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WORLD MEDICAL ASSOCIATION STATEMENT

on

ALCOHOL AND ROAD SAFETY

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Preamble

Death and injury from road crashes and motor vehicle collisions with pedestrians constitute a major public health problem. Because so many of those killed and maimed on the roads are young, the years of expected life lost as the result of motor vehicle crashes and collisions rival what occurs with the major modern epidemics of cardiovascular disease and cancer.

In many countries, where the consumption of alcohol is accepted as part of everyday life, it has been shown that alcohol impaired drivers of motor vehicles are responsible for about half of all motors vehicle related deaths and serious injuries.

From this it follows that measures ensuring that alcohol impaired persons never drive will result in a very significant improvement in road safety, and a marked reduction in those killed or maimed on the roads.

Driving a vehicle involves accepting a degree of risk. Prudent drivers constantly monitor the risks they are meeting, and act to ensure that the level of risk never becomes subjectively unacceptable. Alcohol alters the driver's subjective estimate of risks, so that risk taking behaviour becomes more likely, at the same time as objectively measured driving skills are deteriorating due to sedation. This is what leads to alcohol related road crashes.

The person who has been drinking and is making a decision to drive is faced with an analogous decision about risks. The risks to be considered include negotiating the roads safely. The subjective assessment of such risk is progressively distorted by the effects of alcohol. It is therefore necessary to ensure that drivers consider whether they will drive or not before sufficient alcohol has been consumed to materially affect such judgments. This implies that legal limits on blood alcohol concentration in drivers must be set low, at the level indeed where subjective assessment of risks remains realistic in virtually all people.

Serious public health problems demand coordinated approaches. The detail of any successful approach must be based upon an analysis of the problem as it affects a particular country and culture. In most countries road crashes involving alcohol involve adolescents and young adults disproportionately and special efforts to reduce alcohol consumption by this group will be relevant. In many such examples the problems of alcohol on the road are mirrored by problems associated with alcohol in the workplace or in social or domestic environments.

Successful programmes will involve:

- education of the population concerning the seriousness of the problem and of the reasons why alcohol is dangerous to the driver, with the aim of changing the attitude of the population to drinking and driving;

- underpinning these attitudes with appropriate enforcement policies and legal sanctions; and

- identification of problem drinkers in whom additional measures may be required.

RECOMMENDATIONS

The World Medical Association urges all National Associations to promote the following principles:

1. Alcohol related road traffic crashes constitute a major preventable public health problem. Public health resources commensurate with its seriousness must be directed to this problem.

2. Detailed prevention measures necessitate a good understanding of the age and social groups involved and the social forces that prevail to create the problem in these groups. Research that details these issues must be undertaken. Where particular social groups are found to be involved, comprehensive strategies must be undertaken to deal with their problem. This may involve limiting the availability of alcohol to that group and ensuring that those involved in the sale of alcoholic beverages share some liability for the consequences of the sale. There must be education aimed at attitudinal change, backed by sanctions if necessary, and attention given to the elimination of alcohol from the workplace.

3. An alcohol related road crash must be seen as one of the inter-related alcohol problems that may affect an individual, the others include work accidents, domestic disharmony and violence, and personal alcoholic disease. The legal and medical treatment of individuals must reflect this.

a) No opportunity to rehabilitate a person who abuses alcohol should ever be lost. Any driver convicted of driving under the influence of alcohol or with excessive blood (or breath) alcohol should be assessed for other alcohol related problems, and where appropriate, entered into a rehabilitation programme.

b) Rehabilitation programmes for such purposes should be publicly funded, in view of the significant risk to the public wellbeing of unresolved alcohol dependence.

4. Education of the population must ensure that the progressive effect of alcohol on both driver skills and the assessment of risks is well understood. The effects of alcohol abuse on health generally must not be forgotten, and there should be a better appreciation by the public of the greater likelihood of medical complications when a drunk person is injured.

a. The primary health message should be that the drinking of alcohol should always be in moderation.

b. The specific message should be that driving should not be undertaken by one who has been drinking.

c. The special problem of adolescent and young adult drivers who drink must be addressed by educational programmes on the effects of alcohol that extend through school years and promote responsible attitudes to drinking and driving. Other issues to do with alcohol should be simultaneously addressed.

