Five years' experience of injured children

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Summary

This study was undertaken to analyse admission data on all patients seen in the Red Cross War Memorial Children's Hospital Trauma Unit during the period 24 April 1984 - 31 March 1989. Data were retrieved from computerised records completed on admission and were reviewed descriptively.

Variations in age, sex and population group pattern for different causes of injury were evaluated together with data on the nature and place of injury and time seen. Data for analysis of nature of injury by cause were also retrieved, but over a 2-year period only (1986-1987). Accuracy of recorded data was assessed from a random sample of hospital records.

During the 5-year period 57 468 patients were seen in the Trauma Unit, of whom 17,1% were admitted. In addition 6 377 cases of poisoning and 119 of near-drowning were seen by the medical departments. Forty-three per cent of injuries were due to falls, which were the most important cause of injury in both admitted and non-admitted patients of all age, sex and population groups. Other main cause groups were bumps and blows (15%), transport (11%) and burns (11%). Transport and burn injuries had the highest admission rates.

This is the first study of children's injuries in southern Africa and provides information essential to future design of paediatric trauma care systems and accident prevention programmes.

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Between 1981 and 1985, a total of 14 118 South African children aged under 15 years died from injuries, an average of 2 824 per year.[1] These deaths resulted in an average of 64 619 potential years of life under 65 years being lost annually.[1] It has been estimated that for each death caused by injury, 500 patients are treated in South African hospitals for non-fatal injuries and approximately 20% of these require admission.[2] The number of adults and children who survive their injuries but sustain temporary or permanent disability is unknown. Although responsible for only 17% of all injuries in South Africa, transport-related trauma is the most important cause of fatal injuries over the age of 1 year and is estimated to cost the nation R16,69 million per day.[3] The true economic, social and medical cost of injuries to our society, however, is inestimable.

In April 1984, a unit dedicated solely to the treatment of injured children opened at Red Cross War Memorial Children's Hospital (RCH) in Cape Town. This study describes our experience of children's injuries over the 5-year period since then and represents the first study of injury morbidity in children in southern Africa.

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Methods

RCH is a teaching and service hospital in the city of Cape Town that sees patients from all over the Cape Peninsula (1,5 million people)[4] and beyond. Although it is the only paediatric hospital in the peninsula, it is not the only hospital to see children. A recent study of the major Cape Town hospitals[3,2] showed that RCH sees 48% of children treated after road traffic accidents. In addition there are many day hospitals throughout the peninsula that provide primary care, as do private general practitioners and specialists. The number of injured children presenting to these health facilities is not known.

Data on all patients seen at the Red Cross Trauma Unit between 24 April 1984 and 31 March 1989 were collected on the hospital mainframe computer by the Informatics Unit and analysed retrospectively. Patients over the age of 13 years (574) and patients who absconded before assessment by a doctor (87) were excluded from the study. The computerised data are based on information recorded by the doctor on a standardised record form completed after initial assessment. The criterion for being seen in the Trauma Unit is any history of trauma without overt sepsis. Cases of poisoning and near-drowning are treated by the paediatricians in the medical wards, and since they do not have a trauma record form completed on admission they could not be included for analysis. The numbers of cases of poisoning and near-drowning seen in the study period were supplied respectively by the RCH Poison Centre and the Informatics Unit.

Information analysed included age, sex, population group,* month and time of assessment, cause, nature and place of injury. Treatment, admission status and in-hospital mortality were also analysed, and these results will be reported later. The causes of injury were grouped as follows: transport (pedestrian, passenger, bicycle and other); assault (rape and other); burns (fluid, fire and other); falls; bumps and blows; sharp instruments; and other (including bites, firearms, choking, unknown and other). Cause of injury was analysed with respect to age, sex, population group and by admission for all 5 years. Data for analysis of nature of injury by cause were also reviewed but over a 2-year period only (1986-1987).

