

## Review Article

# Paediatric trauma care

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### Summary

Paediatric trauma care varies in different countries. In South Africa injury is the leading cause of death in the 5 - 14-year-old age group — 1,5 - 3,8 times higher than in the USA. In 1978 the Child Safety Centre was established and prospectively collected data on paediatric injuries. The various types of injuries are discussed. Trauma is responsible for the highest percentage of years of life lost but the least amount of money is being spent on research and prevention of injuries. The Child Accident Prevention Foundation of Southern Africa has been constituted to research, prevent and reduce the risk factors of the injuries and to improve facilities for the injured child.

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Most developed countries pride themselves on their low rates of infectious diseases — all virtually eradicated because of excellent public health measures. Yet an epidemic of trauma is the biggest killer of children (1 - 14 years) throughout the world — First and Third World.<sup>1</sup> The familiar sight of shrines along the highways of many cities in several countries, reminds us of the carnage on the roads — evidence of those killed — yet for every dead child at least 7 - 8 tax the expertise of surgeons for survival. Many have survived but some with varying degrees of residual physical or mental handicap, or psychological wrecks with destroyed home life — some amenable to rehabilitation, others not. AIDS is the condition today and millions are being spent in seeking a cure or a preventive measure — yet in 1990 the epidemic of trauma, the poor orphan, or as Harris<sup>2</sup> called it 'the neglected disease of modern society', is still largely ignored by governments and society.

Paediatric trauma care varies in different countries according to the expertise and facilities available. Excellent paediatric accident prevention programmes, monitoring and surveillance bodies and trauma units exist in Sweden, Australia, the USA, the UK and Canada. The injury prevention foundations in Australia and Sweden in particular are well organised, with branches established in all the main centres of the country fully supported by their government, health authorities and the community. But what about paediatric trauma in other countries? As infectious diseases are controlled and exposure to technology increases, injury becomes a major source of childhood mortality — in fact it is the major cause of death in children between the ages of 1 year and 15 years in all indus-

trialised as well as in many developing countries. This is well illustrated by the estimated number of deaths by major causes by the World Health Organisation (Table I).<sup>3</sup> The differences between the developing and developed countries for infectious and parasitic diseases and conditions in the perinatal period are quite obvious, but there is much less of a difference for injury and poisoning.

In this review, paediatric trauma care will be considered primarily for South Africa, which has features of both a developing and a developed country. In this country, as in many others, sociological, environmental and behavioural factors that influence society contribute to the complexity and scope of the injury problem.<sup>4</sup> Industrialisation, rapid urbanisation, a migratory labour system and westernisation have resulted in the loss of traditional lifestyles.<sup>5</sup> Many of the differences found in the pattern of childhood injury between population groups are related to socio-economic factors and not to ethnicity, although cultural factors do play a role. There is substantial evidence from most countries that socio-economic factors influence the incidence and pattern of injuries.<sup>6-8</sup>

### Incidence and causes

In South Africa injury is the leading cause of death in the 5 - 14-year age group, while infections and parasitic diseases are the major causes under 5 years (Table II).<sup>9</sup> As in other countries, road traffic-related injuries are the major cause of injury mortality followed by drowning and burns (Table III). The causes of injury vary from one area of the country to another and especially from urban to rural areas, while the distribution of the causes of injury varies considerably with age. The South African all-injury death rates are approximately 1,5 - 3,8 times higher than in the USA, depending on age and population group (Fig. 1).

While the mortality figures for the country are available, no national trauma registry or injury surveillance systems exist in South Africa, except for statistics regarding road accidents.

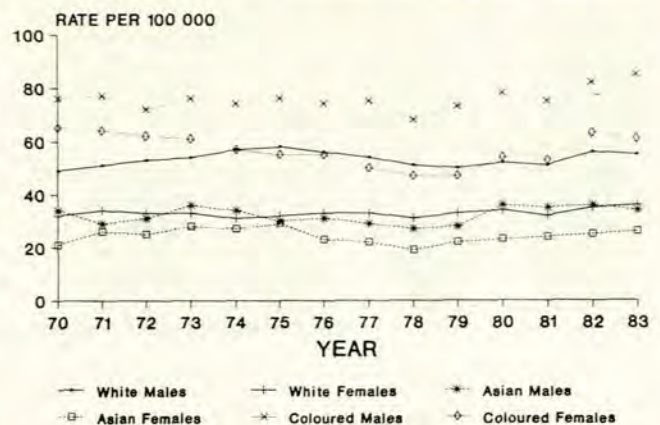


Fig. 1. The total injury mortality rates for South Africa show a slight rise among the coloured population over the last few years with minimal change in the other groups.

