

Brief Report

Risk factors for injury in Pakistani children

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Summary

Over 1 million fatal child injuries occur per year, the bulk of them in less-developed countries. There remains a need, from country to country, to identify personal and environmental risk factors correlated with this mortality. The present study focused on Pakistan, home to a sizeable pediatric population of 60 million. The study employed case-control methods (i) to identify situational risk factors and (ii) to test when children were most at risk, and whether these patterns differed for preschool versus school children. For two months the families of 300 consecutive inpatients were interviewed at Children's Hospital in Islamabad. Most children (79%) were unsupervised at the time of the injury. The case-control study found risk factors in the mother's level of education, size of the home, and number of children in the home (all $p < 0.05$). With respect to temporal patterns, the time period of greatest risk was 3-6 PM. Compared to preschoolers, school children showed elevated risk on weekends (odds ratio 4.0, $p < 0.001$) and reduced risk during school (odds ratio 0.2, $p < 0.0001$); in contrast, the risk of injury for preschool children remained constant throughout the week. The results support the conclusion that overall, poor supervision, domestic crowding, and low maternal education were risk factors for injury in our sample of Pakistani children. Based on this conclusion, we recommend further efforts to keep children off roofs, isolate them from hazards, promote supervision, educate parents, and provide safer play.

Keywords: Pediatric, Trauma, Case-control study, Pakistan

Introduction

Worldwide, over 1 million children die from injuries annually (1,2). This mortality is compounded by considerable morbidity, disability, and economic cost (1-5).

Of the 1 million fatalities per year, the bulk occurs in the developing world (2). There remains a need to identify personal and environmental risk factors that correlate with this mortality. We wished to lay a foundation for this work in Pakistan, where studies have already examined injuries in adult and general populations (6-10), but not specifically in pediatric populations.

We conducted a case-control study of children at one of Pakistan's leading public children's hospitals.

Our objectives were (i) to identify situational risk factors for child injury and (ii) to test when, in the context of their schedules, children were more likely to be injured, and whether these patterns differed for preschool versus school children.

Methods

The study enrolled 150 consecutive cases and 150 consecutive controls at Children's Hospital of the Pakistan Institute of Medical Sciences (PIMS), Islamabad. This hospital is the principal public children's hospital in the capital of Pakistan, and was chosen as the one of the best available sites in Islamabad to obtain a representative cross-section of the Pakistani pediatric population. PIMS serves a complex catchment area in northern Pakistan, where several other hospitals overlap. The hospital includes both public and private inpatient wards and serves people from all points on the socioeconomic spectrum. We interviewed eligible patients for 60 consecutive days in

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the months of November and December.

Cases were children up to 12 years old admitted to PIMS due to an injury. Injury was defined prospectively as any fracture, burn, foreign body, internal injury, blunt injury, crush, laceration, penetration, animal attack, poisoning, or drowning. Controls were children up to 12 years old admitted for any other reason. Data from the control group was used for other research, but not in a way that duplicates any of the work described in this paper.

The study was carried out under a protocol approved by PIMS and the Human Investigations Committee (HIC) at the Yale University School of Medicine (USA). The parent or guardian of each subject was approached, and informed consent was obtained. The parent or guardian received an information sheet describing the purpose of the study, the subject's rights, and contact information for the investigators. The investigator collected all information verbally from the family.

SAS software was used for all statistical analysis (SAS, Cary, North Carolina, USA), which included chi-square analysis and logistic regression with a forward conditional model using as variables age, sex, family income, maternal education, number of rooms in home, number of children in home, and use of tent as a home.

For analysis of time-related risk, we surveyed children on their typical daily schedule and then divided the schedule as follows: "Sleep Time," Monday through Sunday 22:00-06:00; "Before School," Monday through Saturday 06:00-08:00; "School Time," Monday through Thursday and Saturday 08:00-14:00, Friday 08:00-12:00; "After School," Monday through Thursday 14:00-22:00; "Friday PM" (when students are dismissed from school early for prayers), 12:00-22:00, and "Holiday Time," Saturday 14:00-22:00, Sunday 06:00-22:00, and national holidays 06:00-22:00.

From the schedule we developed a model to predict the distribution of injuries expected by chance. The model made two assumptions: (i) no injuries occur during "Sleep Time" and (ii) injuries occur with equal frequency during all other periods. The proportion of injuries expected for each period was calculated as the proportion of hours occupied by each period, with "Sleep Time" excluded.

Results and Discussion

Of 190 cases who presented, 39 did not qualify because a parent could not be reached for consent, and one other family chose not to participate. Of the 150 cases recruited, 59% percent had suffered a fall, 16% a road collision, 13% a burn, and 12% other (foreign body ingestion or aspiration, animal attack, toxic ingestion, assault). Overall, only 21% of children were accompanied by an adult when the injury occurred. For cases, 36% were from Islamabad, 36% from Rawalpindi, 15% from other parts of Punjab Province,

6% from Kashmir, and 6% from the Northern Areas and NWFP (5% were Afghan refugees).