To estimate coding validity, a randomised sample of 59 patients was selected from the 57 468 study patients using the Random Number Generator module of the PC statistical programme EPISTAT. These patients' records were checked for errors on the part of the doctor and the computer operator. Validity of the doctors' history taking and examination could not be assessed retrospectively. Date of birth, sex, population group, date, time seen and place of injury were assumed to be accurate if the trauma record form and computer data were consistent. Admission ward, cause of injury, anaesthetic, anatomy, pathology of injury and treatment were checked against the written history and other hospital notes for validity. All estimates were expressed as percentages. Sampling error was accounted for by calculating 95% confidence limits assuming that the estimates were binomially distributed.

* Categories used were black, white and coloured, based on the South African Population Registration Act of 1950. Asians, who constitute a small proportion of the population of the Cape Peninsula, were included in the coloured group.

Results

Between 24 April 1984 and 31 March 1989, 57 468 children under the age of 13 years were seen in the Red Cross Trauma Unit, an average of 11 493,6 per year. This constituted 4,4% of all patients seen at the hospital during this period. In addition, 6 377 cases of poisoning (10% of all injured patients) and 119 near-drownings were treated by paediatricians in the medical wards. Of those patients seen in the Trauma Unit, 47 665 (83%) were outpatients and 9 803 (17%) were admitted. The majority of patients (87,1%) came directly to hospital from the site of injury or home. Only 1,6% were referred by a private doctor or another hospital and 2,4% from another ward within RCH. In 8,8% of cases the source of referral was not known. Ten per cent of all the patients attended the unit on more than one occasion within the study period.

The number of patients seen in the Trauma Unit increased steadily to a peak of 12 362 in 1987/8 and then fell slightly. Monthly attendance ranged from 84 when the unit opened in April 1984 to 1 202 in December 1986. Attendance was greater in the summer months, October - March, than in winter, the highest number of patients being recorded in December (5 782). This pattern was consistent over the 5-year period. The majority of patients (72,8%) were seen between 12h00 and 20h00 (Fig. 1) with two peaks around 13h00 and 17h00.

The mean age was 4,9 years (5,2 years for boys and 4,5 years for girls). Eleven per cent were under 1 year of age, 38% between 1 and 4 years, and 51% between 5 and 12 years. Overall the ratio of boys to girls was 1,5:1, but this ratio increased steadily with age from 1,2:1 in the under-1-year age group to 2,1:1 in the 10 - 12-year group. Fig. 2 shows the proportion of children of each population group seen in the Trauma Unit, the proportion seen in the hospital as a whole and the proportion in the Cape Peninsula population aged under 15 years.[4]

Overall, falls accounted for the largest number of injuries (43,4%), followed by bumps and blows (15,3%), transport (11,4%) and burns (10,9%). Sharp objects accounted for 5,4% of injuries, assault for 2,9% and bites for 2,4%. The remainder (8,3%) included unknown, medical and surgical causes, firearms (1,1%) and choking (0,6%). Fig. 3 shows how the cause of injury varied for in- and outpatients. Variations in the causes of injury with age are shown in Fig. 4. Boys outnumbered girls for all types of injury except rape. The ratio of boys to girls was greatest for cycle injuries (2,6:1), assault other than rape (2,0:1) and injuries caused by sharp instruments (2,0:1). The

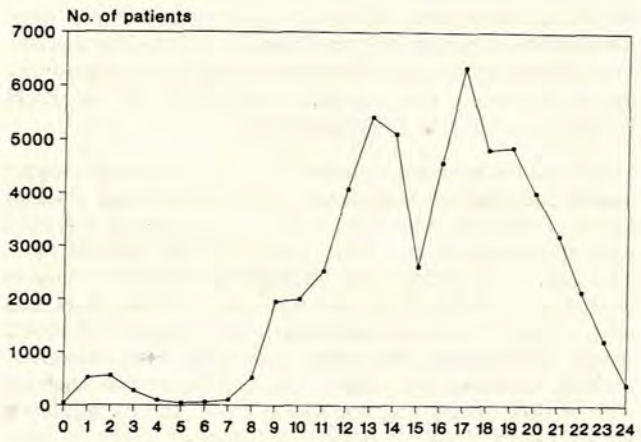

Fig. 1. Time of presentation to the Trauma Unit.

