TRANSPORT RESEARCH LABORATORY

TRL REPORT 232

DRINKING AND DRIVING IN GREAT BRITAIN - A REVIEW

by G Maycock

Prepared for: Road Safety Division, Department of Transport
Project: The High Risk Offender Scheme (S219K)

Transport Research Foundation Group of Companies
Transport Research Foundation (a company limited by guarantee) trading as Transport Research Laboratory. Registered in England, Number 3011746.
TRL Limited. Registered in England, Number 3142272. Registered Offices: Old Wokingham Road, Crowthorne, Berkshire, RG45 6AU.

First Published 1997
ISSN 0968-4107

CONTENTS

EXECUTIVE SUMMARY

The Road Safety Act 1967 made it illegal to drive with a blood alcohol concentration of more than 80mg per 100ml and introduced roadside screening for alcohol for the first time. The Transport Act 1981 introduced additional measures to curtail drinking and driving including evidential breath testing and stiffer penalties. The High Risk Offender scheme was introduced at about the same time. Since June 1990, a High Risk Offender (HRO) is defined as: (i) a driver who has been disqualified once for driving with an alcohol level in excess of 2.5 times the legal limit, or (ii) a driver who has been disqualified twice within a 10-year period for any drink-drive offence, or (iii) a driver who has been disqualified for failing to provide a sample for analysis.

Over the years, the publicity about the dangers of drinking and driving have increased the public's awareness of the road safety risks involved, with the result that the extent of drinking and driving has fallen considerably over the last decade or so. This report provides an overview of the research that has been undertaken over the last few years into the patterns of drinking and driving and the characteristics of drinking drivers.

DATA SOURCES

Whether the objective is to monitor trends in drinking and driving or to attempt to understand the nature of the problem, accurate and reliable data are essential. This review considers the various sources of drink-drive data and draws out the strengths and weaknesses of each. The data sources discussed are:

(i) data from Coroners in England and Wales and Procurators Fiscal in Scotland giving blood alcohol levels in road accident fatalities,

(ii) breath test information included in the STATS19 national injury accident database,

(iii) data on drink-drive offences held in the Driver and Vehicle Licensing Agency's driver file,

(iv) data available from police files about prosecutions for drink-drive offences, and,

(v) specific research surveys.

The specific research surveys include the roadside surveys of drinking and driving carried out between 1988 and 1990, a survey of the BrAC levels in accident-involved drivers carried out in 1986, and a survey of the blood alcohol levels in a sample of road users admitted to the John Radcliffe Hospital in Oxford during 1988 and 1989.

VARIATIONS OF DRINKING AND DRIVING OVER TIME

Analysis of STATS19 data indicates that accidents of all severities involving alcohol have fallen considerably faster over the last decade than accidents in general. Thus, fatal accidents involving alcohol have fallen about 2.3 per cent per year faster than fatalities generally, serious accidents at a rate of 4.4 per cent per year faster than all serious accidents, and slight accidents at a rate of 5.3 per cent per year faster than all slight injury accidents. The Coroners data for 1984-94 shows that fatalities involving car drivers and motorcyclists who are over the legal limit have fallen during this decade whilst fatalities involving pedestrians have remained at about the same level for most of the period. The report also gives the patterns of drinking and driving by hour of day, day of week and month of year.

THE CHARACTERISTICS OF DRINKING DRIVERS

Much of the research that has been undertaken in relation to drinking drivers has been aimed at obtaining an understanding of the characteristics of these drivers so that countermeasures may be effectively targeted. This review has examined the evidence available for the identification of drinking drivers in terms of social background, gender, age, and alcohol levels.

The overall picture which emerges from an examination of the social effects is that drivers in the more affluent areas and in occupation groups AB and C1 (managerial, professional and administrative) tend to be under-represented in the drink-drive accidents and in the High Risk Offender scheme, whilst those in less well-off areas and in occupational groups C2 (skilled manual workers) and DE (semi-skilled and unskilled manual workers and the unemployed) tend to be over-represented.

In terms of the actual number of offenders, drinking and driving is male dominated. The roadside survey showed that 13.3 per cent of the male drivers stopped in the survey had been drinking to some extent (BrAC >3µg/100ml) compared to 6.8 per cent of women drivers. Because a higher proportion of men are likely to be driving, of those detected in the roadside surveys driving after drinking some alcohol, 74 per cent were men, and of those driving whilst over the limit, 89 per cent were men. However the ratio of men to women drinking drivers appears to be changing - STATS19 data suggests that the proportion of drinking drivers who are female has increased from 9.8 per cent in 1990 to 12.4 per cent in 1994.