5. Doctors should endorse the need for a low legally permissible blood alcohol concentration in drivers, certainly not greater than 50mg/100mi of blood, or comparable breath concentrations.

a) Low legal limits are of limited effect if enforcement is uncertain. National Associations should carefully consider the advisability of insisting:

i) that every driver involved in a significant crash be tested for blood (or breath) alcohol concentrations.

ii) that there be random testing of drivers, either generally, or at those times when research has indicated that alcohol related crashes are particularly likely to occur

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Section VI.—ALCOHOL AND CRIME

Chapter 35

ALCOHOL IN RELATION TO ROAD TRAFFIC

INTRODUCTION

The steadily increasing incidence and severity of road traffic accidents in technically developed countries represent a major public health problem which justifies a very close examination of the factors which influence such accidents occurring. The situation is aggravated by certain changes which have occurred in the pattern of mortality and morbidity arising out of road accidents. Whereas previously the high risk group amongst road users was pedestrians, the distribution has now changed in that far more drivers and passengers are being killed and seriously injured than pedestrians (*Table* 54) with a peak incidence in the

Table 54. PERCENTAGE INCREASE IN ROAD USERS KILLED IN 1970 AS COMPARED WITH 1961 IN EIGHT EUROPEAN COUNTRIES

COUNTRY	ALL ROAD USERS	PEDESTRIANS	PRIVATE CAR USERS	PERCENTAGE INCREASE IN PRIVATE CARS
France	65	54	150	99
Netherlands	59	29	241	306
Belgium	44	29	135	137
Austria	36	33	136	152
West Germany	32	25	116	161
Switzerland	10	21	90	139
Italy	15	19	114	318
U.K.	9	8	86	90

(Source: European Conference of Ministers of Transport (1972) Annex 1 (p. 49) and Table 1 (p. 29))

15–24 years age group of young male drivers. The increasing differential velocity of road traffic accidents, arising out of improvements in vehicle design and highway construction which permit higher speeds, has led to a considerable increase in the number of cases of irreversible damage to the central nervous system and in the number of severe multiple injuries. Improvements in medical techniques of resuscitation have tended to add to the problem by saving the lives of victims who would otherwise have died but who are now resigned to a life of permanent incapacity. This is further aggravated by the greatly increased chances of survival in the younger age groups where the accident risk is greatest. Many of these young drivers survive injuries which would have been fatal to the older age group of drivers.

Although a very large number of experiments have been reported on the effects of alcohol on skills resembling driving and on actual driving performance, conclusive evidence of the effect of alcohol on risk of accident has to depend upon the results of epidemiological studies which will be the subject of the next section in this chapter. Meanwhile, reference is made to a few of the 'laboratory' studies which have been carried out as they help to explain the ways in which alcohol can increase the risk of accident.

In England experiments were carried out on 40 volunteers from the Road Research Laboratory and it was found that the mean error of performance showed an increase of about 16 per cent at blood alcohol concentrations of 80 mg per 100 ml. Decreased accuracy of steering, steering 'wobble', tendency to deviate over to the crown of the road, increase in steering-wheel movement and tracking errors were found to be present and increasingly marked at concentrations of between 10 and 80 mg per 100 ml (Drew *et al.*, 1959).

In the U.S. it was found that deterioration occurred at concentrations as low as 30 mg per 100 ml, and that at 100 mg per 100 ml performance had decreased by 15 per cent. At 150 mg per 100 ml it had deteriorated by some 30 per cent (Loomis and West, 1958). In passing it is interesting to note that none of their subjects showed any deterioration in the standard clinical tests for intoxication between 30 and 90 mg per 100 ml and that only 2 subjects showed even slight impairment of co-ordination between 100 and 170 mg per 100 ml. It was noticed that with increasing concentrations of alcohol the subjects became progressively less able to divide their attention between the road and traffic lights, i.e. the one would be sacrificed for the other.

In Sweden impairment in capacity to drive a car by between 25 and 30 per cent was found at

concentrations as low as 40–50 mg per 100 ml (Bjerver and Goldberg, 1951). In Germany, 24 per cent increase in changes of position of the steering wheel at 100 mg per 100 ml and increases in steering-wheel movement by as much as 35 per cent were noted. These changes were particularly noticeable on long straight stretches of the course (Abele, 1958a, b).

In Canada particular attention has been paid to differences between light, moderate and heavy drinkers. The majority of subjects showed marked impairment at 120 mg per 100 ml. Whereas persons who were both experienced drivers and heavy drinkers were able to compensate to some degree for the effect of alcohol, the ability to do so fell off very rapidly at about 100 mg per 100 ml. At 79 mg per 100 ml the impairment in the various grades of drinker was as follows: light drinkers, 68 per cent; intermediate drinkers, 47 per cent; heavy drinkers, 40 per cent (Coldwell *et al.*, 1958).

