

Epidemiology of Head Injury in Malaysian Children: A Hospital-Based Study

J Rohana, MD*, L C Ong, MRCP*, A A Abu Hassan, FRCS**, *Department of Paediatrics, Universiti Kebangsaan Malaysia, **Department of Emergency, Hospital Kuala Lumpur

Summary

A prospective observational study was carried out at the Emergency Department, Hospital Kuala Lumpur to determine the proportion of accidental head injury among children and the circumstances of injury. The study was carried out from November 1993 to January 1994 on all children below 14 years who presented to the Emergency Department with accidental head injury. Accidental head injury made up (4.75%) of all cases seen at the Casualty Department. The ratio of boys to girls was 2:1. The mean age of head injured children was 5.2 (S.D. 3.63) years. The leading cause of head injury was fall (63%) followed by road traffic accidents (RTA) in (30.7%) while the rest were due to 'impact' (injury caused by flying object or missiles) injuries. More than half (54.4%) of those injured in RTA were pedestrians. Pedestrian injury was particularly important in the 5- < 14 years age group, where adult supervision was lacking in two thirds of the children. None of the patients who were involved in vehicle-related injuries had used a suitable protective or restraining device. All three patients who died were from this group. This study emphasises the need for stricter enforcement of laws related to the use of protective devices and measures to decrease child pedestrian injury. The issues of lack of adult supervision, both in and outside the home need to be addressed.

Key Words: Head injury, Epidemiology, Children, Pedestrian injury.

Introduction

Patients with head injury constitute a major health problem throughout the world. In developed countries head injury ranks as a major cause of morbidity and mortality in children beyond the first year of life^{1,2}. It is even more important in children aged 5 to 15 years, in whom a quarter of deaths results from head injury¹. With rapid industrialization resulting in increased traffic accidents and urbanization leading to problems of housing, there is every indication that head injury will become a major problem in our country too. To date there are as yet no studies done to evaluate the magnitude of this problem in Malaysia. However in the last decade, accidents have been consistently the third commonest cause of death in Peninsular Malaysia³. The trend of death amongst children 0-14 years from 1965

to 1987 shows that accidents have become increasingly important as a major cause of deaths⁴. In road traffic accidents, head injuries and multiple injuries caused deaths in the majority of cases⁵.

This major cause of unnecessary morbidity and mortality should as far as possible be reduced by preventive measures and legislation. However, studies on the epidemiology of head injury are necessary before any planned attempt at prevention is made. Information on the causes and circumstances surrounding head injury in children is required to allow strategies for preventing head injury to be devised and implemented. We in Malaysia lack epidemiologic data on the prevalence rate, clinical profile, family and social background of children with accidental head injury hence this study was conducted. The aims of the study were to:

(i) estimate the proportion of accidental head injury among a group of Malaysian children presenting at the Emergency Department, Hospital Kuala Lumpur and (ii) determine the causes of head injury among these children and the circumstances surrounding the injury.

Materials and Methods

The study was conducted over 3 month period from November 1993 to January 1994 on all consecutive children below 14 years who presented to the Emergency Department with accidental head injury. Head injury was diagnosed when there is a history of blow on the head and the child showed either some external evidence of the injury (laceration, abrasion, haematoma) or had symptoms suggesting concussion⁶. Children with head injury due to birth trauma or suspected to have non-accidental injury were excluded from the study. Children who died enroute to the hospital were also excluded.

Data regarding the demographic and social characteristics, accident condition, physical findings and investigations were recorded on a standard questionnaire. Patients were managed according to the discretion of the attending doctors. For those discharged home or admitted for less than a week, their guardians were contacted by phone or self-addressed letter enquiring about the child's condition a week post injury.

Results

During the study period there were 8,138 children aged less than 14 years seen at the Emergency Department. Out of these, 1,532 (18.8%) were classified as trauma cases while the rest were classified as medical cases including all non-emergency cases of infants. Of those classified as trauma, 388 (25.3%) children were diagnosed to have accidental head injury. Head injury cases therefore made up (4.75 %) of all cases seen at the emergency room during this period. Other cases that were also classified as trauma were poisoning, burns or scalds, foreign bodies and cuts. Complete data were obtained from 335 (86.3%) families. The rest were either incomplete data (35 patients) or the families could not be traced from their addresses provided to the hospital (18 patients). Only those with complete data were included in this study.