Of 150 controls whose families were invited to participate, all provided their consent. Recorded reasons for admission, from more common to less common, included pneumonia, gastroenteritis, tonsillitis, pharyngitis, cleft palate, club foot deformity, meningitis, sepsis, Hirschsprung's disease, asthma, hydrocephalus, renal failure, malnutrition, thalassemia, and neural tube defect. For controls, 28% were from Islamabad, 27% from Rawalpindi, 29% from other parts of Punjab Province, 6% from Kashmir, 10% from the Northern Areas and NWFP, and 1% from Afghanistan (3% were Afghan refugees).

The 88 children with a history of fall presented with head injury or serious fractures. Only 15% were accompanied by an adult when they fell (below the overall mean supervision rate of 21%). Most (70%) fell from a rooftop, typically at home from an unprotected roof. Only 12% of roofs were protected by rails or walls. Kite flying and cricket were common activities. The male:female ratio was 71:29, similar to the overall ratio for cases and controls. Half of the children were under 5 years old.

Most of the 24 children with a history of road collision were admitted due to head injury or complicated fractures. The male:female ratio of 71:29 was similar to the overall mean. Of the 20 children admitted with burns, 32% were accompanied by an adult when the burn occurred (above the overall mean). Many burns occurred near dinner time: 60% between 3 and 9 pm; 35% between 5 and 7 pm. In 85% of cases the burn source was at ground level. Burn sources included stoves and cooking fires (60%), tea or hot water (30%), and outdoor fires (10%). In contrast to other types of injury, the male:female ratio was 50:50. Half of the children were 2 years or under.

Table 1 compares cases and controls for different descriptors. Cases tended to be older than controls; however, logistic regression and pairwise linear correlations showed that age did not cause an interaction effect with any of the other variables. Case mothers reported significantly less education than control mothers ($p = 0.016$). Cases reported significantly more children in the home ($p = 0.047$). They also reported significantly fewer rooms in the home ($p = 0.023$). Cases were more likely to live in tents than controls: 6% for cases and 1% for controls ($p = 0.023$).

When we analyzed the results by logistic regression (by a number of forward conditional models), results compared favorably with the chi-square analyses reported above: most notably, maternal education, rooms in home, and type of shelter emerged as significant independent factors (all $p < 0.05$). The number of children in the home, however, did not emerge as an independent variable.

A child's risk depended on the time of day. For

Table 1. Descriptors for cases versus controls

Factor	Cases (n = 150)		Controls (n = 150)		Odds ratio	p value
	Number	%	Number	%		
SEX						
Male	100	67	101	67	1.00	0.902
Female	50	33	49	33	1.00	
AGE (years)						
Under 2	21	14	89	59	0.24	< 0.001
2-5	63	42	32	21	2.00	
Over 5	66	44	29	19	2.32	
INCOME (Rp. per month)						
Up to 5,000	92	61	117	78	0.78	0.045
Over 5,000	38	25	26	17	1.47	
Not reported	20	13	7	5		
MATERNAL EDUCAT.						
No school	79	53	67	45	1.18	0.016
1-8 years	32	21	32	21	1.00	
> 8 years	25	17	49	33	0.52	
Not reported	14	9	2	1		
CHILDREN IN HOME						
1-2	37	25	58	39	0.64	0.047
3-4	52	35	49	33	1.06	
> 4	54	36	42	28	1.29	
Not reported	7	5	1	1		
ROOMS IN HOME						
1-3	112	75	99	66	1.14	0.023
> 3	31	21	50	33	0.64	
Not reported	7	5	1	1		
TYPE OF SHELTER						
Tent	9	6	2	1	6.00	0.023
House	134	89	144	96	0.93	
Not reported	7	5	4	3		

Table 2. Injury risk in the context of children's daily routine

Time period	Odds Ratios (95% CI), p value		
	ST vs. PS ^a	PS vs. Model	ST vs. Model
Before school	2.1 (0.4 - 11.4), p = 0.538	0.4	0.7
School	0.1 (0.03 - 0.4), p < 0.0001	1.2	0.2
After school	0.9 (0.5 - 1.6), p = 0.901	1.0	0.9
Friday PM	0.7 (0.2 - 2.7), p = 0.739	1.0	0.7
Holiday	4.0 (1.8 - 9.0), p < 0.001	1.0	2.5

^aST = Students; PS = Preschoolers.

both preschoolers and students, the frequency was low between 9 PM and 6 AM. Frequency rose during the day, peaked between 3 PM and 6 PM, then declined after 6 PM for preschoolers and after 9 PM for students.

The risk of injury further depended on the day of week, and whether the child attended school. Table 2 shows the odds ratios for comparisons of students, preschoolers, and the model. "Holiday Time" was a critical period of risk for students compared to preschoolers, with an odds ratio of 4.0 ($p < 0.001$). On the other hand, "School Time" was a period of pronounced safety, with an odds ratio of 0.1 ($p < 0.0001$). The same patterns emerged when students were compared to the model, with odds ratios of 2.5 for "Holiday Time" and 0.2 for "School Time." Comparison of preschoolers with the model showed odds ratios of 1.0-1.2 in four of five time periods. This implies that the model successfully predicted the distribution of preschooler injury.

