J Accid Emerg Med 1997;14:316–320

REVIEW

Childhood accidents: epidemiology, trends, and prevention

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The prevention of injuries to children remains a high priority for society. Doctors who are confronted with a seriously injured child in the accident and emergency (A&E) department or in the children's wards would like to have prevented the episode rather than be treating it. The steps needed to do this are not easy and involve actions from people far removed from the medical context.[1] For instance, a pedestrian road traffic accident might have been prevented by introducing traffic calming. This involves the local community, local politicians, traffic engineers, and town planners.

It is very tempting to try to prevent all accidents. However, when this has been tried it has rarely been successful. The focus should be on individual injuries, with collection of details about the mechanism of the accident to determine the epidemiology and causes of injury. This makes it possible to formulate strategies for prevention which can then be implemented and evaluated. However, the successful implementation of these strategies can be extremely difficult.

Mortality from accidents

Accidents are the most frequent causes of death of children over one year of age. Therefore any efforts to reduce mortality in childhood must address the reduction of accidents. In 1992, 559 children under 14 years of age died in England and Wales from injuries and poisoning.[2] Road traffic accidents remain the most frequent cause of accidental death in children, accounting for an average of 240 deaths each year. They are also an important cause of death in young people, in particular young men. Child pedestrians deaths are the most numerous but many die on bicycles and in cars. Deaths from conflagrations and complications of burns and scalds have been highlighted, with house fires due to foam furniture causing just under 100 deaths a year in England and Wales. Nearly 50 children die each year from drowning in England and Wales. Table 1 sets out the causes for accidental deaths for England and Wales for 1992.

Morbidity from accidents

Accidents are a significant cause of handicap in children. Head injuries, which may follow pedestrian, cycle, or passenger road traffic accidents, falls, or child abuse, are the major cause of handicap following injury. Children may also be brain damaged following near drowning or suffocation episodes. Burns, scalds, and road traffic accidents may result in scarring and cosmetic damage which can be psychologically damaging to the child. The child may be damaged by post-traumatic stress following the accident or from the effects of the subsequent hospital admission and treatment.

Childhood accidents are a frequent cause of attendance at A&E departments. Studies in Sheffield and South Glamorgan[3] have shown that in one year one in five of the child population attended hospital because of an accident. We have recently reviewed these figures and found that one child in four now attends the A&E department in Cardiff in one year.[4] On the basis of such studies, it has been estimated that 2.33 million children attend an A&E department in England and Wales annually. Although the majority of these injuries are relatively trivial, among them there are many that are serious. Twelve per cent of children attending an A&E department have fractures. Childhood accidents are also a frequent cause of admission to hospital. Between 5% and 10% of the children who attend hospital require admission.

Aetiological factors in childhood accidents

Social factors are important risk factors in childhood accidents.[5] Road traffic accidents are five times more common in children whose fathers come from the social class V than in children from professional families. The death

Table 1 Accidental deaths from injuries and poisoning, England and Wales 1992, 0-14 years

Cause	*M*	*F*	*Total*
Transport accidents	185	96	281
Accidental poisoning	6	4	10
Accidental falls	29	8	37
Medical misadventure	2	3	5
Fire and flames	47	35	82
Environmental	2	4	6
Accidental drowning	34	13	47
Inhalation	9	8	17
Mechanical suffocation	35	6	41
Others	22	11	33
Total	371	188	559

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Accepted for publication
10 April 1997

rate in boys aged 0–14 years from fires is 15 times higher in social class V than in boys from professional families. Similar social class gradients are seen in other types of accidents, with disadvantaged children having more accidents. There is an increased injury rate in children of single mothers, who are often among the poorest and most isolated groups in the population.[6]

The reasons for this social gradient in childhood accidents are complex. Poorer families live in poor housing and in more dangerous environments. It is much easier for a child to have a road accident if his or her house opens straight onto a main road in the inner city than if he lives in a detached house with a front garden.

Psychosocial stress factors are also involved in the aetiology of many childhood accidents. Backett and Johnston[7] and Sibert[8] studied the social pattern of road accidents and accidental poisoning in childhood respectively and found that stress factors were more common in cases than in controls. Brown and Davidson[9] found that accidents were more common in children of psychiatrically disordered mothers than in controls. Beautrais *et al* found adverse life events to be a factor in deaths from injury.[10]

The question of personality in childhood accidents, and whether children can be accident-prone, is difficult. It is likely that accident proneness is multifactorial. We know that it is related to the environment, both physical and social, and it is useful to recognise an accident-prone community. Some children have underlying disorders that are associated with poor motor coordination or poor concentration span, with little awareness of danger, for example, dyspraxia, attention deficit hyperactivity disorder. These children are often described as accident-prone.