The experimental evidence suggests that the most notable effect of alcohol on driving performance is to reduce the capacity to deal with a crisis, and this must be an important factor in causing accidents.

EPIDEMIOLOGICAL STUDIES

There are five well-known studies in which the blood alcohol concentration of drivers involved in accidents has been compared with those of drivers not involved in accidents: three of them in the U.S., one in Canada and one in Czechoslovakia, and they have been the subject of a number of comparable reviews. There are important differences between these surveys, in the samples studied, in the findings which were obtained and in the conclusions which were reached, but all lend support to the thesis that there is a significant over-representation of drivers with blood alcohol concentrations in excess of 80 mg per 100 ml in drivers involved in accidents, and that the degree of over-representation appears to increase rapidly at higher concentrations. Of the five studies only the Grand Rapids survey (Borkenstein *et al.*, 1964) included all accidents which occurred at all times of the day and under all meteorological conditions.

The first of these surveys (Holcomb, 1938) at Evanston was not representative of accidents occurring at all times of day and under all conditions, as the sampling was carried out largely at the times when the heaviest drinking might be expected, e.g. at weekends and particularly at night. The basis of the selection of drivers was not statistically acceptable by today's standards and the samples were relatively small. It remains only to add that it was the first attempt at a controlled survey to establish the relationship of blood alcohol concentration to risk of accident involvement, that the principles adopted in the survey represent the most important advance in research on alcohol and traffic safety in this century, and that one can only marvel that so much was achieved on so small a budget, reputedly as little as $500. The next study to be published was from Toronto (Lucas *et al.*, 1955). It also suffered from the fact that sampling was limited to certain periods of the day (1830–2230 hr) and to accidents involving drivers most likely to have accidents, bias being directed to selecting older vehicles. There followed the survey from Bratislava (Vámosi, 1961). This was limited to the hours of 0600–2000 hr, at sites which were chosen on the basis of traffic density on main roads. All drivers approaching from one direction over scattered periods of about 20 minutes were tested. The accident group included traffic violations and 'incidents' reported by the police as well as collisions. The next study from New York (McCarroll and Haddon, 1962) was limited to fatal accidents, so that the control group was limited to time and places where fatal accidents occurred, and these occurred mainly at nights and particularly during weekends.

Meanwhile, the development of the digital computer had made possible analysis of a wide number of factors which might, or might not, be important in influencing risk of accident involvement, and the next logical step was to utilize the computer in a controlled survey involving many variables. The Grand Rapids survey (Borkenstein *et al.*, 1964) did just this. The introduction of computer analysis has made it possible for a very high degree of certainty to be achieved in determining the risk effect of various factors, and of combinations of factors on risk of accident involvement. However, an immense amount of data is required if such analyses are to be pursued to their logical conclusion. Even with samples as large as those studied in the Grand Rapids survey, anything beyond two factors analysis is not feasible. One complete replication of the applied factorial design with only one case in every cell of the design would have required about 2 million interviews of drivers, both for the accident and for the control group (Sutherland and Borkenstein, 1965). Each case would have to conform to rigid specifications of a specific combination of all nine factors studied. In fact, 13 575 subjects were interviewed. Another problem is that even with the large number of tests carried out in the survey there were, as might have been expected, relatively few cases of drivers in the higher blood alcohol range. As the blood alcohol

concentration increases, the number of cases available for study goes down.

The importance of the Grand Rapids survey is such that it is summarized below in some detail. The purpose of the survey was to investigate the relationship between road accidents and certain factors present in the drivers involved, in particular the blood alcohol concentration (BAC). The basis of the survey was a comparison of these various factors in a group of drivers involved in accidents (accident group) with a group of drivers who had not been involved in accidents (control group), and a statistical assessment of the significance of any over- or under-representation in either group.

Both the accident and the control groups were taken over a period of 1 year, the total numbers involved in the blood alcohol concentration sampling being 5985 (accident) and 7590 (control). An important feature of the survey was the care with which the control group was selected. It represented a fair sample of the entire non-accident driving population and was related to the times and places where accidents normally occur, based on the records of 27 000 accidents which had taken place in the city of Grand Rapids over a period of 3 years. This minimized the effect of any unusual influences, such as unduly early cold weather, which could have occurred in any one year. As weekends fall on different dates over the 3-year period, dates had to be corrected to correspond with days of the week, although some difficulty was experienced with holidays such as Christmas Day and New Year's Day which fall on different days of the week.