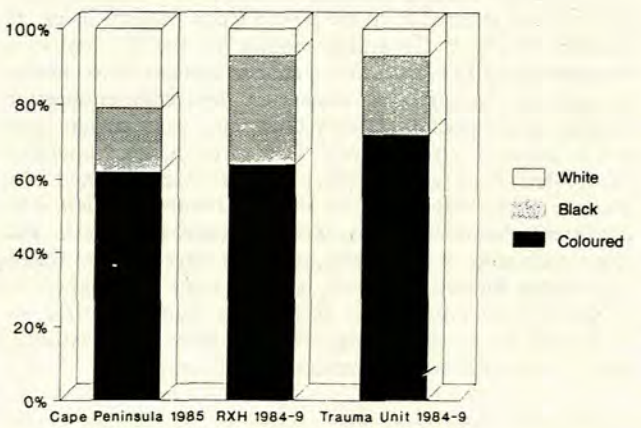

Fig. 2. Proportion of coloured, black and white children seen in the Cape Peninsula,[4] RCH and the Trauma Unit.

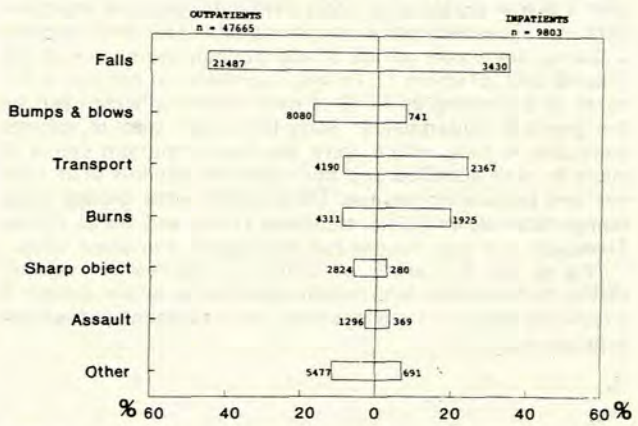

Fig. 3. Main causes of injury for out- and inpatients.

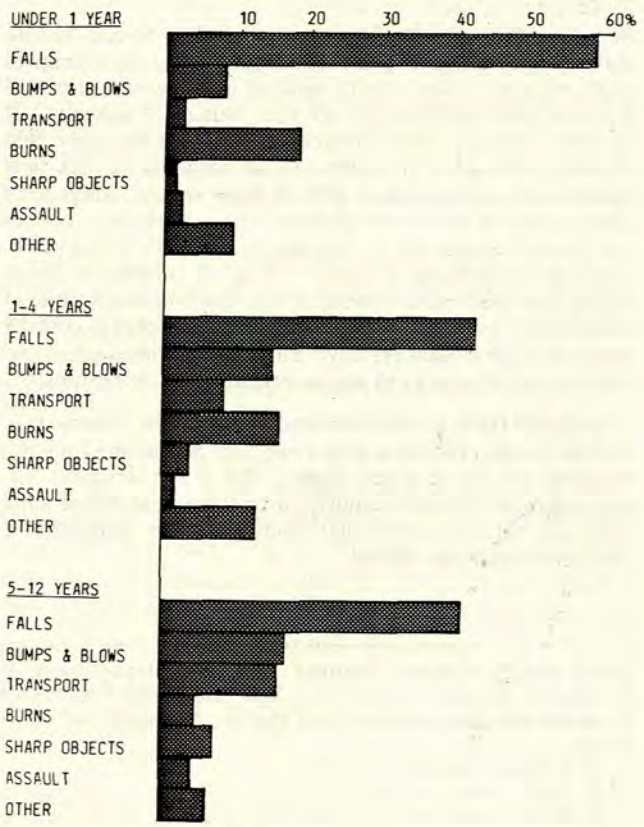

Fig. 4. Cause of injury by age group.

