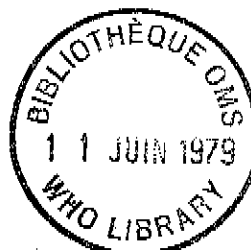




Technical Group on Protective Devices and Restraint  
Systems in Road Traffic Accidents Prevention

Meknes, 26-28 June 1979



ICP/ADR 010/8  
17 May 1979

ORIGINAL: ENGLISH

*De G.M. Mackay*  
*Accidents, Traffic* *Dr G.M.*  
CURRENT PROBLEMS AND PRIORITIES IN VEHICLE OCCUPANT PROTECTION

by  
Dr G.M. Mackay,  
Reader in Traffic Safety,  
The University of Birmingham,  
United Kingdom

Over the last 15 years the benefits which can be obtained from improvements in the circumstances of the collision phase of traffic accidents have become widely acknowledged, and cooperation between engineers and doctors has resulted in recognition of the validity and success of this particular branch of preventive medicine.

Improvements to the collision phase of a crash result in lower forces and accelerations being applied to the vehicle occupants, with a consequent reduction in death and morbidity rates. This management of the kinetic forces of a collision is achieved either through active solutions, which require the road user to take some action, such as wearing a seat belt, or through passive solutions, where the design of the vehicle is changed so that the loads applied to the occupants are lessened or certain exposures to risk are reduced; for example, minimizing the risk of ejection by adopting anti-burst door lock designs.

Active crash protection

Seat Belts. Fundamental to occupant protection is the prevention of ejection and the elimination of localized high-energy contacts with the vehicle interior. A seat belt provides this protection and also couples the user to the car structure so that he can "ride down" on the crush zone at the front of the car with an attenuation of the forces applied by the restraint system. Bohlin (1967) showed that the use of seat belts reduced the number of fatalities by approximately one half, and lesser levels of injury by a similar amount. Many subsequent studies in other countries have shown similar benefits, and the advantages of seat belt use are so enormous that to date 23 countries have enacted legislation making the wearing of seat belts compulsory (Seiffert, 1976).

A major uncertainty at the present time is what level of usage can be achieved through such mandatory legislation. In developed countries, without such legislation, voluntary usage rates appear to stabilize at approximately 30% (this figure is influenced greatly by the environment, ranging from 10% in cities up to 60% on expressways). Propaganda campaigns have marginal and only temporary effects on these levels. With compulsory legislation, usage rates in the general traffic stream rise to between 70% and 85% after a learning period. However, this experience is restricted to countries with a somewhat sophisticated driving population, and in developing countries it is doubtful that the same effects would be produced.

Recent Australian data (McLean, 1977) suggest that those car occupants involved in reported accidents have seat belt usage rates significantly lower than surveys of usage in general. In other words, those people most likely to have collisions are the very people most resistant to a compulsory belt use law.

The issue of this document does not constitute formal publication. It should not be reviewed, abstracted or quoted without the agreement of the World Health Organization Regional Office for Europe. Authors alone are responsible for views expressed in signed articles.

Dieses Dokument erscheint nicht als formelle Veröffentlichung. Es darf nur mit Genehmigung des Regionalbüros für Europa der Weltgesundheitsorganisation besprochen, in Kurzfassung gebracht oder zitiert werden. Beiträge, die mit Namensunterschrift erscheinen, geben ausschliesslich die Meinung des Autors wieder.

Ce document ne constitue par une publication. Il ne doit faire l'objet d'aucun compte rendu ou résumé ni d'aucune citation sans l'autorisation du Bureau régional de l'Europe de l'Organisation Mondiale de la Santé. Les opinions exprimées dans les articles signés n'engagent que leurs auteurs.

Настоящий документ не является официальной публикацией. Не разрешается рецензировать, аннотировать или цитировать этот документ без согласия Европейского регионального бюро Всемирной организации здравоохранения. Вся ответственность за взгляды, выраженные в подписанных авторами статьях, несут сами авторы.

However, the benefits obtained from seat belt use are so great that even partially successful legislation is probably the first priority in occupant crash protection. Belt use applies to all sitting positions in the car, and it is therefore important to encourage both the fitting and use of rear seat belts in those countries which have omitted to do so.

Child restraints. Although, in developed countries, the numerical importance of child car occupant casualties is not great, the possibilities of the extensive use of special child restraint systems are considerable, because parents are perhaps more willing to use an active system to protect their offspring than they are to use one themselves. In this area, acceptability and therefore daily usage are probably much more important than a very high level of crash protection. A number of countries have specified that children must sit only in the rear of cars. This is undoubtedly a reasonable, short-term measure.

