

## Current topics

# Hazards to children in traffic

## A paediatrician looks at road accidents

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**SUMMARY** An overall view is presented of the hazards to children in traffic. The importance of the developmental aspects of childhood accidents is stressed, and a plea is made for doctors working with children to recognise the part they could play in reducing the number of road accidents to children by their understanding of child development and behaviour. It is an aspect of preventive paediatrics that is largely neglected at present.

Whether they are measured in terms of mortality or morbidity, accidents are one of the most important problems of child health today. The facts are clear and incontrovertible: they are the commonest single cause of death between ages 1 and 15, account for one-fifth of all hospital admissions in that age group, result in about one-third of all attendances at accident and emergency departments, and bring one in 6 of all the children in our cities to their local accident and emergency department in any single year. Yet doctors, whether they are working in the fields of primary care, community medicine, or hospital-based paediatrics, take little notice of accidents, and I believe those who deal with children could do more in the preventive field than is being done at present. Because of the large energy forces in a moving vehicle, road accidents cause the greatest problem in terms of the severity of injuries, and this paper aims to give an account of the problem in terms of mortality and morbidity, and then to analyse the factors from the viewpoints of child growth, development, and behaviour.

### Statistics

**Mortality.** Table 1 shows the total number of deaths and the proportion of accidental deaths in 3 different age groups during 4 separate years. In the last few years the total number of deaths from all causes and from accidental deaths has fallen in the younger age groups, but in the 10-14 group the total number

Table 1 *Total and accidental deaths by age groups and years*

Age group	Deaths	1951	1966	1971	1974
1-4	Total	4133	2662	2204	1922
	Accident	583	605	617	447
	(%)	14.1	22.7	27.9	22.25
5-9	Total	1771	1320	1484	1225
	Accident	565	473	552	442
	(%)	31.9	33.1	37.2	36.1
10-14	Total	1328	1186	1109	1091
	Accident	323	364	439	468
	(%)	24.3	30.7	39.5	42.8

From The Registrar General.

and proportion of deaths caused by accidents has risen. The decrease in the proportion of accidental deaths in the 1-4 age group is associated with more accurate certification of the cause of death: certain children previously categorised as dying from suffocation, etc. are now more properly included in the sudden infant death syndrome.

In a similar way the proportion of deaths caused by road accidents has risen slightly in the last few years, although the total number has fallen, as has the death rate per 100 000 population (Table 2).

This reduction in total numbers should not make us complacent. In the 7 years, 1968-74, 5354 children were killed on the roads: 3756 as pedestrians, 745 as passengers, and 710 as cyclists. Not all these deaths were due to actual collisions, but children knocked down by cars accounted for 3675 out of the 3756 pedestrians, collisions between vehicles for 545 out of the 745 passenger deaths, and vehicles hitting cyclists for 634 out of the 710 cycle deaths.

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Table 2 Total deaths from accidents, and road accident deaths by years, in children

	1967	1976
Total no.		
Of accident deaths	2194	1306
Of road accident deaths	812	557
Percentage of accidental deaths due to road accidents	37	42
Road accident deaths/100 000 population	7.25	5.0

From Office of Population Censuses and Surveys, 1977.

The suggestion of improvement in the figures is most pronounced in the younger age group, the numbers of deaths in the 10-14 age group remaining virtually unchanged. The 10-year totals show that 1185 children were killed in the age group 0-4, 1861 in the 5-9, and 1384 in the 10-14 age group. As may be expected, more boys than girls are killed—for example, in 1976, 365 boys were killed compared with 189 girls. Figures issued recently from the Office of Population Censuses and Surveys have again drawn attention to the striking social class differentiation both in accidental deaths from all causes and road accident deaths (Table 3).