TABLE I. RATIO OF COLOURED, BLACK AND WHITE PATIENTS FOR MAJOR CAUSES OF INJURY, RED CROSS TRAUMA UNIT

Cause of injury	Coloured	Black	White
MVA, pedestrian	**24,9**	**10,0**	**1**
MVA, passenger	**9,3**	**2,3**	**1**
Cycle	**6,3**	**1,5**	**1**
Assault	**17,4**	**7,2**	**1**
Fluid burns	**15,3**	**13,7**	**1**
Flame burns	**18,5**	**20,9**	**1**
Falls	**9,6**	**2,2**	**1**
Bumps and blows	**8,4**	**1,7**	**1**
Sharp instruments	**10,1**	**2,5**	**1**
All causes	**9,7**	**2,9**	**1**
RCH	**8,7**	**3,9**	**1**

MVA = motor vehicle accident.

causes of injury also varied with population group and the ratio of coloureds and blacks to whites for the major groups is shown in Table I.

Transport injuries included injuries involving motor vehicles, pedestrians, passengers, bicycles and other transport. The distribution of these cause groups varied with age, population group and severity of injury as assessed by admission status (Table II) but not substantially with sex.

Fig. 5 shows the place of injury according to age group. Overall, 72% occurred at home, 15% on the pavement, 4% at school, 1% at sport and 9% at another or unknown site. The most common type of sport involved was football (46%), followed by rugby (19%).

The total number of injuries seen was 61 124; 4,5% of all patients had no discernible injury, 87,5% had 1 injury, 5,8% had 2 injuries and 2,2% had 3 or more injuries. Nature of injury by cause for a 2-year sample is shown in Table III.

A total of 5 errors were detected from 59 patients' records (708 items). Four of these errors were misclassifications of the cause of injury on the part of the doctor, and in one case the time seen in the Trauma Unit was incorrectly entered by the computer operator. Expressed as a percentage the error for cause of injury was 6,8 ± 6,4% (95% confidence limits) and for the time examined 1,7 ± 3,3%. There were no errors detected for date of birth, population group, sex, date of visit, admission

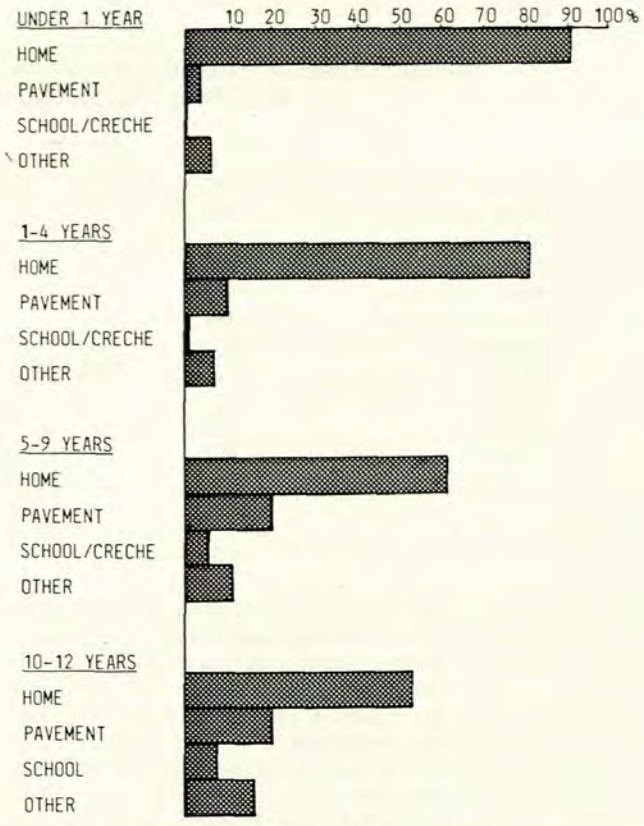

Fig. 5. Place of injury by age group.

ward, anaesthetic, place of injury, anatomy, pathology or treatment.