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**TABLE I. ESTIMATED NO. OF DEATHS (000s) BY MAJOR CAUSES BY WHO REGION, 1980<sup>3</sup>**

	Americas		World	
	Developing	Developed	Developing	Developed
Infectious and parasitic disease	981	76	16 019	805
Neoplasms	282	447	2 201	2 041
Circulatory and degenerative disease	773	1 135	7 614	5 708
Perinatal conditions	263	25	3 080	169
Injury and poisoning	198	175	1 978	687

**TABLE II. MAJOR CAUSES OF DEATH IN CHILDREN < 15 YEARS IN THE RSA, 1981 - 1985 (%)**

< 1 yr		1 - 4 yrs		5 - 14 yrs	
Infectious	33	Infectious	42	Injury	43
Perinatal	31	Respiratory	17	Infectious	14
Ill-defined	14	Ill-defined	13	Ill-defined	13
Respiratory	13	Injury	11	Respiratory	9
Congenital	3	Endocrine nutrition, immunity	11	Nervous system	7
No. of cases/yr (mean)	24 112		8 512		3 611

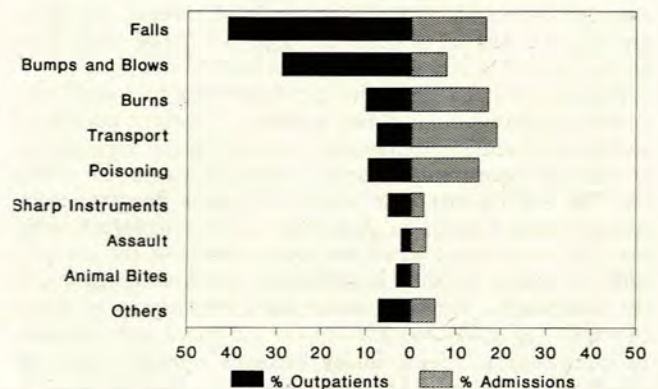
**TABLE III. AVERAGE NO. OF INJURY DEATHS PER YEAR IN CHILDREN < 15 YEARS, 1981 - 1985**

Cause	No.	%
Road	868	30,8
Drowning	546	19,3
Burns	304	10,8
Assault	182	6,4
Choking and suffocation	166	5,9
Poisoning	112	4,0
Other	247	8,8
Undetermined	396	14,0
Total (per year)	2 821	100,0

This applies also to other developing countries where only *ad hoc* studies have been carried out, mainly to describe the nature of the accidents and the injuries rather than to determine the frequency of accidents among the population. Regional morbidity statistics of non-fatal childhood injuries based principally on data from the Red Cross War Memorial Children's Hospital have been collected and analysed. Since April 1984 all injured children presenting to this hospital have been managed in a paediatric trauma unit.

From 1985 to 1988, 46 675 children presented to this unit, of whom 7 350 (15,75%) required admission. As in other countries, falls were the most common cause of injury, being

responsible for 70% of musculoskeletal injuries, 56% of head injuries and 33% of soft-tissue injuries and the commonest cause of injury requiring admission (Fig. 2). Bumps and blows ranked second but compared with American<sup>10</sup> and Canadian<sup>11</sup> studies, sport-related injuries were uncommon, which may be attributable to our age-limit of 13 years. Burns were responsible for even more injuries than motor vehicle accidents, accounting for almost as many trauma admissions, as is also seen in several other developing countries, especially in the rural areas (Table IV). This contrasts sharply with both the UK,<sup>12</sup> where



**Fig. 2. The causes of injuries in patients seen in the Trauma Unit of Red Cross War Memorial Children's Hospital from 1985 to 1988 (N = 39 325 outpatients; N = 7 350 admissions).**

**TABLE IV. INCIDENCE OF BURNS AND MVAs IN DEVELOPING COUNTRIES**

Cause	Sao Paulo, Brazil	Cuba (8 provinces)	Senegal		Turkey	
			City	Rural	Ankara	Rural
Burns (%)	9,3	7,7	36,5	33,6	2,5	18,0
MVA (%)	45,1	6,3	15,0	3,6	17,2	4,3