**Morbidity.** Mortality figures are of course accurate, but morbidity figures for the total number of children injured on the roads must be interpreted in the light of the means used to obtain them. They are, in fact, obtained from the police, who make out a report (Stats. 19) on road accidents that come to their notice: the constable filling in the form estimates the degree of severity. This has two drawbacks: firstly, the police can only report on those accidents of which they are informed—a child who fractures his skull after coming off his bicycle when he hits a stone might well not come to their notice at all—and, secondly, the constable's estimate of severity may well be inaccurate.

Figures published by the Department of the Environment (Table 4) show that in 1976 over 11 000 children were seriously injured, nearly 7000 as pedestrians, and nearly 40 000 were slightly injured, just over half as pedestrians.

The validity of these data is particularly questionable when they relate to bicycle accidents. In a

Table 3 Death rates (per 100 000 population) by social class in age groups, 1959-63

Age group	Accident deaths	Social class				
		I	II	III	IV	V
1-4	Total	9.5	12.77	16.87	24.00	44.86
	Road	2.85	3.87	7.35	9.25	15.80
5-9	Total	6.28	9.73	12.68	16.10	28.90
	Road	3.61	5.23	7.00	8.08	14.76
10-14	Total	7.36	8.09	9.70	11.23	15.50
	Road	2.91	4.03	5.12	5.35	7.30

From Office of Population Censuses and Surveys, 1976.

Table 4 Statistics on road accidents to children in England and Wales 1976

	Killed	Seriously injured	Slightly injured
Pedestrians	405	7461	21072
Cyclists	102	2022	7937
Passengers in vehicles	100	1759	10209
Driver or passenger on motor bicycle, etc.	2	94	266

From Royal Society for the Prevention of Accidents, 1978.

study of all traffic accidents attending the Battle Hospital, Reading in the course of a year Grattan *et al.* (1976), from the Transport and Road Research Laboratory (TRRL), found that only 32% of cycle accidents at all ages had been reported to the police, and even more significantly, Craft *et al.* (1973) in a study of 400 consecutive bicycle accidents to children in Newcastle, found that only 11% were known to the police. It is therefore difficult to know how much reliance to place on reports, such as leaflet 395 (Transport and Road Research Laboratory, 1974b), which reports a study of pedestrian and cycle accidents to schoolchildren in 6 towns (total population about 784 000) collected over 2 years, during which time only 417 bicycle accidents were reported. In contrast, the 400 cases of Craft *et al.* (1973) were collected in the space of a few weeks from accident and emergency departments.

Havard (1974) drew attention to this problem of data collection for pedestrian accidents. In his paper he stated, 'The first comment to be made is that the epidemiological information on child pedestrian accidents is very inadequate in relation to the size of the problem. . . . The question must therefore be asked if the public health authorities are assigning the right priorities to childhood accidents, having regard to the fact that children are far more liable to be killed or disabled by accidents, and especially road traffic accidents, than by any other cause'. It would seem that the best place to collect such data is at the accident and emergency (A and E) department of the local hospital: there are not likely to be many road accidents of any degree of severity which do not come either directly to that department or indirectly via the family doctor. This has been receiving attention, and to try to bring greater concordance between police and hospital statistics, revised instructions have been issued (Department of Transport, 1977). In due course more reliable figures may therefore become available.

### The child

However, figures themselves do not tell us everything about accidents. Road accidents, like other

accidents, can be looked at from 3 different aspects: the child himself, the 'agent' causing the accident—the car, bus, bicycle, etc., and the circumstances surrounding the accident. There is increasing recognition of the interaction between children's development and their liability to have accidents, and I believe that it is in this field that doctors working with children could play a larger part, not only by increasing our knowledge of this interaction, but by making its importance much more widely known to others concerned with children—parents, health visitors, teachers, etc.