Prevention of childhood accidents

The prevention of accidents is an important public health issue. They are unlikely to be prevented by blanket campaigns that attempt to cover all accidents, as the epidemiology and causes are so varied. Well researched multidisciplinary action on individual types of accidents may be successful.[1] In preventing a particular type of accident a methodological approach is needed. This must first look at the size and nature of the problem, then decide what preventative solutions are possible. These can be implemented and evaluated on a small scale and then introduced more widely when they have proved to be effective. There are three main strategies for accident prevention: education of children and parents, changing the environment of the child, and enforcing changes in the environment by law. Research suggests that while in some fields education is important, most successes in accident prevention have followed environmental changes. Educational campaigns by themselves are only of limited value.[11–13]

An example of a methodological approach to the prevention of accidents is the prevention of accidental child poisoning. This is a significant problem for children under five. The epidemiology has been studied and education campaigns have been evaluated and shown to be ineffective.[14] An environmental solution (child resistant containers (CRCs)) was evaluated on a small scale,[15] shown to be worthwhile, and then introduced more widely, both in the United States[16 17] and the United Kingdom. This resulted in a reduction in the numbers of children admitted to hospital with accidental poisoning.[18 19]

Accident prevention and injury control is the responsibility of many government departments, from the Department of Health to the Home Office. This means there is difficulty getting a focus on the problem, as any successful intervention is likely to need a multidisciplinary team approach.

ENVIRONMENTAL CHANGE IN CHILD ACCIDENT PREVENTION

Environmental change can prevent accidents.[1] Examples are:

Pedestrian road traffic: Traffic calming.[20]

Bicycle injury: Cycle helmets[21–25]; attention to bicycle design.[26]

Passenger in cars: Seat belts and car safety seats[27 28]; car design.[29]

House fires: Smoke detectors.[30–33]

Nightdress fires: Reducing flammability of nightdresses.[34 35]

Bath scalds: Thermostat reduction of the temperature of the hot water in domestic systems.[36 37]

Drowning in municipal pools: Supervision of swimming pools by Health and Safety regulations has meant that only one child dies per year in England and Wales.[38]

Drowning in water at home: Fencing domestic swimming pools prevents drowning in Australia.[39–42]

Falls from windows: Window guards reduced falls in "Children Can't Fly" programme in New York.[43]

Falls in playground: Attention to playground design: impact absorbing surfaces,[4] reducing height of equipment.[44]

Accidental child poisoning: have reduced following the use of child resistant containers (CRCs).[14–19]

Accidental choking: Small part toy safety regulations.[45]

Glass injuries: Safety glass.[46 47]

In many cases an environmental measure can be shown to be effective; however, voluntary uptake of such measures is generally poor. Environmental change needs to be enforced by law before it is used by the population as a whole. Seat belt wearing only increased significantly after seat belt legislation was introduced.

The story of cycle helmets illustrates the international evolution of an environmental solution to a problem. Analysis of accident and emergency admissions showed that a significant number of children sustained severe head injuries after a cycle accident.[48]

Research based evidence includes at least five case-control studies that show the effectiveness of cycle helmets in preventing head injury:

- Thompson *et al*[21] in Seattle studied 235 patients with head injuries. As controls they used two groups of patients with bicycle injuries not involving the head. Seven % of the case patients were wearing helmets, compared to 24% of emergency room controls and 23% of the second control group. Of 99 cyclists with serious head injury only 4% wore helmets. Cyclists had a 85% reduction in their risk of head injury by wearing helmets.
- Maimaris *et al*[22] from Cambridge reviewed 1040 patients. Cycle helmets were worn by 114. Head injuries involved 4% of helmets wearers and 11% of non-wearers. This was a protective factor of 3.25 for wearing helmets.
- Thomas *et al* from Brisbane, Australia,[23] studied 102 children with bicycle head injuries compared to 278 other injuries. They showed a reduction of bicycle head injuries of 63% as a whole and of loss of consciousness by 86% by the use of helmets.
- McDermott *et al*[24] looked at the effectiveness of bicycle helmets in Victoria, Australia. In a study of 1710 casualties head injury was reduced by 45% by approved helmets.
- Spaite *et al*[25] from Tuscon, Arizona, undertook a prospective analysis of injury severity among helmeted and non-helmeted bicyclists involved in collisions with motor vehicles (116 wore helmets; 168 did not). Mean injury severity score was much greater in those not wearing helmets ($P<<0.001$).

In addition to this compelling evidence, there is also evidence of a reduction in injuries following increases in cycle helmet use: three of these studies followed the introduction of safety legislation.