Source: *World Health Quarterly*, Vol. 39, No. 3. Geneva: World Health Organisation, 1986.



burns and scalds are responsible for barely 5% of all domestic injuries, and North America<sup>10</sup> where burns accounted for less than 3% of all injuries. Transport-related injuries, although constituting only 12,8% of all accidental trauma, accounted for most of the multiple injuries requiring intensive care and in-hospital deaths due to trauma. Motor vehicle accidents (MVAs) have also been shown to be the commonest cause of severe head injuries in children requiring hospital admission.<sup>13</sup>

Compared with Australian<sup>14</sup> and North American<sup>11</sup> studies, bicycle MVAs were uncommon — only 0,4%. As elsewhere, misuse of alcohol is significantly responsible for the high rate of road traffic deaths. The legal blood-alcohol limit is 0,08 g/ml in South Africa compared with 0,05 g/ml in most Australian states.<sup>15</sup> Secondly, seat-belt legislation and enforcement have only recently come into effect, despite compulsory use of seat-belts being introduced in 1977. A third factor responsible for the high accident rate is the paucity of playgrounds, especially in certain areas, where streets act as play areas.

## Management and results

*Head injuries* due to blunt trauma have been the most common indication for admission to hospital. Most are minor injuries. Our management of head-injured children does not differ significantly from that of other units. The vast majority are treated non-operatively. The mortality from head injuries was 7% of all major head injuries admitted to the intensive care unit during 1987 and 1,3% of all head-injured children seen in the Trauma Unit (J. Peter — personal communication, 1989).

Because of the high prevalence of blunt trauma, predominantly due to MVAs, closed *chest and abdominal injuries* are frequently seen. Since April 1984 106 children with blunt *chest injuries* were treated mainly for lung contusions, rib fractures and haemothoraces.<sup>16</sup> Conservative management, with blood gas and oxygen monitoring and drainage of intrapleural collections, has been successful in all. Penetrating chest injuries in children have been uncommon.

**TABLE V. BLUNT ABDOMINAL TRAUMA  
IN CHILDREN < 13 YEARS, 1978 - 1988 (N = 587)**

Kidney	333
Liver	228
Spleen	96
Pancreas	40
Bowel	26
Bladder	5
Diaphragm	4
<b>Total No. of organs</b>	<b>732</b>

During an 11-year period (1978 - 1988), 587 children under 13 years of age presented with *blunt abdominal trauma* at the unit. There were 732 organ injuries, as outlined in Table V. The renal, hepatic, splenic and pancreatic injuries were all treated according to the non-operative conservative management regimen.

Of the 333 suspected *renal injuries*, 91 were visualised on intravenous pyelography. Only 14 were surgically explored — 11 requiring nephrectomy. The remainder, 95,8% responded to non-operative treatment. There were 2 deaths.

Two hundred and twenty-eight suspected *hepatic* and 96 *splenic injuries* were confirmed and delineated on radionuclide scan. Since our series was a prospective study, we detected many hepatic injuries that, under normal circumstances, would

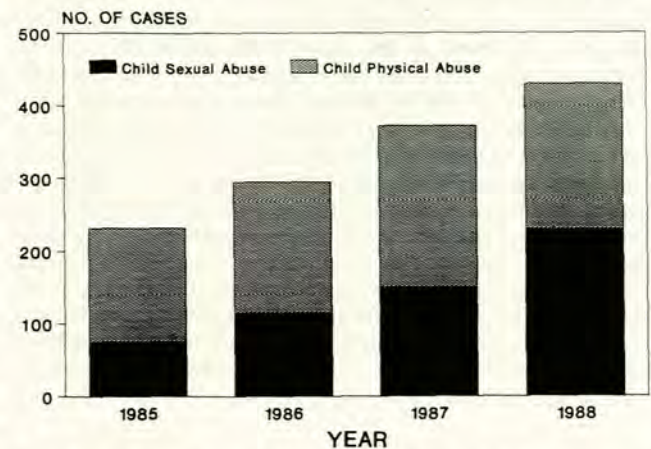
in all probability have gone unnoticed, accounting for the fact that these outnumbered the splenic injuries, contrary to the findings of many other series. Ninety-four per cent of the *liver* and 87,5% of the *splenic injuries* were successfully treated non-operatively. Of the 12 patients with splenic injuries who came to laparotomy, only 3 required splenectomy. Two of the 228 liver-injured patients died; there were no deaths in the splenic group.