The accident sample was based on a round-the-clock schedule and not on specified periods of the day and night, this having been a weak point of some of the previous surveys. As subjects in the control group could not be selected with a probability which was proportional to their exposure, a danger always existed that an unpredictable bias might be introduced, and any systematic bias in sampling would affect the results. Considerable care was taken to avoid this and the correlations between the accident group and the scheduled control sample were remarkably good, the largest differences being 1·9 per cent for months of the year (October), 2·2 per cent for times of day (1800–2100 hr), and 1·7 per cent for days of the week (Saturday).

Grand Rapids is the principal trading centre in West Michigan. The city centre had an area of 42·15 square miles and a population of 201 487. The vehicle registration area (Kent County) had one privately owned car for every 2·5 persons and the accident record of the city was better than the national average for the U.S. The City police force was efficient and there was a good accident recording service. The design of the survey called for four observations at each selected site for the control group. It was found impossible to handle more than two sites in any one hour of the day and there were 68 cases in which adjustments had to be made because more than two sites were scheduled in a 1-hour period. Emergency vehicles, public transport and traffic on a new motorway were excluded from the groups. Hit-and-run accident drivers could not be excluded from the survey and they could not generally be interviewed. There was some doubt whether they were proportionately represented in the control sample.

A trial run was carried out in Bloomington (Indiana), as a result of which certain problems were eliminated before they could affect the main survey. Interviewers were trained by the staff of the Indiana University Institute of Sex Research (Kinsey) who had accumulated much useful experience in interviewing persons on subjects associated with social stigma. Drinking habits, particularly in connection with driving, came into this class. The survey itself was heralded by a press, radio and television campaign in which full details were given, as well as assurances that the information obtained would be treated in complete confidence and not given to the police.

Two vehicles equipped with two-way radio on the police frequency were used by the interviewing team, members of which wore distinctive uniforms. A Grand Rapids police ordinance requires all accidents to be reported to the police irrespective of the amount of damage, and this helped to ensure that few accidents were missed. The accident group was based on 9353 drivers, of which no complete record was made in 2764 cases. These were classified as 'missed', but statistical analysis of some of the variables showed that no bias existed as a result of the 'missed' cases. In one week of the survey interviewing had to be abandoned completely because of exceptionally bad weather, and the team returned to work on the coldest day for 45 years. About 0·5 per cent of sites had to be abandoned because of rush-hour traffic on certain roads which made it dangerous to stop cars.

Single Factor Analysis

Nine variables were selected: blood alcohol concentration (BAC), age, estimated annual mileage, completed years of education, race or nationality, marital status, occupation, reported drinking frequency and sex. Differences in the rates of refusal to supply information were significant; 0·047 in

the accident group as against 0·019 in the control group. The accident-involved drivers were naturally more suspicious, and, as survey data could not be obtained from them until after the police procedure was completed, they were more inclined not to co-operate by the time the survey team could approach them. In many cases the police themselves obtained survey data at accident scenes. Samples of breath for BAC analysis were obtained from 7590 drivers in the control group and 5985 drivers in the accident group. Mylar polythene bags were used and the breath was later analysed in a Breathalyser. Drivers with a BAC below 10 mg per 100 ml were classified as not having taken alcohol. In general the statistical significance of over- or under-representation of variables in the two groups was tested by postulating a null hypothesis and applying a chi-square test at the 0·05 level of significance.

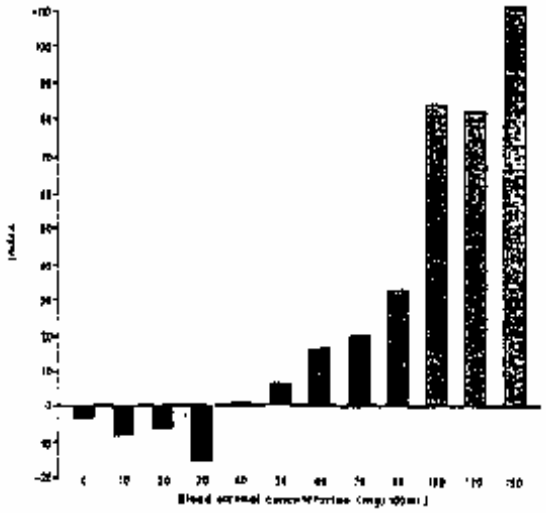

Fig. 303. Index of probability relating to accident involvement of drivers at various blood alcohol concentrations. *(Reproduced by kind permission of the 'New Scientist', 23, 25, 25.)*

Blood Alcohol Concentration (BAC)

Of the accident-involved drivers, 17 per cent had positive BAC as compared with 11 per cent in the control group. No driver in the control group had a concentration in excess of 250 mg per 100 ml, but there were 0·27 per cent in the accident group above this concentration, the highest being 370 mg per 100 ml. The most interesting finding was that at concentrations below 40 mg per 100 ml drivers were under-represented in the accident group, and that they only began to be over-represented as the concentration approached and exceeded 50 mg per 100 ml, after which their over-representation increased extremely rapidly (*Fig.* 303).

