Injuries, seat-belts and further research

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This study is important for three main reasons. Firstly, it demonstrates the success of the seat-belt law in Britain on a detailed multi-hospital basis, illustrating the wisdom of such a law. Secondly, it illustrates the limitations of the seat-belts which have been fitted to cars in the last 10 years, by describing the nature, frequency and severity of injuries to restrained occupants. Thirdly, it illustrates how new knowledge about trauma can be acquired by cooperation between accident and emergency departments in separate hospitals in the UK. This is the first major study of its kind, and the first time that the Department of Health and Social Security has put any significant funding into road injury research.

The report analysed the data by Year 1 (pre-legislation) and Year 2 (post-legislation), and, consequently, some of the data cells were small. In the former there was approximately 25% belt-use, and in the latter 90%. The data could be re-analysed solely in terms of belt usage, giving larger cells and, perhaps, greater meaning to some of the findings.

What are the long-term consequences of traffic injury? There is a questionable view among some legislators and car manufacturers that AIS 3 is an acceptable level of injury in design terms. AIS 3 to the chest, for example, may be an injury with few residual complications for most healthy adults, but AIS 3 level injuries to the brain or the lower limbs are predominantly disabling to some unknown degree. It would be of interest, therefore, to recall a sub-set of patients who were wearing seat-belts, 2 years after their crashes, to document and classify the long-term consequences of their injuries in functional, social and financial terms. Such a project on disability would be complementary to the initial assessment of their injuries and would give insights into the more general problems of the costs and consequences to the National Health Service and to the community in general of traffic injuries.

Present-day cars are designed, in terms of crashworthiness, to protect primarily fiftieth percentile male 'dummies'. Some recognition is given of the fifth percentile female and the ninety-fifth percentile male dummy, but the current state of development of such biomechanical devices, which aim to replicate the human frame, do not address many aspects of the actual population at risk in cars.

The study would have to contain a great deal of useful information on certain population groups besides the obvious ones of age and sex (for example, belt function for children, old people, the obese, the arthritic and the pregnant) which could be pursued.

The seat-belt is discussed as if it was a uniform device in all cars. In reality, seat-belt geometry and design have varied greatly over the last 10 years. It would be of interest to see how some of these more vulnerable populations feature in the post-law data, particularly in terms of abdominal and neck injuries.

Even allowing for the substantial differences in seat-belt design, one may define from the study four general limitations to current seat-belts which should all be the subject of further investigation.

Steering wheel contacts. The study rightly emphasizes the high frequency of head and face contacts by drivers with steering wheels. Current design regulations do not adequately address

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this issue, and new legislation needs to be formulated when better biomechanical criteria for the face are developed. Further research is needed into padded steering wheels, supplementary air bags, and other design modifications to the steering wheel and column.

**Injuries from belts and forward contacts.** Many of the injuries documented in the study occurred because the forward motion of the lower limbs and the head, even with seat-belt use, was such that injurious contacts occurred. Optimum restraint performance arises from a correct combination of webbing stretch, crush of the frontal engine compartment, and the geometrical separation between the occupant and the interior of the car. Too soft a belt system gives too much forward motion, while too rigid a belt system generates high loads in the seat-belt which can be injurious. The study showed that fractures of the sternum and abdominal injuries are a feature of seat-belt use (for injured occupants), but so are injuries from head and face contacts. Are seat-belts really optimized for the population in the car's structure? Even with seat-belt use, fractures of the sternum and abdominal injuries can be expected for rear passengers once they have functioned perfectly, but only in accordance with their design. It is their design which has been shown to have limitations.

**Crush of the compartment.** Most people who die wearing seat-belts do so because of intrusion of the car's structure into the occupant's sitting-zone. The high levels of seat-belt-use now achieved, mean that further protection will come from improved structural design of the car. Research is therefore needed on what can be called 'survivable fatalities' to document those conditions in detail.

The application of computer-aided design to current car structures, plus an urge to eliminate all redundant components, and thus save weight and enhance fuel economy, have resulted in current designs which are extremely efficient in the standardized crash tests required by legislation. One may suggest, however, that in the real world of asymmetrical, complex crashes, these new designs are prone to come apart more than older, less efficient structures. Guidance from the real world of collisions and injuries is needed to see if, in fact, this is a significant problem.

**Rear loading.** The study rightly concludes that all occupants in a car should be sensibly restrained. Rear belts provide two benefits: they help rear passengers themselves, and they protect front-seat occupants. However, rear occupants do not have an instrument panel in front of their knees, and the seat-belt geometry in many rear seats is far from optimal. An even bigger increase in abdominal and lumbar spine injuries can be expected for rear passengers once they adopt seat-belts. Overall, rear belts will produce major benefits, but the epidemiology of rear passenger trauma will need examination.

**CONCLUSIONS**

In summary it seems that something as important as the seat-belt legislation, perhaps the most significant public health measure for a generation, should be further evaluated and monitored at several levels.

Firstly, there are the changing epidemiological patterns, and the Rutherford study has illustrated what can be achieved purely on a hospital base. This could be developed through further analysis.

Secondly, there are the more detailed questions relating to injury mechanisms. These can, to a degree, be dealt with by more specific hospital-based studies, and are a logical extension of the current work.

Thirdly, more specific studies of belt function and mechanisms of injury require in-depth studies in which vehicles are examined and that information combined with hospital data.

Fourthly, the actual operation of the law in terms of belt-use in general and in crashes needs to be evaluated. It would be easy to let the system slide through complacency at this time.
Finally, it should be remembered that traffic collisions cost the community in Britain some £2-5 billion annually. Road crashes can be thought of as an industry which, in a sense, they are. Even the most moribund of industries tends to spend 3–4% of turnover on research and development, say £80 million a year. Looking around Britain and defining research generously, it is hard to reach an annual research budget of more than £8 million for the whole field of traffic safety research. For work related to traffic injuries specifically, the total must be less than half a million annually. So less than 0.25% of the cost of the problem, in terms of resources is devoted to research on traffic injury. It does not seem unreasonable that not only the public sector, the Department of Health and Social Security and the Department of Transport, but also the private sector, should give road injuries a much higher priority. It is to be hoped that the findings of this important hospital study will generate more interest in what is a much neglected subject.

POINTS RAISED IN OPEN DISCUSSION

- Cars are now increasingly bought and sold on the virtues of their safety features and most manufacturers are aware of this.
- Seat-belts are often worn incorrectly, and this may contribute to morbidity.