Head restraints. Early United States' requirements for head restraints allowed them to be adjustable vertically. Surveys showed that approximately 80% of head restraints were in the fully down position, rendering them ineffective in preventing hyperextension of the neck in a rear end collision (O'Neill et al. 1972). This illustrates the limitation of an active solution; a preferable design is one fixed at the correct height, and if necessary hollow, to minimize vision restrictions. Of injury producing collisions approximately 10% are rear end ones, but the nature of a whiplash injury may well mean that these cases are significantly underreported.

#### Passive crash protection

Of all cars currently manufactured, approximately 10% will cause a serious injury or a death to a road user before the car is scrapped (Mackay 1978). In developing countries that figure may well be several times greater. Hence crashworthiness is a normal and important design criterion to be considered. Over the last decade car design has moved from an almost entirely *laissez-faire* condition to one where many of its basic characteristics are controlled through legislation. This process is likely to continue. Because the basic design of cars is conducted in a very small number of developed countries it is important that the legislation which controls design should take account of more than just the specific needs of those developed countries.

In the past, major improvements in injury reduction have been achieved with the introduction of anti-burst door locks (Garrett, 1961), laminated windscreens (Mackay et al., 1970), energy absorbing instrument panels and anti-intrusion steering assemblies (Anderson, 1972). Recent work has shown that none of these improvements has resulted in optimal solutions. There is a basic need to evaluate continually, in actual injury studies, the consequences of design changes and associated legislation, to ensure that the reality of collision circumstances and associated injuries are reflected in the controlling legislation.

#### Future priorities in occupant crash protection

The following list of items is suggested as the most important topics for future action. They are listed in descending order of priority:

- Provision and use of front seat, lap/diagonal belts
- Provision and use of rear seat belts
- Fitting of laminated windscreens
- Improvements in passenger compartment integrity
- Improvements in side impact protection
- Greater adoption of child restraint systems
- Greater adoption of head restraints
- Prevention of fires following collisions.

#### International cooperation

A large number of national and a small number of international agencies are involved in the development of crash protective design of vehicles. In the past there has been little contribution from the field of preventive medicine, and there is a current need for a greater flow of medical and public health knowledge into this area. One consequence has been that not enough attention has been paid to physiological variations among the population at risk, and the particular needs of the young and the old. This criticism extends from the basic research areas to the implementation of action programmes.

Because resources are limited and because both the problems and solutions are common to many countries, it would be most efficient for the process of international harmonization to be extended.

Crash protection is a topic to which engineers and doctors contribute equally. Administratively the problem falls between ministries of health and ministries of transport. Public health authorities could contribute substantially by encouraging cooperation between these different units.

#### Developing countries

Vehicle ownership is entering a period of very rapid and probably sustained growth in a large number of developing countries. At this time it is important to establish public health procedures which can be introduced with little difficulty when ownership levels are low, for example, on the fitting and use of seat belts.

Programmes for the developing world need to be encouraged by a transfer of knowledge from the highly motorized countries. Both the technical and the administrative aspects should be structured appropriately for this rapid growth in vehicle ownership (and accidents) in areas where resources are limited. For example, the proportion of light vans and buses to cars is much greater in some developing countries than in Europe. The application of crash protective measures to these vehicles deserves particular attention. In general terms the knowledge available would allow developing countries to avoid a number of the problems which have only recently been recognized in highly motorized societies.

#### REFERENCES

- Anderson, T.E. Analysis of vehicle injury sources. Calspan Report No. 2M-5010-V12R. New York, Buffalo, 1972
- Bohlin, N.I. A statistical analysis of 28 000 accident cases with emphasis on occupant restraint value. Proc. 11th Stapp Conf. New York, S.A.E., 1967, p.299
- Garrett, J.W. An evaluation of door lock effectiveness. New York, Cornell University, 1961
- Mackay, G.M. Safety criteria in vehicle design. London, Conf. Instn. Mech. Engrs., 1978, p.5
- Mackay, G.M., et al. Tempered versus laminated windscreens - a comparative study: Proc. 14th Stapp Conf. New York, S.A.E., 1970, p.369
- McLean A.J. Seat belt effectiveness in urban crashes. Proc. 6th International Association for Accident and Traffic Medicine Conf. Melbourne, Australia, 1977, p.160
- O'Neill, B., et al. Frequency of neck injury claims in relation to the presence of head restraints. Amer. J. publ. Hlth, 1972, p.399
- Seiffert, U. Restraint systems for occupant protection. Proc. Seat Belt Seminar. Melbourne, Australia, Dept. of Transport, 1976