An attempt was made to relate BAC to responsibility for accidents and was based on the assumption that the drivers were personally responsible for accidents in which no other vehicle was involved, of which there were 622. It was further assumed that only one of the two drivers involved must have been responsible for each of the remaining multiple-vehicle accidents, and that the innocent driver would exhibit the same characteristics as drivers in the control group. This was a reasonable assumption, but the significance which is attached to it must be qualified accordingly.

The results corresponded broadly with the findings on accident involvement. At 30 mg per 100 ml a driver was one-third less likely to cause an accident than when entirely sober. At 60 mg per 100 ml he was twice as likely to cause an accident; at 100 mg per 100 ml he was 6–7 times more likely, and at 150 mg per 100 ml he was 25 times more likely to cause an accident (*Fig.* 304). Analysis of other variables shows that at the extremes of age (16–25, and over 75 years) drivers were twice as likely to cause accidents, with a peak at 17 years of age.

As might be expected, accident involvement decreases with increasing annual mileage, those driving less than 1000 miles annually having the worst accident experience. Single persons were over-represented in the accident group and married persons under-represented. There was a slight over-representation of females in the accident group and accident experience was found to decrease with increasing number of years of completed education. 'Upper' social classes were under-represented in the accident group, and non-white drivers were over-represented, although much of this was the result of their own over-representation in lower class and incompletely educated groups, so that little significance can be attached to colour in isolation. An interesting and unexpected finding was that drivers who admitted taking alcohol daily were under-represented in the accident group by 40 per cent.

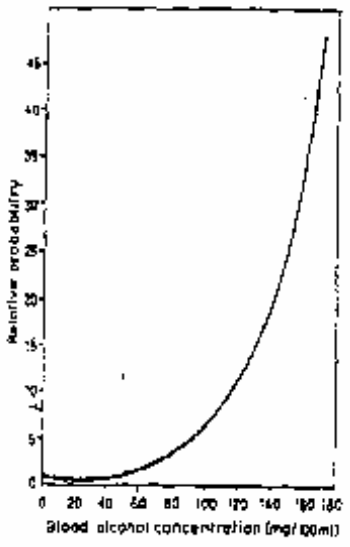

Fig. 104. Relative probability of causing an accident at various blood alcohol concentrations in the driver. (*Reproduced by kind permission of the 'New Scientist'*, 13, 25, 26.)

Multiple-factor Analysis

Even in this massive survey there was not enough data to consider all possible inter-reactions. Within the limited multiple-factor analysis which was statistically acceptable, it is clear that, within each variable, accident experience increases rapidly as the BAC approaches and exceeds 50 mg per 100 ml. Up to 80 mg per 100 ml there is considerable variation in the proportion of accident-involved drivers in the various groups, but above 80 mg per 100 ml these differences disappear. In other words, given enough alcohol all drivers become equally likely to be involved in accidents.

The Nature of Accidents

Other surveys have shown that alcohol is most important in accidents which are the most serious in terms of severe personal injuries or fatality. This survey showed that damage worth £1000 or more was incurred in 3·8 per cent of accidents in which drivers with a BAC in excess of 50 mg per 100 ml were involved, as compared with only 2·1 per cent of accidents involving sober drivers. At 80 mg per 100 ml or over, serious personal injuries or fatalities were caused in 10 per cent of accidents as compared with only 5 per cent of accidents involving sober drivers. For less serious injuries the corresponding figures were 10 and 6 per cent. At 80 mg per 100 ml, drivers were involved in more single vehicle accidents, more expensive and more serious accidents than were sober drivers.

Finally, attempts were made to relate drinking habits to accident involvement. Those who drank most often at parties were found to be over-represented and those who drank most often in public houses under-represented in the accident group. Those who drank most often in the morning appeared twice as often in the accident group as in the control group, although none of them showed a BAC higher than 80 mg per 100 ml. Those drivers who drank most frequently with business contacts were under-represented and those who drank most frequently with casual acquaintances over-represented in the accident group, although again none of the latter showed a concentration in excess of 80 mg per 100 ml. Beer and wine drinkers were over-represented and spirit drinkers under-represented in the accident group, although only one wine drinker was found to have a concentration of over 50 mg per 100 ml. Beer drinkers, on the other hand, were over-represented in the higher BAC classes.