As in so many matters relating to accidents Swedish workers have been prominent in this field. Sandels (1975) has gathered together her experience and her book *Children in Traffic* well repays study by paediatricians interested in child growth and development. Certain physical attributes of growth are important: a child's height may make it impossible for him to see on-coming traffic from behind parked cars or other road-side obstructions, and I have seen accidents in which a significant factor has been the small child's inability to see traffic coming over the brow of a hill. Sandels has drawn attention to the difference between 6-year-old children and adults in localising sounds, e.g. a car horn, and to the child's limited visual perception. Most important of all is the difficulty the young child has in concentrating on two things at once, e.g. on traffic in the road and what his mother is saying to him, and in sequencing and co-ordinating the various sensory inputs he is receiving. Right-left discrimination is also limited, and it is not surprising that children find it difficult to understand that in crossing the road via a traffic island they have to look one way before doing the first part of the journey and the other way before they complete it. The mathematical complexities involved in crossing the road are considerable: one has to estimate accurately the varying speeds of traffic coming from two different directions—or more if it is a cross-roads—as well as one's own speed in moving from A to B in deciding whether you can reach B before the traffic reaches you. As Bäckström (1977) said, 'Traffic is the most complicated environment that a child can experience'.

A further interesting study by Sandels (1975) and her coworkers has been into children's understanding of road signs and of words used in relation to traffic. Certain road signs, e.g. no parking, do not need to be understood by children, but others—such as pedestrian crossing or school crossing—are important. Child cyclists too should know road signs such as, a one-way street. In Sandels's study, 20 boys and 20 girls in each 6-month age group from 4 to 7 were asked about their understanding of road

signs: in no age group did all the children understand even the best understood signs (pedestrian crossing and school). The pedestrian crossing sign had a variety of interpretations including, 'It means it is forbidden to cross the street here', and 'A warning that people must not walk along the middle of the street'. The children crossing sign—and it should be noted that the sign in this country shows children *running* across—was likewise variously interpreted, such as 'It is a place where cars can drive', 'You are only allowed to run', and 'Children have to run across as fast as they can so that no cars will knock them down'. There were similar misunderstandings by children who were somewhat older when asked the meaning of such terms as 'crossing', 'pedestrian', 'main road', and even 10-year olds had difficulty in understanding 'keep to the left' and 'traffic island'. One important phrase that younger children could not understand was 'to cross the road'. Examples of 6-year olds were, 'You drive in a cross', 'You stand in the middle of the road when it is a crossing', 'One street crosses the other', etc.

This developmental aspect of children and their behaviour means that children have different accidents at different ages. Fig. 1 shows the sex differences in pedestrian and cycle accidents in terms of yearly numbers of fatal and serious casualties over 3 years. It shows that at age 7, boys are twice as likely to be involved as girls in these accidents, but the difficulty in interpreting this lies partly in the fact that the actual number of exposures

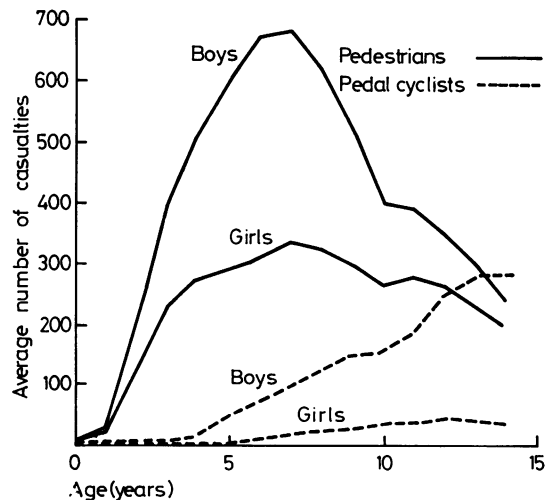


Fig. 1 Average yearly number of fatal and serious casualties during years 1973–75 (Russam, 1977).