The racial distribution of head-injured children was comparable with the racial pattern of all casualty attendances (Table I). The ratio of boys to girls was 2:1. The mean age was 5.2 (SD 3.63) years, and almost half were below 5 years of age (Table II).

Table I
Pattern of Emergency Department attendances between Nov 1993-Jan 1994

Race	Number of patients	
	All patients	Head injured
Malay	5165 (63.5)	225(67.2)
Chinese	1047(12.8)	47(14.0)
Indians	1580(19.4)	44(13.1)
Indonesian	186(2.3)	8(2.4)
Others	160(2.0)	11(3.3)
Total	8138(100)	335(100)

Table II
Age and sex distribution of head-injury children

Age group(years)	Number of patients		
	Male	Female	Total
0-<5	88	65	153
5-<9	77	47	124
9-<14	43	15	58
Total	208	127	335

Sixty three percent of injuries resulted from a fall, (30.7%) were due to road traffic accidents (RTA) while the rest were caused by flying objects and missiles. Of those injured as a result of RTA, (54.4%) of them were pedestrians (Table III). The majority of them were hit either by a car or a motorcycle. In 9 (56.2 %) of the 14 motorcycle related injuries, there were more than 2 people on the motorcycle.

With regards to the place of accident, 183 (54.6%) of them occurred at home while another 112 (33.3%) occurred on the road. Only 16 (4.8%) accidents occurred in schools, and 12 (3.6%) in the playground. In children below 5 years of age, (77.1%) of the injuries were caused by falls (Table3). There were 4 baby-walker-related injuries. Children in the 5-<9 years and 9-<14 years age groups had a lower percentage of injury caused by falls (55.6%) and (43.1%) respectively. As the age increased, a higher proportion of injuries resulted from RTA. Among children in the 5-<9 and 9-<14 year age groups, pedestrian injuries constituted (60%) and (50%) of all RTA for the respective age group. The mean age of the pedestrians was 7.2 (SD 0.92) years. Twenty

one (37.5%) pedestrians were hit by a motorcycle while another 17 (30.3%) were hit by a car. It was observed that a suitable protective device was not used in all patients who were involved in vehicle-related accidents.

Supervision was lacking in (40%) of all cases. Forty one (26.8%) of the children below 5 years were not supervised at the time of injury while 38 (65.5%) of those over 9 years lacked supervision. Overall, 27 (66.1%) of 56 pedestrians were alone at the time of accidents, with 19 (59.3%) of those aged 4-<9 not supervised. Children below 5 years who were injured as a result of falls were left unsupervised in 41 (34.7%) of the cases.

In 44 (78.5%) of the pedestrians, it could not be determined whether the accidents happened due to unsafe behaviour of the children (crossing street without looking, running into street, playing in the streets) as they could not give an accurate account of what actually happened. Neither could it be determined whether those accidents happened due to the drivers' or riders' faults. Falls due to unsafe environment or lack of parental vigilance were present in 67 (31.7%) of cases.

Table III
Agents of injury according to age group

Agent	Number of patients			Total
	0-<5 years	5-<9 years	9-14 years	
Falls	118	69	25	212
RTA	27	48	28	123
- cyclist	0	5	9	14
- passenger	10	5	2	17
- pillion rider	7	6	3	16
- pedestrian	10	32	14	56
Missiles	7	7	6	20

These included leaving small children unattended or failure to lock up doors or not having railings or staircases. Unsafe behaviour of the children such as climbing ladders or attics to play or jumping down from a verandah caused injury in 48 (23%) of cases.