*Pancreatic injuries* were diagnosed in 40 patients. Eighty per cent were successfully treated non-operatively. A pseudocyst formed in 13 patients and resolved in 7 on conservative treatment.

Compared with solid organ injuries, *ruptured bowel*, suspected in 27 patients, was difficult to diagnose, since plain abdominal radiography was singularly unhelpful in all but 3. A rupture was confirmed in 20 patients at laparotomy. Six patients had duodenal obstruction caused by an intramural haematoma. The 5 *ruptured bladders* and 4 *ruptured diaphragms* were repaired with no mortality. No data are available for peripheral or district hospitals.

*Burns* are a major problem in South Africa, as in many other developing countries.<sup>17</sup> They formed 11% of the injury-related deaths in children under 15 years (Table III) and 17,5% of all trauma admissions to the Red Cross War Memorial Children's Hospital in 1986 and 1987 (Fig. 2). Eighty-six per cent of these deaths were fire burns while 82% of all burn injuries presenting, were due to scalds. The majority of burn-injured children requiring hospitalisation in the Cape Town area are managed in the Burns Unit at this hospital. The incidence of burns is closely related to socio-economic conditions and over the past few years there has been some improvement, with a downward trend in the burn rates. What is often overlooked in this maze of statistics is the effect of such a burn injury on the individual. The poor body image, psychological changes and social ostracism have a marked effect on the patient. The effect on the family has also been highlighted recently by Harris *et al.*<sup>18</sup> Because of these observations, mirrors have been installed in our burn unit to improve body image acceptance and before the child is returned to his or her school an illustrated talk on burns is given to the staff and pupils to ensure a smooth acceptance and to avoid name calling, etc.

At the Red Cross War Memorial Children's Hospital, *assault/abuse* represents only 3% of patients admitted for trauma and 2% of trauma outpatients. As in other countries, the true incidence of child assault/abuse is unknown.<sup>19,20</sup> The annual increase in reported cases at this hospital (Fig. 3),



**Fig. 3. The steady but significant rise in the incidence of assault/abuse in children seen at Red Cross War Memorial Children's Hospital, 1985 - 1988. Sexual abuse is differentiated from physical abuse and also shows a steady increase (N = 232, 1985; N = 296, 1986; N = 372, 1987; N = 430, 1988).**



TABLE VI. DEATHS IN CHILDREN UNDER 15 YEARS CAUSED BY FIREARMS, RSA — 1981 - 1985

	Accidents		Suicide		Assault		Unknown		Total
	No.	%	No.	%	No.	%	No.	%	
White	13	13,7	16	16,8	43	45,3	23	24,2	95
Coloured	2	9,5	2	9,5	14	66,7	3	14,3	21
Asian	0		1	10,0	6	60,0	3	30,0	10
Black	9	9,5	1	1,1	57	60,0	28	29,5	95
Total	24	10,9	20	9,0	120	54,3	57	25,8	221

including those of child sexual abuse, has also been documented in other cities.<sup>21</sup> It is to be hoped that this reflects not only an increase in public awareness but also the value of the multi-disciplinary child protection teams and safe houses that now exist in some metropolitan areas in South Africa. Each team consists of consultant paediatricians and/or paediatric surgeons, clinical psychologists and social workers. The latter liaise, when necessary, with regional child protection units of the South African Police and this system is aimed, so far successfully, at maximal detection of child abuse victims with minimal additional trauma to both child and family.

Between 1981 and 1985 *firearm injuries* in South Africa accounted for 221 deaths in children under 15 years (Table VI). Fifty-four per cent of deaths were due to assault/homicide — some of these children being the victims of a spate of family slayings and, more recently, of civil violence. These figures contrast with those of the USA, where firearm injuries are extremely high.<sup>22</sup>

*Drowning* is the second most important cause of injury-related deaths in children in South Africa. As in other countries, the 1 - 4-year-old age group is at greatest risk.<sup>23</sup> Although Cape Town is a coastal city, only a small percentage of fatal and non-fatal immersion accidents in childhood occur in the sea (9%), which is consistent with findings in Honolulu<sup>24</sup> and Brisbane<sup>25</sup> and differs from adult drownings. Forty-six per cent of deaths from drowning in our children under 15 years occur in swimming pools, 18% in buckets,<sup>26</sup> water-holes, etc. and 13% in other sites — canals, springs, etc. Of the 107 patients admitted to hospital because of near-drowning between 1976 and 1987 12% died and 7% of the survivors had neurological sequelae. Studies from Hawaii<sup>24</sup> and Australia<sup>25</sup> have shown a far better outcome with morbidity and mortality rates of under 5%.