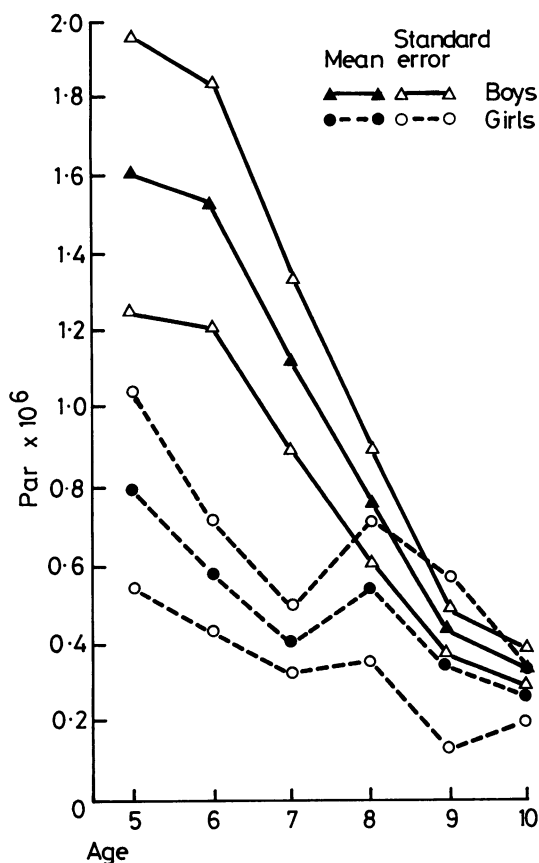


Fig. 2 Risk per road crossing for boys and girls aged 5–10 years (Russam, 1977, after Howarth *et al.*, 1974).

to road crossings in children of this age is not known. The work of Howarth *et al.* (1974) in this field (Fig. 2) using a variety of techniques involving close observation of children on their way to and from school, seems to indicate that boys at ages 5, 6, and 7 have a much greater risk per road crossing than girls, but the risk falls rapidly and there is no significant difference between the two sexes by age 10.

But it is not only the children themselves that we have to consider: we also have to consider adults' expectations of their behaviour. An important study was done by Sadler (1972) of mothers' expectations of their children's behaviour in traffic. The replies to the question, 'At what age do you think it is safe to let your child cross a main road in safety' are revealing. Over half of mothers said it was safe to let their 5-year-old child cross the

main road by himself, 10% of mothers of children aged 3, and 13% of mothers of children aged 2. A further study in Sweden (Sandels, 1977) looked at the characteristics of car drivers who have knocked children down: there is an over-representation of adolescent men without a family of their own, and in whom the knowledge of the behaviour to be expected of young children is clearly deficient.

Perhaps more attention should be paid to educating adults about children in traffic. This is not to say that children do not need to be taught road safety, and the Green Cross Code and the books on road safety by Jolly (1977) from Reading University were published after considerable research into children's behaviour and educational abilities. Nevertheless, children's needs in traffic are still neglected, and I would agree with the statement of Sandels (1975) that, 'It is impossible to adapt fully small children to the traffic environment. They are biologically incapable of managing its many demands. Children are unreliable in traffic until childhood has matured out of them. What we can do however is to adapt the traffic environment to the children. This would also mean that other risk groups would be protected, such as old people and the handicapped'.

#### The agent

In most cases the 'agent' in an accident is a car, and it must be borne in mind that children are injured as passengers as well as pedestrians. So far as the external design of cars is concerned, improvements have undoubtedly taken place by the removal of sharp or pointed edges on surfaces—e.g. by the prohibition of sharp-pointed mascots on radiators. The importance of bumper height relative to leg injuries has been stressed by Ashton *et al.* (1974). Some work has been done on devices designed to retain a child on the bonnet of the car and thus to prevent the injuries caused by the secondary impact on the ground or by being run over (Lowne, 1974), but these are nowhere near practical application at present.