Discussion

Although RCH is a teaching hospital, it is significant that 87% of the patients admitted, i.e. those with more serious injuries, were unreferred. The corresponding figure for outpatients was not available but can be assumed to be greater. Although selection bias towards more severe cases is inevitable, the patients described represent a significant proportion of child-

TABLE II. TRANSPORT-RELATED INJURIES ACCORDING TO AGE, POPULATION GROUP AND SEVERITY, RED CROSS TRAUMA UNIT, APRIL 1984 - MARCH 1989

	Pedestrian		Passenger		Cycle		Other		
	No.	%	No.	%	No.	%	No.	%	Total No.
Overall age group*	**4 636**	**70,7**	**830**	**12,7**	**980**	**14,9**	**111**	**1,7**	**6 557**
Under 1 yr	**48**	**35,3**	**79**	**58,1**	**4**	**2,9**	**5**	**3,7**	**136**
1 - 4 yrs	**1 304**	**71,3**	**245**	**13,4**	**264**	**14,4**	**15**	**0,8**	**1 828**
5 - 9 yrs	**2 456**	**74,1**	**352**	**10,6**	**460**	**13,9**	**45**	**1,4**	**3 313**
10 - 12 yrs	**827**	**64,7**	**154**	**12,0**	**252**	**19,7**	**46**	**3,6**	**1 279**
Population group									
Coloured	**3 216**	**69,7**	**615**	**13,3**	**700**	**15,2**	**84**	**1,8**	**4 615**
Black	**1 291**	**79,3**	**149**	**9,2**	**168**	**10,3**	**19**	**1,2**	**1 627**
White	**129**	**41,0**	**66**	**21,0**	**112**	**35,6**	**8**	**2,5**	**315**
Severity									
Outpatient	**2 699**	**64,4**	**594**	**14,2**	**821**	**19,6**	**76**	**1,8**	**4 190**
Inpatient	**1 937**	**81,8**	**236**	**10,0**	**159**	**6,7**	**35**	**1,5**	**2 367**

* Age unknown in 1 patient.

TABLE III. CAUSES AND NATURE OF INJURY IN CHILDREN AGED UNDER 13 YEARS PRESENTING TO RED CROSS TRAUMA UNIT, JANUARY 1986 - DECEMBER 1987

	Nature of injury						
Cause of injury	Soft tissue	Burns	Head injury	Musculo-skeletal	Foreign bodies	Trunk injuries	Total
MVA, pedestrian	**773**	**3**	**1 064**	**413**	**—**	**175**	**2 428**
MVA, passenger	**109**	**—**	**171**	**57**	**—**	**25**	**362**
MVA, other	**175**	**1**	**143**	**82**	**—**	**17**	**418**
Bumps and blows	**1 824**	**—**	**1 208**	**524**	**28**	**294**	**3 878**
Sharp instruments	**1 199**	**—**	**—**	**2**	**27**	**15**	**1 243**
Assault	**246**	**—**	**234**	**48**	**4**	**79**	**611**
Burns	**—**	**3 610**	**—**	**—**	**—**	**7**	**3 617**
Falls	**2 537**	**—**	**4 033**	**3 038**	**5**	**568**	**10 181**
Animal bites	**578**	**—**	**—**	**—**	**1**	**4**	**583**
Others	**264**	**—**	**156**	**170**	**896**	**157**	**1 643**

MVA = motor vehicle accident.

hood trauma in Cape Town. Children from lower socio-economic groups are over-represented, because people from higher income groups have access to private health care.

Differences in classification of the cause and nature of injury, as well as the selection and age of patients studied, make comparison with other countries difficult. However, this study confirms that many features of childhood injury appear to be consistent around the world, although there are also a number of important differences. Features consistent with other studies include the increased incidence of injuries in the summer months[5-8] and the predominance of boys in all age groups.[5-11] Both socialisation and inherent behavioural differences between the sexes may account for more hazardous behaviour in boys than in girls.[12] This study also confirms that at certain ages children are more prone to some injuries than to others.[9,11,13] For example, the majority of burns occurred under 5 years, whereas children between the ages of 5 years and 9 years are most vulnerable to pedestrian road traffic injury. As in other studies, falls were the most common cause of childhood injury, followed by bumps and blows. Transport-related injury and burns had the highest rates of admission, and because they resulted in the most serious injuries they represented a greater proportion of inpatients than outpatients. In this way, morbidity data differ considerably from mortality data. In South Africa the injuries causing most deaths in childhood are transport-related, drowning and burns.[1,14] The number of children who survived submersion to get to hospital was relatively small (119). Conversely, falls were responsible for only 2,2% of non-natural childhood deaths in a 15-year Cape Town study.[14] The majority of fatal burns are caused by fire, whereas 80% of the burns were scalds (hot fluid).