Higher blood alcohol concentrations were found most frequently in those who reported drinking most often, but the worst accident experience was amongst those who admitted to drinking only once a month. Drinking at parties was found to be more likely to result in an accident than drinking elsewhere, although none of the higher BACs was found amongst party drinkers in the control group.

breath test if they had been involved in an accident or a moving traffic offence and were therefore driving more carefully whether or not they had been drinking. The casualty savings following the Act can, however, be shown to have continued over a long period by the chart in *Fig.* 301.

THE FUTURE

Acceptance of the relationship between blood alcohol concentration and risk of accident involvement, based on epidemiological studies, is now widespread. Tests based on clinical examination are no longer relevant and laboratory studies on skills resembling driving, although providing valuable information on the way in which alcohol impairs driving performance, are no longer needed to justify legislation. Future developments are likely to be based on the results of roadside screening surveys using the highly sophisticated and accurate breath methods to which reference is made in Chapter 38. These advanced breath methods are already being incorporated in legislation in some countries and may be expected to revolutionize the legal procedures for dealing with the drinking driver in the future. Meanwhile, the immediate need is for the courts (always backward in accepting evidence based on scientific evidence) to appreciate that alcoholics are likely to repeat alcohol-related offences so long as their alcohol condition remains untreated.

References

ABELE G. (1958a) *Dt. Z. Ges. Gerichtl. Med.* 47, 447, 462.
ABELE G. (1958b) *Dt. Z. Ges. Gerichtl. Med.* 48, 33.
BURGER K. H. (1972) Punishment or treatment for intoxicated drivers. *Blutalkohol* 9, 39.
BURGESS R. M. and GOLDBERG L. (1951) *First International Conference on Alcohol and Road Traffic*, p. 112.
BØ O. (1971) Norwegian countermeasures to driving under the influence of alcohol and other drugs. *Proceedings of the International Symposium on Countermeasures to Driver Behaviour under the influence of Alcohol and other Drugs*. British Medical Association, London, 22–23 September 1971.
BORKENSTEIN R. F., CROWTHER R., SHUMATE R., ZIEL W. B. and ZYLMAN, R. (1964) *The Role of the Drinking Driver in Traffic Accidents*. Indiana University, Dept. of Police Administration.
BRITISH MEDICAL ASSOCIATION (1963) *The Drinking Driver*. London.
BRITISH MEDICAL ASSOCIATION (1974) *Alcohol, Drugs and Driving*. London.
BUSHMAN W. (1969) *Criminological and Psychological Aspects of Drunken Driving*. State University of Groningen.
COLDWELL S. J., PRISER D. W., SMITH H. W., LUCAS G. H. W., ROGERS R. F. and DARROCH J. (1958) *Q. J. Stud. Alcohol* 19, 590.
COUNCIL OF EUROPE (1970) *Structure and Organization of Road Accident Prevention*. Strasbourg.
COUNCIL OF EUROPE (1971) *Explanatory Memorandum on the Resolution on the Deprivation of the Right to Drive a Motor Vehicle*. CESP (71) 1, Annex II.
COUNCIL OF EUROPE (1972) *Accidents in Childhood as a Public Health Problem*. Strasbourg.
COUNCIL OF EUROPE (1973) *Report of Action taken by Member States on Resolution (69) 31 on Road Accident Prevention*. CESP (73) 20. Strasbourg.
DEPARTMENT OF ENVIRONMENT (1971) *Road Accidents in Great Britain in 1971*. London, H.M.S.O.
DEPARTMENT OF TRANSPORTATION (1968) *1966 Alcohol and and Highway Safety Report* Committee on Public Works Paper 90–34, Washington, U.S. Government Printing Office.
DRAPER J. C., COLQUHOUN W. P. and LOSIC M. A. (1959) *Br. Med. J.* 2, 393.
EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT (1967) *Resolution No. 21*, 14 June 1967. Paris.
EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT (1972) *Report on Recent Trends in Road Accidents*. CM (72) 10. Paris.
FARRER P. J. (1973a) Review and evaluation of legislation and evaluation of legislative and enforcement programs related to the use of alcohol and other drugs. *Proceedings of the Conference on Medical, Human and Related Factors Causing Traffic Accidents including Alcohol and Other Drugs*. Ottawa, Traffic Injury Research Foundation of Canada, p. 13.
FARRER P. J. (1973b) The role of legislation and community education in the prevention of alcohol related traffic accidents. *Symposium on Alcohol, Drugs and Traffic Safety, 8th Annual Conference of Canadian Foundation on Alcohol and Drug Dependencies*.
