ganveer *et al*., 2005). This study found shorter hospital stays compared with other studies in Trinidad and Tobago, the average hospital stay due to RTI was 27 days, (Bernad *et al*., 2003) and in Kenya, it was 3 weeks to 1 month (Mashreky *et al*., 2010).

Children emerged as the other vulnerable group for fall injuries. This study found that the average duration of suffering due to fall injury was 5.68 days. Previous studies from Bangladesh have reported a high burden of fall-related mortality, morbidity and disability among children (Rahman *et al*., 1998; Rahman *et al*., 2016). This could be because children in LMICs lack designated and safe play areas (Moshiro *et al.,* 2005). Strategies such as installing window guards, making environmental modifications in and around homes, and enforcing standards in playgrounds may also help prevent fall injuries among children (WHO, 2014).

Generally, burn injury is more pathetic and time consuming to treated and cure than other type of childhood injury. The average duration of hospital stay for burns children was 16.97 days, which was significantly higher than the duration of stay for any other injury. Results from Iran and Turkey for burn injuries shown similar durations of hospital stay (Rouzbahani *et al,* 2004; Duzgun *et al.,* 2003) and in Papua New Guinea, the duration of hospital stay was 22 days (Torova *et al*., 1996). In NewZealand, the duration of hospital stay was 68.7 days (Lofts, 1991) with more complex injuries normally attend tertiary hospitals, resulting in longer hospital stays and higher costs.

5. *Conclusions*

Unintentional injury (UI) of children and violence against women are growing problem in our country; childhood injury requiring particular attention, as many of these injuries is preventable if proper measures can be adopted. For this purpose, proper investigation of duration of suffering periods for UIs along with the injury patterns to the event is required. In this study, average burden of suffering periods of childhood injury considering the severity in the form of longer or shorter disability days were less than one week in Bangladeshi tertiary hospitals admitted children. Besides, any damage of organs, RTI, injury due to fall, and burn injury were also identified as suffering factors of children. Proper supervision at home, social mobilization and education to gain

knowledge of parents can reduce the incidence of burn injury as well as RTI and injury due to fall of children.

Ethical consideration

The Institute of Biological Sciences ethics committee of the University of Rajshahi, Bangladesh, examined and approved this study protocol (Memo No: 09(17)/320/IAMEBBC/IBSc). Potential participants were notified about the study, extended an invitation to participate, and made aware of their right to withdraw from the study prior to the survey.

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