From the results one can deduce three overall risk factors: (i) lack of adult supervision, as demonstrated by low rates of adult supervision in the case sample and by elevated odds ratios for times when students were outside of school; (ii) crowded homes, as demonstrated by elevated odds ratios for children with relatively more siblings or relatively smaller homes; and (iii) poor maternal education, as demonstrated by higher odds ratios for children whose mothers had little or no schooling. The value of these results is that they provide clues for further research to identify children at risk.

Poor supervision is a recurrent theme. Only 21% of the children in our sample were supervised when the injury occurred. Weekends and holidays were associated with the most risk of injury for students, with an odds ratio of 4.0 ($p < 0.001$) compared to preschoolers. Students were relatively safe at school with an odds ratio of 0.1 ($p < 0.0001$) compared to preschoolers. In contrast, preschoolers did not vary in

injury frequency, with odds ratios of ~1 for most time periods. These results provide multiple convergent lines of evidence for the importance of adult supervision. More specifically, the results show that more vigilance is needed on weekends, holidays, and afternoons, and they imply that the risk of injury can be reduced by improving access to school.

Low maternal education was a risk factor in chi-square analysis ($p = 0.016$). Logistic regression showed that this effect was present even when controlled for income. We postulate that less educated mothers, particularly those who cannot read, are not as empowered to recognize and promote healthy behaviors in their children.

Crowded homes, expressed in our results by the number of rooms and number of children in the home, also differed between cases and controls ($p = 0.023$ and $p = 0.047$, respectively). We postulate that crowded homes: (i) made supervision more difficult and (ii) displaced children to more perilous play spaces such as roadsides.

Worldwide, boys show higher overall injury rates than girls (2). We found similar results in the present study, with 67% males and 33% females. For burns, however, the distribution was 50% and 50% (see above). A result we did not anticipate was that the control group also consisted of 67% males and 33% females. These values differ dramatically from the nearly equal numbers of boys and girls found in the Pakistan 1998 census (11). The literature has established that some families in Pakistan are more likely to seek medical care for their male children as compared to their female children (12-14). While the results of this study are provocative in this respect, the study was not designed to test whether a child's gender influences the parents' health-seeking decisions. Carefully designed household-based studies will be needed to test this hypothesis and understand to what extent such gender biases still exist.

Pakistan is a large and remarkably diverse nation. The present study only represents a small portion of Pakistan's geographic, cultural, and economic diversity. Further work is needed to test whether these results generalize to other regions. Another potential limitation to the results is that we collected data over the months of November and December. While many types of injury occur year-round, we postulate that other types, such as drownings and snake bites, are likely to be less common in months characterized by colder weather.

We limited our study to children admitted to the hospital. Our sample may not generalize to children who die outside of the hospital or those who are treated in the emergency department and released. This consideration limits our ability to generalize to minor injuries, or very serious ones such as high-speed motor vehicle collisions.

As commonly occurs in case-control studies, not

all differences seen are likely to be causally related to injury. Cases were older than controls ($p < 0.001$), a difference which is likely to be an artifact of our control group. As mentioned above, the control group included a number of children with infections of infancy (pneumonia and gastroenteritis) as well as congenital conditions. These diagnoses may have skewed the analysis in a number of ways. Furthermore, there are selection biases, both geographic and economic, inherent to samples from any one hospital in Pakistan. The findings of this study should be re-tested in a multi-center context.

Based on the above results, as well as the interviews we conducted, we can briefly enumerate some areas that would benefit from further study and policy considerations. Where possible we have referred to works by authorities in these areas. Falls were the most prominent cause of injury in our sample, accounting for 59% of injury admissions. An Indian study found similar results, with 44% of children injured by a fall (15). This is in contrast, however, to studies in Iran (16) and Thailand (17), where falls were less common than motor vehicle collisions. Compared with other causes of injury, falls were associated with less adult supervision (15%). Most Pakistani roofs are unprotected, and the vast majority of fall victims in our sample fell from unprotected roofs. A special cultural issue is kite flying, which is popular in Pakistan and is the focus of the Basant celebration.

Road collisions (8,9) accounted for 16% percent of injuries in our sample, consistent with the result of 26% found in India by Tandon *et al.* (15). There is a paucity of sidewalks in many areas of Pakistan. Where the government has provided sidewalks and pedestrian overpasses, pedestrians frequently fail to use them. Many pedestrians walk with their backs to traffic. Many cars lack seatbelts, and education about seatbelt use has been inconsistent.

Fires were the third principal cause of injury, accounting for 13% of the sample. The vast majority of burns were at home, from fires at ground level (18). There was a clear association between burns and meal times, particularly supper time. Notably, half of fire victims were girls, compared to falls and road collisions, for which boys were over-represented. This reflects that girls spend more time in the kitchen. Many Pakistani females wear loose clothing, which is more prone to ignite.

With over 60 million children, Pakistan is home to one of the world's five largest pediatric populations. As in many countries, child injury has become one of Pakistan's most pressing public health problems. The social and financial burdens have important implications for Pakistan's future development. We hope the results of this study will be useful in guiding future injury research and focusing injury prevention efforts on children most at risk.

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