Although *poisoning* results in only 4% of injury deaths it causes considerable morbidity. The Red Cross War Memorial Children's Hospital Poisons Information Centre provides a 24-hour service and in 1986 and 1987 a total of 2871 patients with poisoning were seen and a further 2798 telephone calls were received asking for advice. Twenty-five per cent of the children seen required hospitalisation. As in other countries, the majority of cases (28,4%) involved children under 5 years. Although medicines comprised the largest group, 28% of our poison cases are due to paraffin ingestion, the most commonly used domestic fuel for stoves, lamps, heaters and refrigerators in areas without electricity. Paraffin is sold in unlabelled bottles of all sorts and although we have launched a public awareness campaign to inform people of the dangers, there is as yet no legislation controlling the sale of this poison in unsafe containers. In the USA petroleum distillates have to be sold in child-resistant containers.<sup>27</sup>

## Transport and medical emergency services

The *emergency service* attention varies from ordinary ambulance first-aid attendants to the sophisticated paramedical critical

care assistants of the Metropolitan Emergency Transportation and Rescue Organisation (METRO), depending on the area and magnitude of accident and injuries. They function only in some of the metropolitan areas, are able to start resuscitation and are directly in radio communication with trauma medical personnel. South Africa is a large country with long distances between the major cities. An injured South African child may be treated in any one of a wide range of institutions, from rural clinics, mission stations and peripheral hospitals, to trauma units in teaching hospitals. Paediatric accident victims are taken to the nearest clinic or hospital where resuscitation is started and, where necessary, they are then transferred to a regional tertiary referral centre. No doubt some preventable deaths do occur or irreparable damage may be precipitated by delay in or inadequate treatment. Adequate stabilisation of the patient's condition before secondary transport and the initial care provided by ambulance personnel or METRO at the roadside, and medical practitioners in smaller hospitals and during transit, constitute a vital link in the chain of trauma management in our country. Helicopters, charter flights or the Red Cross Mercy aircraft — well-equipped — are available to convey seriously injured children from the peripheral centres to the tertiary referral hospitals. There are paediatric surgical units in the main teaching hospitals in Johannesburg, Pretoria, Durban, Bloemfontein, and two in Cape Town. However, the Red Cross War Memorial Children's Hospital is the only paediatric medical centre with a designated paediatric trauma unit serving all paediatric accident victims in the Greater Cape Town region and further afield. The best results are obtained in the centres with major trauma units, as has been clearly documented by the Toronto group and also in the United States.<sup>28,29</sup> However, is the decline in mortality in these centres associated with an increase in morbidity, especially in permanent disabilities?

## Research and prevention

From the foregoing, the magnitude of the problem is evident. These childhood injuries are not random events, occurring without pattern or predictability, but their causes are foreseeable, researchable and, to a great extent, avoidable. In 1978 the Child Safety Centre was established in the Department of Paediatric Surgery at the Institute of Child Health of the University of Cape Town. Before this the Road Safety Council was the only body collecting road injury statistics and producing public awareness campaigns in an attempt to reduce the carnage on our roads.

Local statistics are vital, since it is futile transferring prevention programmes from other countries based on their conditions. With the establishment of the Child Safety Centre, for the first time prospective collection of data was started, and with the opening of the Paediatric Trauma Unit at the Red Cross War Memorial Children's Hospital a proper database for all childhood injuries was established on a regional basis. Studies on the causes and nature of burns in childhood



in particular were completed in addition to an on-going project with the South African Bureau of Standards on fabric flammability.