GRUNDAL L. and HAVARD J. D. J. (1968) *Research on the Effects of Alcohol and Drugs on Driver Behaviour*. Paris, OECD.
HOLCOMB R. L. (1938) Alcohol in relation to traffic accidents. *J.A.M.A.* 111, 1076.
JONES T. A. and WEST T. C. (1958) *Q. J. Stud. Alcohol* 19, 30.
LUCAS G. W. H., SALOOJEE Y., MCCOLL J. D., GRIFFITH R. A. and WARD-THOMAS H. (1965) *Second International Conference on Alcohol and Road Traffic*, p. 139. Toronto.
MCCARROLL J. R. and HARPER W. (1962) *J. Chronic Dis.* 15, 811.
MAURER H. (1971) *Proceedings of the Fifth International Conference on Alcohol and Traffic Safety*. Freiburg-im-Breisgau, Section VI, p. 18.
MINISTRY OF TRANSPORT (1965) *Road Safety Legislation 1965–6*. London, H.M.S.O., para. 20.
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION (1972) *Federal Register* 37, 13 602.
NEW ZEALAND ROAD SAFETY COMMITTEE (1972) *Paper C.17*. Wellington, Government Printer, para. 28.
PETTILA A., TENHU M. and KATAJA M. (1971) *Clinical Examination in Cases of Suspected Drunken Driving*. Helsinki, Central Organization for Traffic Safety in Finland.
PHILIP P. (1970) *Alcohol and Road Safety*. Melbourne.
RATHBONE A. (1970) Characteristics of drivers breathalysed in Melbourne in 1967. *Proceedings of the Fifth Conference of Australian Road Research Board*, 5, 309.
RATHBONE A. (1972) *Alcohol in Relation to Road Safety*. Melbourne, Road Research Board, Doc. W.R.U. p. 41.
ROSS H. L. (1973) Law, Science and Accidents. The British Road Safety Act 1967. *J. Legal Studies (Chicago)* 2, 1.
SCHAEFER R. L. (1967) Constitutionality of 'implied consent' statutes. In *The Enforcement of Traffic Laws—Some Current Legal Problems*. University of Michigan, Highway Safety Research Institute, p. 13.
SUTHERLAND M. L. and KOLLEVEEN R. J. (1967) *Proceedings of the Fourth International Conference on Alcohol and Traffic Safety*. Department of Police Administration, Bloomington, Indiana, p. 144.
SWEDISH GOVERNMENT COMMITTEE (1970) *To Restrict Legislation on Driving under the Influence of Alcohol*. SOU 1970: 61. Stockholm, p. 270.
VINGILIS W. (1961) *Traffic Safety Research Review* 4, 3.
WORLD HEALTH ORGANIZATION (1972) *World Health Statistics Report* 25, 756.

2. Alcohol and road safety

Alcohol and driving ability

2.1 Most drivers are imperfectly aware of the ways in which drinking affects them. As alcohol enters the blood-stream it affects the higher centres of the central nervous system, blunting perception, impairing co-ordination and, in particular, diminishing the power of evaluating one's own performance. Being imperfectly aware of his condition, the driver who is so affected does not sufficiently compensate for his slower mental processes, and may take more risks on the road. These results of taking alcohol have been measured both in practical tests, and by studying the accident records of drivers in relation to their drinking.

2.2 There have been a number of experiments in which drivers' performance has been compared when completely sober, and after drinking measured doses of alcohol. One in 1959, using experienced Manchester bus drivers, found for instance that some were willing, after taking only 2 oz of whisky, to attempt to drive through a gap 14 inches narrower than their vehicles. A more extensive study of driving performance after drinking carried out for the Medical Research Council in the same year found that some impairment was detectable at levels as low as 20-30 mg/100 ml, and that for a level of 80 mg/100 ml (which was to be chosen as the legal limit in 1967) the mean deterioration in performance was 12%. Swedish tests in 1950, showing an even more marked deterioration at levels as low as 40 mg/100 ml, were recently confirmed in a demonstration test (mentioned in para 9.6 below): particularly striking was the inability of drivers at these relatively low BACs to avoid hitting unexpected obstacles which were raised in their path, whereas sober drivers were almost all able to do so. The British Medical Association summed up research findings in 1960 by advising that 50 mg/100 ml was the highest BAC that could be accepted as entirely consistent with the safety of other road users, even in the case of hardened drinkers and experienced drivers; they confirmed this advice in 1965, adding that 'there can be very few persons in whom impairment of the ability to drive properly and increased risk of being involved in accidents are not present to a significant extent at blood alcohol concentrations in excess of 80 mg/100 ml.