One hundred eighty four (54.9%) of the patients were admitted while the others were sent home. The most common type of injury sustained was external injury (83.6%) followed by cerebral concussion (45.4%). Serious intracranial injury was noted in only (7.2%). One week after injury, sequelae were present in (10%) survivors. These included headache, vomiting, impaired and concentration. Three patients (0.9%) died, all were due to road traffic accidents. Two were motorcycle pillion riders, whose front riders were underaged and unlicensed. The other was an infant seated on the mother's lap in the front seat of the car.

Discussion

The study showed that head injury made up (25.3%) of all trauma cases seen at the Emergency Department. Even though serious injury occurred in only (7.2%) of patients, it placed a significant burden on the hospital's resources. Our study showed a predominance of boys, the male to female ratio being 2:1. Other studies have also shown the male preponderance, quoting similar ratios⁷⁻¹¹. The higher incidence in boys is attributed to their more adventurous and aggressive behaviour. The highest rate of injury was among young children - almost half of them were below 5 years. This concurs with findings of several studies done in developed countries^{9, 10, 12}. This is possibly due to the physical and psychological developmental limitations of young children in coping with dangerous situations. There were significant age differences with respect to the agent and place of injury. For the infants and toddlers, falling from stairs, windows or furniture was the most frequent cause of injury. Baby walker related head injury was not a prominent problem. Younger children appear to be injured more commonly within the home environment whereas a higher proportion of older children were injured in RTA. This is most probably because older children spend most of their time outdoors, either playing or making journeys to and from school⁸ whereas younger children are mostly

confined to the home environment. The lower proportion of injury occurrence within the school environment was most probably because the study was conducted during the long school holiday.

Falls were the leading cause of head injury in this study, especially in young children. Two other studies have also reported similar figures^{6,13}. Most of these falls occurred at home. With regards to head injuries that occurred within the home premises, it was found that elements of unsafe house environment or lack of parental vigilance were present in one third of cases. These included leaving small children unattended, failure to lock up doors and not having railings on staircases. These hazards could surely be reduced by improved stair and window design, with particular emphasis on stair railings and stairs gate. Concomitant parental education is necessary for the prevention of home accidents.

The records of the Royal Malaysian Police in 1994 showed that 435 children aged 0-14 years died on the road and 3,906 were injured. Of those who were injured, 177 (40.7%) were pedestrians⁵. In our study 30.7% of head injuries resulted from RTA, similar to that reported by others^{6,10,13}. More than half were pedestrians. Studies elsewhere reported pedestrian injuries ranging from (46.6%) to (73.0%) of all vehicle related accidents^{14,15}. Because of the seriousness of this problem, there have been many studies done looking into various aspects of pedestrian injuries especially to ascertain if there were any risk factors that could be modified. As with other type of injuries, prevention of pedestrian injury can be approached through changes in the host, the agent, the environment, or in their interaction with one another. In our study, it could not be determined in most cases whether the accidents happened because of the unsafe behaviour of the children or the drivers' fault as the children could not give an accurate account of what actually happened. A study on the behaviour of children in traffic concluded that their behaviour is often unsafe and that little reduction in the incidence of these injuries could be expected from attempts at behaviour modification¹⁶. The fact that almost half of our pedestrian injuries were in the 5-<9 age group suggest that behaviour modification is not feasible. Another approach is to educate parents, emphasizing the importance of supervising their

children. About two thirds of the injured pedestrians in this study were unsupervised at the time of accidents. Saddler found that many mothers were unrealistic about the age at which children could be expected to cope with traffic¹⁷. On the other hand it is also probably unrealistic to expect parents to provide constant supervision outside the home. Another alternative therefore is to make the environment safer for the children. Countries such as Denmark and Sweden have experienced large decreases in mortality of child pedestrian injury after placing greater emphasis on the modifications of the urban traffic environment¹⁸. Interventions may vary from simple measures such as having more child crossings especially near school in high traffic zones, employing traffic wardens, enforcing speed limits to more ambitious town planning modifications and introducing a good public transport system that encourages a shift from private cars to public transport^{15,18}. A limitation of this study was the lack of detailed information as to the actual circumstances of injury, hence we are unable to provide guidelines as to which of the various measures mentioned above should receive priority to minimize pedestrian head injury. A more detailed study would be required to address this issue.

