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EPIDEMIOLOGICAL FEATURES OF ROAD TRAFFIC INJURIES

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In developed and many developing countries road traffic accidents are now a main cause of death and disability, particularly among young adults. World statistics are incomplete but are sufficient to give an outline of this man-made twentieth century epidemic.(1, 2)

Though figures are not readily available for several countries (e.g., Argentina, China, Egypt, India and USSR) world annual road deaths probably approach 250 000 and total casualties perhaps 10 million.

The most recent road traffic accident statistics show the following distribution according to geographic regions, although it must be borne in mind that the figures are underestimates, since only certain countries furnish such statistics regularly.

Annual road deaths
(K = per 1000 population)

The main known contributors to annual road deaths are:

Europe	80K	(Federal Republic of Germany 15K, France 14K, Italy 9.8K, Great Britain 6.6K)
The Americas	60K	(USA 46.4K, Canada 5.2K, Brazil 3.3K)
Africa	23K	(Nigeria 8K, South Africa 6.4K)
Asia	21K	(Japan 9K, Republic of Korea 3.5K)
Oceania	4.3K	(Australia 3.7K).

Satisfactory international figures for nonfatal injuries are not available but some illustrative examples from individual countries are mentioned later.

The following paragraphs outline international comparisons, trends, the contribution of different categories of road users, severity of injury, personal factors and some lessons for prevention.

International comparisons

As Smeed (3) showed 30 years ago, much of the variation in road deaths between different countries and at different times in the same country can be explained in terms of population size (P) and numbers of vehicles (V). Smeed found the best fit was road deaths = $0.0003\ (V.P^2)^{1/3}$ and it is remarkable that this continues to be valid for developed countries.(4) A key concept is the degree of motorization or vehicles per head ($\frac{V}{P}$). With increase in V road deaths rise but less than might be expected; there seems to be a developing sophistication in vehicle use so that deaths per vehicle fall as $\frac{V}{P}$ rises. This sophistication covers many changes such as improved roads, better vehicles and fewer pedestrians, as well as improvements in driving behaviour and in medical care of casualties.

In the developed countries these adaptations to road transport have been spread over 70 years or more. It is perhaps not surprising that studies in certain developing countries where changes have been much more rapid show both a different statistical relationship and in some cases rates per vehicle rising rather than falling with the very rapid development of motorization (e.g., Zambia and Nigeria).(5) Other countries have figures comparable to those of the earlier days of European experience.

Further analysis of the developed countries shows that in spite of the general fit with the Smeed formula there are persistent differences between countries such that the same ones continue to be above or below the expected values. Thus, for similar degrees of motorization the risk of road deaths in say France or the Federal Republic of Germany is about twice as high as in Great Britain or Sweden. (6, 7)

Trends

In the 1950s and 1960s road deaths in most countries increased in accordance with increase in vehicles. In some (e.g., Great Britain) the numbers then became nearly constant. This corresponded to a balance between a diminished use of motorcycles and an increase in cars.

The next major trend change dates from the 1973 oil crisis. In many oil-importing countries voluntary restriction of travel related to rising fuel prices combined with statutory speed restrictions to cause a drop of about 15% in road accidents and deaths. Some countries made further changes (e.g., banning of large motorcycles in Japan) which further accentuated the fall. In most developed countries the initial fall has now levelled out and total deaths are again beginning to rise. In several countries the number of motorcycles has recently increased, with a marked rise in deaths and injuries to their riders.

In those developing countries which are also rich in oil, road casualties have increased spectacularly. Reliable statistics are not easily obtained but road deaths in Nigeria, for instance, have doubled since 1973 and at 8000 per annum are more than the figure for Great Britain and the highest notified in any African country.

In other developing countries increases have been less abrupt, but there are many special problems in the introduction of motorized transport in a less developed background. For instance the scooter-based three-wheeled taxis of Indian cities have numerous accidents, as have also the overloaded and antiquated trucks and buses of many poor tropical countries. Studies show that urban road death rates can be eight times those of European cities, (8) and further studies are needed to obtain an accurate picture of the numbers of casualties and circumstances of accidents in such communities.

Contribution of different categories of road user

Most road vehicles are cars and the majority of road injuries are to car occupants or to pedestrians struck by cars. In spite of great changes in numbers of vehicles, pedestrian fatalities per million population tend to remain steady though the rates differ between countries. In developed countries pedestrian casualties account for 15% to 30% of total road deaths. They shared the fall in numbers related to the fuel crisis but are now tending to increase again. Deaths of vehicle occupants account for 40% to 60% of the total and in developed countries the deaths of vehicle occupants per thousand vehicles have fallen with time and with increasing numbers of vehicles. In Great Britain, for instance, in 1966 it was 0.48 and in 1976, 0.18; corresponding figures for the Federal Republic of Germany were 1.07 and 0.36.