Armed with these statistics, educational programmes on prevention of some of these injuries were compiled, but problems with inadequate resources, linguistic and cultural differences of the various population groups had to be overcome. Despite these, the members of the Child Safety Centre have a remarkable achievement record. The adult target groups reached include the nursing profession, workers in industry, social workers, medical students and a wide variety of groups in the community. Representative workers have been trained to teach safety awareness in their own communities. Excellent co-operation has been obtained from the Department of Education over access to school children. The Child Safety Centre was instrumental in ensuring adequate specifications for type and installation of seat-belts and safety-chairs for babies and children in motor vehicles and is at present seeking legislative measures to protect children from the indiscriminate sale and dispensing of certain poisons, particularly paraffin.<sup>30</sup> The long-term effects of some of these injuries on the patients and their families are also being studied.

The prevention of childhood injuries and research into this problem are relatively new concepts in our country and exist only on a regional basis. Pertinent national information is required. In our mixed complex society (with different trends in each ethnic group) the development of national injury prevention programmes that are culturally and socially appropriate are urgently required. It is also imperative that the effectiveness of the prevention programmes be constantly monitored and evaluated. With this in mind, the Child Accident Prevention Foundation of Southern Africa (CAPFSA) has recently been constituted and it is hoped to have branches in all the major centres within the near future. Unfortunately, the prevention of injuries — as in many other countries — remains low in the hierarchy of medical priorities and progress in creating an awareness of the childhood injury problem in the public of South Africa has been slow. This is clearly demonstrated when one looks at the number of years of life lost from the three important causes of deaths, viz. injuries, cancer and heart disease (Fig. 4). We have a major discrepancy in the amount of money being spent on research into the prevention of these three conditions. The bar graphs of the statistics in 1986 in South Africa are much the same as those reflected by Trunkey<sup>31</sup> and also by Manciaux and Romer.<sup>3</sup>

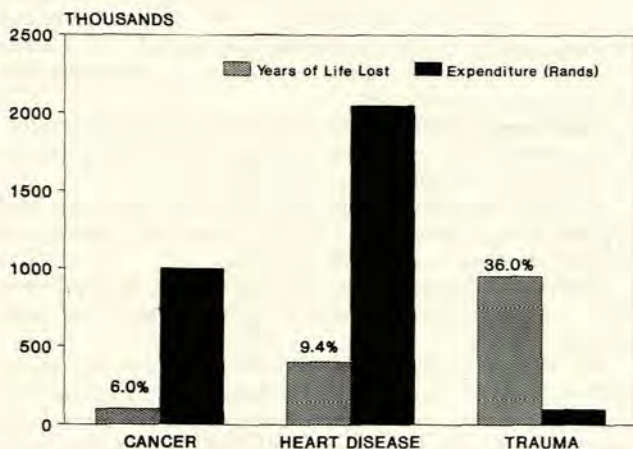


Fig. 4. Years of life lost v. research expenditure. Although trauma is responsible for the highest percentage of years of life lost compared with heart disease and cancer in South Africa, the least amount of money is being spent on research into the causes and prevention of injuries.

The only difference is that in South Africa more is being spent on heart disease than on cancer.

Thus far the role of the Child Safety Centre has been a pioneering one in South Africa. In countries such as Sweden, the UK, Canada, Australia and the USA, the beneficial effect of preventive programmes is already clearly evident and it is to be hoped we in southern Africa will be able to see a similar downward trend in the near future.

It is of interest to speculate why there is such a reluctance to support the cause of the injured child. Is it because these unfortunate victims are unable to speak for themselves, and do not contribute in the form of taxes or medical insurance? Or are the pharmaceutical industries more concerned with the management and rehabilitation of the injured child rather than with the prevention thereof? What effect has the fear of possible litigation? In contrast, look at the control of occupational and industrial injuries, where earnings are affected by accidents. In South Africa in 1950 4% of the work force annually lost one or more shifts due to injury. In 1984 this was reduced to 1.6%.<sup>32</sup> I believe that not all the blame lies with society or government bodies but perhaps some with us. It is only during the past 10 years or so that we as medical practitioners have taken an active interest in all aspects of childhood injuries. It behoves all of us to champion the cause of the injured child with community and health organisations, as well as in government circles. For several reasons paediatric trauma care has obviously lagged behind, particularly in developing countries. It is to be hoped that with the exchange of experience and information between countries at different levels of development and with differing sociocultural values we will succeed in furthering our aims, viz.: (i) to improve facilities for the injured child; (ii) to reduce risk factors; (iii) to increase public awareness of these accidents; (iv) to improve monitoring and evaluation of the effects of our preventive programmes; and (v) to encourage and support research in all areas of paediatric trauma.

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