The rest of the children injured in RTA were pillion riders and vehicle passengers. Although there were only three deaths in this study, two of them were related to motorcycle injuries and the third was an infant on the front seat, in all, protective devices were not used. Even though the use of crash helmets and seat belts has been legislated in our country, the enforcement is still poor.

We found that there were usually more than two individuals on a motorcycle in most of the motorcycle accidents. Stricter adherence to current laws and sterner deterrence for such offenders is required.

Conclusion

Head injury is an important cause of childhood trauma in this study. The large numbers of head injuries also placed a significant burden on the hospital's workload and resources. The pattern of head injury with regards to causative agents seems to be similar to that of developed countries. Road traffic accident is an important cause of head injury especially in the 5 to 14 years age group. There is a high incidence of pedestrian injury among children in the 5-<9 years age group who are not mature enough to look after themselves on the road. A significant proportion of these children was unsupervised. It was alarming to find that suitable protective devices were not used in vehicle-related injuries despite the fact that it's use has been legislated.

We suggest that the results of this study be used as a guideline for a more in-depth study to decide on prioritization of the various aspects of head injury prevention. This study emphasizes the need for stricter enforcement of laws, especially on the use of protective devices and compliance with speed limits. Laws on the mandatory use of child car seats and restraints and bicycle helmets probably need to be legislated. The issues of lack of adult supervision both in and outside the home in a busy urban setting like Kuala Lumpur need to be addressed.

References

1. Sharples PM, Storey A, Ansley-Green, Eyre JA. Avoidable factors contributing to death in children with head injury. *Br Med J* 1990; 300 : 87-91.
2. Kraus JF, Rock A, Heingari P. Brain Injuries among infants, children, adolescents and young adults. *Am J Dis Child* 1990; 144: 684-691.
3. Ministry of Health, Annual Report 1990, 1985-1992.
4. Department of Statistics Malaysia. Vital Statistics, Peninsular Malaysia 1987.
5. Report of Traffic Division of Royal Malaysian Police 1994.

ORIGINAL ARTICLE

6. Burkinshaw J. Head Injuries in Children: Observation on their incidence and causes with an enquiry into the value of routine skull Xrays. *Arch Dis Child* 1960; 35: 205-14.
7. Kraus JF, Fife D, Cox P, Ramstein K, Conroy C. Incidence, severity and external causes of pediatric brain injury. *AJDC* 1986; 140: 687- 93.
8. Klonoff H. Head Injuries in Children: Predisposing factors, accident conditions, accident proneness and sequelae. *Am J Pub Health* 1971; 61: 2405-16.
9. Craft AW, Shaw DA, Cartlidge NEF. Head injuries in children. *Br Med J* 1972; 4: 200-203.
10. Jamison DL, Kaye HH. Accidental head injury in childhood. *Arch Dis In Child* 1974; 49: 376-81.
11. Partington MW. The importance of accident proneness in the aetiology of head injuries in childhood. *Arch Dis Child* 1960; 215- 23.
12. Ivan LP, Choo SH, Ventureyra ECG. Head injuries in childhood: A 2- year survey. *Can Med Ass J* 1983; 128: 281-84.
13. Hendrick EB, Harwood-Hash, Hudson AR. Head injuries in children: A survey of 4465 consecutive cases at the hospital for sick children, Toronto, Canada. *Clinical Neurosurg* 1964; 11: 46-65.
14. Sharples PM, Storey A, Ansley-Green A, Eyre JA. Cases of fatal childhood accidents involving head injury in Northern Region, 1979-86. *Br Med J* 1990; 301: 1193-97.
15. Rivara FP, Barber M. Demographic analysis of childhood pedestrian injuries. *Pediatrics* 1985; 76: 375-81.
16. Sandels S. Young children and traffic. *Br J Ed Psychol* 1970; 40: 111-15.
17. Sadler J. Children and road safety: A survey amongst mothers; HMSO: London 1972.
18. Roberts IG. International trends in pedestrian injury mortality. *Arch Dis Child* 1993; 68: 190-2.