As in most countries[5,8,15] the majority of childhood injuries occurred in and around the home, but this proportion decreased with age. Few sporting injuries and injuries sustained at school were seen in this study, a finding probably explained by the fact that only children under 13 years were included.

Despite differences in classification, there is considerable consistency between studies with regard to the nature of injuries seen. The majority of injuries resulted in minor soft-tissue abrasions, lacerations and bruising. Head injuries were the major cause of admission. Although most of these were minor, in-hospital mortality has been shown to be directly related to the presence and severity of head injury alone.[16] Fifty-seven per cent of head injuries in this study were due to falls, but a previous Cape Town study[17] has shown that 60% of *severe* head injuries resulted from road traffic accidents. Although problems of definition make direct comparison difficult, this figure is similar to that in Australia[18] but almost double that in the UK.[19]

The RCH study has shown a higher proportion of pedestrian injuries, burns, assaults and poisonings than in Western Australia,[5] Toronto,[9] Jerusalem[6] or Wales,[20] but a lower proportion of bicycle injuries. This is in agreement with South African injury mortality rates.[1] These differences, as well as the variations described between the population groups within RCH, can largely be explained by socio-economic factors. The causation of injury involves a complex interaction between the child, the agent of injury and the environment,[21] and the association of socio-economic factors with injury patterns has been documented frequently.[22-24] Socio-economic factors determine not only the type and quantity of hazards present but also the quality of child care and access to treatment facilities.

Although socio-economic data were not available for analysis, these factors are closely associated with the population group stratification in South Africa.[25] The white group, which has the highest standard of living and constitutes 21% of children in the Cape Peninsula, represented only 7% of RCH patients. This may be explained in part by the fact that the black population in the Cape is known to be underestimated in the census figures,[26] but may also be due to lower injury rates in the white community[1] and differing use of State Health services. Many studies[27,28] have shown that disease patterns in South African whites are similar to those of people in industrialised countries, whereas those of coloureds and blacks have more in common with populations in the developing world. Coloureds and blacks were over-represented for burns, pedestrian injuries and assault, a finding consistent with injury mortality patterns.[1] Associated economic factors are most apparent in the case of fire burns, where the ratio of blacks to whites treated in the Red Cross Trauma Unit was 21,0:1 compared with an overall ratio of 2,9:1 in the unit. In a 6-month prospective study of burned children admitted to RCH, De Wet[29] stressed the importance of overcrowding, particularly in black families, as a factor predisposing to burn injuries. The most serious accidents occurred among squatters housed in makeshift shacks, where 70% of burns proved fatal.

The classification of injury is notoriously difficult and complex.[30,31] The data collection form used in the Red Cross Trauma Unit was designed primarily for record keeping and not for research. Although the overall number of errors was low (0,7% of all items), most of these were coding errors for the cause of injury and for this item the percentage error was 6,8 $\pm$ 6,4%. This high error rate indicates the need for

prospective research into coding systems and ongoing training of staff.

This study provides insight into the patterns, causes and effects of childhood injury in South Africa. Clearly the size of the problem is immense. Recently the Child Injury Prevention Foundation of Southern Africa was established to extend the work of the Child Safety Centre of the RCH and Institute of Child Health. This body aims to help prevent childhood injury through research, education and appropriate safety legislation. In-depth research into community beliefs as well as into the physical, economic, sociological and behavioural causes of injury is needed before preventive strategies can be planned.

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