More attention is now being paid to the safety of children travelling as passengers in cars. A good summary of the current situation was given by Lowne (1977). His figures show convincingly that the use of a proper car safety seat for young children, and a properly applied seat belt for older children, greatly reduces the chances of serious injury. A random survey showed that 12% of children wear some sort of restraint in cars, but in 1973–74 out of a total of 2595 injured children, only 5% had been restrained. In a further study, 40% of children with no restraint had minor injuries and 8% had serious ones, compared with 20 and 4% of babies

in carry-cots, 12 and 1% in safety chairs, and 12 and 5% in safety harnesses. However, the problem is to persuade people to use these obvious precautions, and many children still stand in the front of cars with their noses glued to the windscreen. Perhaps this is not surprising in view of the reluctance of so many car drivers to use a safety belt—and there is no doubt that doctors have a duty to set an example. A World Health Organisation booklet has an interesting comment to make: 'Some Member States (of a European Conference) were prepared to spend large sums of money on counter-measures (such as fences on the central reservation of motorways) which saved only a few lives, whereas less expensive measures (such as the compulsory wearing of safety belts) which would save far more lives, had been rejected'. Perhaps something may happen: the European Conference of Ministers of Transport has considered 'the prohibition of children whose age or size does not permit the use of the safety belt being transported in front seats' (World Health Organisation, 1977).

Bicycles are obviously also an important 'agent' in an accident, and much evidence is beginning to accumulate in relationship to bicycle accidents. One of the questions that has been discussed frequently in the last 2 or 3 years is whether so-called high-rise bicycles of the 'chopper' type are unsafe compared with conventional bicycles. The essential difference lies in the wheel sizes, the wheel at the front being smaller than that at the back, and also certain other features relating to the handlebars and the size of the saddle. Craft *et al.* (1973) showed that accidents on this particular type of bicycle were more likely to result in head injuries and fractures and in admissions to hospital, than accidents on conventional bicycles with equal wheel sizes, and it seemed as if a significant proportion of these more serious accidents occurred when children had had the 'chopper' type bicycles for only a short time or even had borrowed them from friends. It seemed as if it was more difficult for children to accustom themselves to these bicycles when they had first managed the conventional bicycles, but in order to prove whether they were inherently more unsafe than conventional bicycles it would really be necessary to have 2 groups of children, (a) those who had learnt on a conventional bicycle and then changed to the 'chopper' type, and (b) those who had learnt on the chopper type and changed to a conventional bicycle. Unfortunately, it would be difficult to obtain a sufficiently large group of the latter type to make a study valid. There is, however, some evidence from theoretical studies done in the USA that bicycles of unequal wheel sizes are inherently less stable than those of similar wheel

sizes. Part of the difficulty in resolving this question lies in the fact that some models most recently introduced in Britain have lost some of the features which it was felt were more likely to produce the increased number of accidents associated with their use. Bicycle riding is also associated with some recognisable injury patterns: the position of the gear change on the cross-bar in some types of bicycle has been associated with genital injuries as a result of the child coming forwards off the saddle, spoke injuries produce puncture wounds of the legs, handlebar injuries were associated with 20% of all bicycle accidents in a series reported by Thorson (1974), and torsion of the testis is associated with the use of racing-type saddles (Jackson and Craft, 1978).

#### Circumstances of the accident

Many factors relating to road accidents in childhood are similar to those in all types of road accidents: the visibility, including street lighting, the road surface, the weather, state of vehicle maintenance, alcohol and other drugs affecting the driver, etc. Traffic engineering is vitally important in view of the fact that 70% of pedestrian casualties in residential areas are children (Transport and Road Research Laboratory, 1974a). Obviously complete separation of pedestrians from moving traffic is the ideal, but this is expensive. Increased safety for pedestrians might well be assured by carefully designed residential precincts which although not excluding cars do not give them precedence. An example of this is the Woonerf precinct in Holland (Royal Dutch Touring Club, 1977).