Blood alcohol and accident risk

2.3 Assessments of performance in experimental conditions were complemented by studies in which the accident involvement of drivers at various BACs was compared with that of control samples, and their drinking habits were noted. The largest of such surveys was conducted by Borkenstein at Grand Rapids, Michigan, in 1962-3. It found that drivers were significantly more likely to be involved in accidents by the time they reached 80 mg/100 ml, and that the curve of accident involvement rose steeply, so that the risk was ten times higher than normal at 150 mg/100 ml and twenty-fold at 200 mg/100 ml.

Although regular drinkers were on average less likely than occasional drinkers to have accidents at lower BACs, they were nevertheless significantly less safe around 80mg/100 ml than the control group. Moreover, young drivers and others who were inexperienced drinkers incurred markedly higher accident risks at levels well below 80 mg/100 ml.

2.4 Recently, detailed investigation of accidents by the Transport and Road Research Laboratory (TRRL) has shown that drinking drivers were at least twice as likely to have been driving too fast, and significantly more likely than average to be involved in ill-judged overtaking.

Drinking and casualties

2.5 Alcohol is thus shown to affect the ability to drive safely. It interacts with other factors, multiplying the chances that accidents will result. In how many accidents in this country is alcohol actually a factor?

2.6 In the TRRL investigations of 2000 accidents, a drinking driver was involved in 25% and his condition was a major factor in 9%. Another indication of the magnitude of this cause of accidents was the 11% reduction in casualties which followed the Road Safety Act 1967. The effect of alcohol on road safety is thrown into sharp relief by the coroners' returns of alcohol levels in drivers who die in accidents in England and Wales. By 1974, over one in three—about 900—drivers had BACs over 80 mg/100 ml when they were killed, and one in ten—about 250—were over 200 mg/100 ml. The vast majority of deaths occur in the hours between 10 pm and 4 am, when the proportion over the legal limit rises to 58% on Monday to Friday, and to 71% on Saturday nights. Thus the relatively small number who drive while intoxicated are a very large factor in road casualties.

The pattern of drinking and driving

2.7 Among those who are convicted of drinking and driving offences or killed as a result of driving while intoxicated, some groups are very heavily represented—they are overwhelmingly male and predominantly young. But it should not be supposed that countermeasures have to reckon with an isolated and atypical group of aberrant drivers. Offenders who appear before the courts come from every social group, even if some are represented more frequently.

2.8 The consumption of alcohol has been increasing in recent years. In some contexts, it may have little effect on road safety; but a growing general use of alcohol is the background against which drinking by drivers causes an increasing number of accidents. Road accidents, however, mostly involve drivers who make a habit of drinking outside the home, and occur mainly at the times when they return (see appendix 2).

2.9 There is a clear link between road accidents and social activities. The level of accidents is high after 10 in the evening, and increases dramatically on Friday and Saturday nights; other evidence shows that alcohol is a factor in far more accidents at these times than during the rest of the day. Those involved are almost all male because men both drive and drink more than women. They are predominantly young, but this is partly because young people go out more than others. The result is that road accidents cause half of all male deaths between

the ages of 15 and 24 and the largest factor in these casualties is alcohol. While their mobile social life and their comparative inexperience both as drinkers and as drivers puts young men particularly at risk, their prominence in the pattern is only an extreme manifestation of widespread social customs in which many others participate.

2.10 The short-term success of the 1967 Act was most clearly shown in its effect on accidents between 10 at night and 4 in the morning. The proportion of drivers killed in accidents between these hours who were over the legal limit was twice the average for the day; following the Act, these casualties were reduced by a third. But recent TRRL accident investigations have found that drivers who had been drinking were involved in 67% of accidents at these hours, and alcohol was a major factor in 30% of these accidents.

2.11 While such reductions can be achieved, this is not the whole story. At least one in ten of those who are disqualified for drinking and driving is likely to repeat the offence. These persistent offenders are likely to be people with drinking problems, and to be unreceptive to both publicity and deterrent measures. Here, as in many other countries, this factor in the situation is now being increasingly recognized, and needs to be dealt with.

Relative risk of crash as a function of BAC