- Rivara *et al*[49] reviewed the Seattle bicycle helmet campaign for children. Helmet use rose from 5.5% in 1987 to 40.2% in 1992. Bicycle head injuries fell by 66.6% over the same time period.
- Cameron *et al*[50] reviewed the introduction of a bicycle helmet law in the state of Victoria, Australia. They showed that the number of insurance claims for bicycle head injuries admitted to hospital fell by 48% in the first year and 70% in the second.
- Pitt *et al*[51] reviewed the effect of a bicycle helmet campaign followed by law in Queensland, Australia. They showed a decline of bicycle head injuries with increasing helmet use.

State legislation regarding cycle helmets has been introduced sporadically in Australia and the USA. Its effect continues to be monitored. No such action has been taken here in the United Kingdom. Despite the research evidence, arguments continue as to whether cycle helmets are the single solution to the problem. It is likely that the optimum way to reduce cycle injuries to children consists of a combination of designated cycle tracks, cycle proficiency education, and cycle helmet legislation.

HEALTH EDUCATION AND CHILDHOOD ACCIDENTS

Several studies have shown that education campaigns to prevent accidents to children are by themselves ineffective.[11–13] There is evidence, however, that health visitors visiting the home and giving specific attention to accident prevention can make a difference to the way families behave,[52 53] in particular with regard to the installation of safety equipment. Health education must therefore be directed on a one to one partnership basis by people such as the health visitor or the general practitioner. We need to deliver safety education to complement environmental measures in many instances. Parents need to be aware of the importance of installing car safety seats correctly. Families need to be reminded to check smoke alarms regularly and keep a battery in them. Before environmental measures are introduced by legislation, education campaigns are needed to encourage voluntary uptake so that ergonomic and effectiveness evaluation can be undertaken. Education can empower public opinion to institute environmental change. For instance, parents can be educated that safe playground equipment is needed for their children. They can then pressure the local authority to act.

Research on childhood injuries

Any programme of injury prevention in childhood should be based on clear evidence and research. There needs to be a comprehensive injury surveillance system underpinning accident prevention. Accurate collection of data is vital to prioritise areas for research and intervention, to evaluate intervention, and to monitor change. Although injuries to children play such a major role in morbidity and mortality in childhood there is no programme of research. The three academic departments of child health in the United Kingdom (Newcastle, Wales, and the Institute of Child Health in London) with a major interest in injury control have to struggle for funding. The subject falls between the Medical Research Council and the Education and Science Research Council, and relatively few projects have been funded. The subject is not a popular one with major charities. The multiplicity of government departments involved also means that funding opportunities are limited.

Action on childhood accidents

In 1977 S D M Court and R H Jackson were instrumental in the formation of the Child Accident Prevention Trust (CAPT) in England. The trust brings many disciplines together to foster research and action on accidents to children, and there are similar groups in other parts of the world.

As well as national action on accident prevention, local action is needed to introduce safety measures. In Sweden, public health physicians, led by L Svanstrom from the Karolinska Institute in Stockholm, developed the concept of local action through the Safe Communities projects. Using this approach,

projects in Sweden reduced home accidents by as much as 20%.[54 55] The First World Injury Control Conference in 1989 approved a manifesto for safe communities: "Safety—a universal concern for all".[56 57] The Second World Conference in Atlanta confirmed this. Throughout the United Kingdom there are small groups under taking community projects. Much is done on a low budget or voluntary scale.

In the United Kingdom the main costs of childhood injuries are felt by the families and by the NHS. The main costs of prevention are undertaken by local authorities. There clearly needs to be collaboration between health authorities, NHS trusts, and local authorities if success is to be achieved. A national safety agenda for children would focus work and give direction to child accident and injury prevention at a governmental level and on local level.

Summary

Accidents are the most common cause of death in children over one year of age. Prevention remains a high priority. We have reviewed the current epidemiology of childhood accidents and their prevention, and made recommendations for the future

In 1992, 559 children died in United Kingdom as a result of an accidents—240 from road traffic accidents and 100 from burns and scalds. Every year 50 children drown. Accidents cause significant disability to children. Many children, up to one in four of the population in urban areas, attend accident and emergency departments, and 5–10% of these are admitted to hospital. Accident risk factors include low social class, psychosocial stress, an unsafe environment, and child developmental disorders. Research has shown that prevention is best achieved by making the child's environment safer, often through legislation.

Insufficient resources have been put into both research into childhood injuries and preventive work in communities. Collaboration between health authorities, NHS trusts, local authorities and community networks is vital if success is to be achieved. A national safety agenda for children would focus the attention that this problem deserves.

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