Perhaps more important to pedestrians are the emotional circumstances related to the accident. Increasing attention is now being paid to the child's state of mind at the time of an accident. Burton (1968) studied 20 injured children and found that mothers of injured children were more likely to be separated from their husbands and to have a physical or mental illness than the mothers of 20 controls. In addition, half the children had experienced a stressful event immediately before the accident—such as a death in the family. The children themselves were more restless and assertive than the controls. Backett and Johnston (1959), in a study of 101 injured children, showed an increase in illness in the mother or some other person in the household, or that there was maternal pre-occupation of some kind: the vulnerable family was more crowded and did not protect the child during play or even have elementary play facilities. Marcus and his colleagues (quoted by Brown and Davidson, 1978) suggest that a child's insecurity

and anxiety are increased by family disturbance, and that accidents occur more often to children who rely on action as a mechanism to cope with their anxiety. Departures from normal in physical development may also play a part: obviously blind, deaf, or handicapped children are at special risk of injury, although their exposure to risk is probably considerably below the average. Temporary hearing loss, such as that associated with a 'glue ear' can obviously be as detrimental to a child's safety on the roads as it can be to his ability to learn in school, and Elliott has drawn my attention to an association between head injuries and otitis media (W. D. Elliott, 1978, personal communication). The effects of departure from normal in terms of intelligence are less clear-cut, but as part of the 1000 family study in Newcastle (Miller *et al.*, 1974) we looked at school-children who had repeated accidents in their school years and compared them with accident-free children. There was no doubt that below average children had a greater liability to repeated accidents; it was also noted that children who lacked reliability, concentration, and initiative and who appeared to have less than average body control and co-ordination, appeared to be more liable to have accidents.

#### What can be done?

The importance of stressing the developmental and psychosocial factors in childhood accidents will be one of the main functions of the proposed Joint Committee on Childhood Accident Prevention which is being established under the wing of the Medical Commission on Accident Prevention, as suggested by Jackson and Wilkinson (1976) and supported by Court (1977). These aspects pervade almost all the events which form the logical sequence of an accident prevention programme. The 1st stage is the collection of satisfactory data—some wide and national in scope, but other more detailed 'in-depth' types of studies are necessary too. The 2nd stage is the analysis of these data in terms of the types and results of the accidents, the ages and personalities of the people and families, and the overall circumstances. The 3rd stage is to identify what one might call 'the principal avoidable factors' in the chain of events culminating in the accident. The 4th stage is the alteration of those factors—whether it be an accident 'black-spot', a particular feature on a bicycle or car, a misleading road sign, etc. The responsibility for this may well lie with local authorities, government departments, engineers, etc. The 5th, and possibly most difficult stage, is to alter people's behaviour in accepting safety features and to improve their understanding and expectations of

children's behaviour. The last stage lies in the evaluation of the cost-effectiveness and cost benefit of these studies. This is far from easy: the introduction of the Green Cross Code and its attendant propaganda was followed by an 11% reduction in child casualties in the period immediately after its introduction, but Firth (1975) found that children between 6 and 12 place very little emphasis on safety and how it can be achieved. Research into cycling proficiency tests have shown different results: the TRRL found that a trained group showed definite and sustained improvement compared with a control group (Russam, 1977), but Risk and Raymond (1976) showed less obvious results.

Improving adults' understanding of children's behaviour is surely a role in which the child health services could take a larger part. In discussing a Swedish campaign in which the year 1976–77 was designated as the year of children's safety in traffic, Sandels (1977) commented, 'In the end adults are always to blame for traffic accidents involving children. Working with traffic problems makes one aware of the fact that not only do adults overestimate children's limited ability to cope with traffic, but that adults themselves have very negative attitudes towards traffic, e.g. crossing the street against a red pedestrian light. This attitude is readily copied by children. We know that children from about 12 years upwards possess the maturity and the knowledge of how to behave in traffic, but they seem to lack the motivation to do so. We hope that this campaign will teach adults about children's limited ability to cope with traffic, and to make all adults—not only parents—take responsibility for the children they meet in traffic situations'. The situation in Sweden is not significantly different from that in this country, and we would do well to take note of these comments.

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