These risks are very much lower than those for motorcycle riders (United Kingdom 1976, 1.1); on average motorcyclists travel only about one quarter the distance of the average car so that the risk of death per mile travelled is about 20 times as high. Mopeds also give special problems in countries such as France where they are numerous.

Pedal cyclists share with pedestrians the role of almost passive exposure to the violence of motor vehicles. Numbers of deaths vary with the popularity of bicycles. It has been estimated that the risk of death per mile travelled in the United Kingdom is about half that of motorcycles.

Statistics of numbers of cycles are not normally available so that comparable risks per thousand vehicles are unobtainable. It would be of interest to compare rates for countries like the United Kingdom and the United States, where few special facilities are provided, with the Netherlands, where there are special cycle tracks, and with countries such as China where there are many cycles but few cars.

Injury severity

For most countries the statistics of nonfatal injuries are unsatisfactory. Studies in Great Britain and Sweden have shown deficiencies in notification of serious injuries of 20% or more, these deficiencies varying for different categories of road user. Notifications of slight injuries are even more unsatisfactory. However, special efforts have been made in Denmark to obtain full information and in Australia road injuries have recently become medically notifiable.

The usual national statistics fail particularly to distinguish the numbers and circumstances of the more severe and permanently disabling injuries. Research series based on hospital cases show the importance of accidents to vehicle occupants, pedestrians and motorcyclists as causes of severe head injuries, and to motorcyclists in causing severe leg fractures. In these types of research the increasing use of severity scores such as the Abbreviated Injury Score and the Injury Severity Score is helping to give comparability.

Another approach has been to survey specific injuries, e.g., head injuries (9) (of which two thirds of fatal cases and one half of hospitalized cases were found to be from road accidents) and spinal cord injuries (10) (about one half of which were caused by road accidents). More work on these lines is needed to define the circumstances where prevention is most required.

Personal factors

For each category of road user there is a marked change of road accident rate with age. The main factors in this are exposure and competence. As soon as a child can walk, accidents as a pedestrian are a possibility. The age-specific risk per exposure is very high in the early years but falls as competence improves. A peak occurs at about the age of seven (United Kingdom), after which exposure increases markedly but is more than outweighed by the improved competence associated with experience. The same sequence can be seen with pedal cyclists (peak rate age 10), motorcyclists (peak rate age 19) and car drivers (peak rate age 21). In other countries with different regulations and traffic customs these peak rates may be at slightly different ages.

The lowest rates are found in mid-adult life, then competence again seems to regress with the impaired motor and sensory abilities of advancing years; new high rates per exposure are again found at the age of 65 years and above. It is disputed whether sex as such has an important effect. Rates per exposure are usually higher in females but experience of traffic is commonly less. There are, however, potentially important differences of exposure within categories, e.g., a higher proportion of females ride as passengers in cars than as drivers. This may have implications for injury protection.

Apart from obvious severe disabilities, medical conditions have rather little bearing on accident risk. It seems that, as with many aged persons, the moderately disabled commonly select relatively safe traffic conditions and so avoid the high accident rates that might have been suspected. Another case of disability which is much more prevalent is that due to alcohol; for example, almost half of the young drivers fatally injured in the United Kingdom have blood alcohols higher than the permitted level.

A major interest has been in the personal and psychological factors which may determine accidents. There have been many country studies which have pointed to an association with other crimes and antisocial attitudes. Whitlock (11) made a major international study which aimed to identify psychological causes for the disparity of accident rates from those expected by the Smeed formula. More recently the topic has been reviewed by Benjamin. (7)

Lessons for prevention

The epidemiological approach can identify certain areas of particular importance, e.g., motorcyclists, young drivers and alcohol.

Some of these areas might be helped by improved training. However, many efforts in the past to alter behaviour have been disappointing, and whatever degree of success they may have, accidents will continue to occur. There are also areas requiring clearer definition, e.g., causes of disabling injury and the special problems of developing countries.

An approach which avoids too great an emphasis on behavioural aspects is that of Haddon. (12) He described 10 strategies to prevent injury. These cover ways of avoiding accumulation of energy, e.g., reduction of speed; of avoiding exposure to the energy, e.g., pedestrian precincts; and of mitigating the exposure, e.g., occupant restraint systems. These are fundamentally physical approaches and need make little demand on the elusive hope for safer behaviour.

Mitigation of the effects of dangerous exposure to energy requires epidemiological and medical as well as engineering research to make it productive. That is the field which this Technical Group is to review.

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