As regards the age distribution of drinking drivers, STATS19 breath test data shows that the peak age for being involved in an accident whilst over the alcohol limit is in the 20-24 year old age group; the distribution declines uniformly with age for older drivers. The age distributions from Coroners data, prosecution data and the DVLA file (High Risk Offenders), show that heavier drinking drivers tend to be rather older than those whose blood alcohol concentration is nearer to the legal limit.

A crucial aspect of classifying drivers into identifiable groups is the amount of alcohol drivers are prepared to drink prior to driving, and their resulting blood or breath alcohol levels. The roadside survey, showed that in the hours surveyed (19.00-02.00 on Thursday, Friday and Saturday nights), 87.5 per cent of drivers were driving with little or no alcohol in their bodies whilst the distribution of BrAC in drivers who had been drinking approximated very closely to a negative exponential. From the Coroners data, the distribution of BAC for drivers killed in road accidents consists of a high peak of drivers who had not been drinking, and a secondary peak for drivers whose BAC was between 200 and 250 mg/100ml at the time of the accident. A comparison of the alcohol distribution observed in the roadside survey with that from accident and fatality data showed that the relative risk of being involved in an accident increases dramatically with the level of alcohol in the body.

The report also gives some results from analyses of the data collected from the police prosecution files and from the DVLA file relating to High Risk Offenders. In the latter case, since the new HRO scheme began in June 1990, 39 per cent of drink-drive offenders in Great Britain, have qualified as an HRO. Just over 7 per cent of HROs are women. The report gives some information about the trends in the numbers of HROs and provides estimates of the re-conviction rates for male HROs.

LOOKING FORWARD

The drink-drive 'problem' has been at the forefront of road safety policy action and research for several decades now, and the reduction in drink-drive accidents documented in this review is clear evidence of the success of the countermeasures which have been implemented over these years. In a concluding section some key issues arising from the findings of the review are discussed.

DRINKING AND DRIVING IN GREAT BRITAIN

ABSTRACT

The Road Safety Act 1967 made it illegal to drive with a blood alcohol concentration of more than 80mg per 100ml and introduced roadside screening for alcohol for the first time. The Transport Act 1981 introduced additional measures to curtail drinking and driving including evidential breath testing and stiffer penalties. The High Risk Offender scheme was introduced at about the same time. This report has attempted to provide an overview of the research that has been undertaken into the patterns of drinking and driving and the characteristics of drinking drivers since these measures were introduced. The report reviews the various sources of drink-drive data, drawing out the strengths and weaknesses of each. The trends in accidents of all severities are examined and the patterns of drinking and driving by hour of day, day of week and month of year illustrated. From a number of studies carried out over the last few years, the review has examined the evidence available for the identification of drinking drivers in terms of social background, gender, and age. A crucial aspect of classifying drivers into identifiable groups is the amount of alcohol drivers are prepared to drink prior to driving, and their resulting blood or breath alcohol levels. The BrAC of BAC distributions from a number of studies are compared, and the relative risk of being involved in an accident is shown to increase substantially with the level of alcohol in the body. The review also gives some results from analyses of the data collected from police prosecution files and from driver licence data for High Risk Offenders. The report concludes with a discussion of a range of issues emerging from the review.

1. INTRODUCTION

It is now over 30 years since the British Medical Association raised the profile of drinking and driving as a key road safety issue in the UK by hosting the 1962 Conference of the International Committee on Alcohol, Drugs and Traffic Safety in London. Following this initiative, screening roadside breath tests were introduced through the Road Safety Act of 1967, and for the first time and it became an offence to drive with a blood alcohol concentration (BAC) of more than 80mg per 100ml. The introduction of the 1967 legislation resulted in an initial 11 per cent reduction in casualties (Sabey, 1989) but the declining impact of these measures in the following years, led to the setting up of the Blennerhasset Committee of Enquiry (DOE, 1976). The Blennerhasset report resulted in increased attention being given to dealing with drinking and driving, and as a result of the Transport Act of 1981, evidential breath testing was introduced and penalties for drinking and driving were increased; the 'High Risk Offender' scheme was initiated at about the same time. These measures actually came into force in May 1983, when it became an offence to drive with a breath alcohol concentration (BrAC) of 35µg/100ml of breath - a level equivalent to the existing blood alcohol level. The introduction of evidential breath testing together with improvements in the reliability of breath testing equipment, greatly increased the ability of the police to enforce the drink-drive limits.

In addition to the effect of legislation and its enforcement, a systematic programme of public education over the last 15 years or so has resulted in most drivers in the UK being well aware of the hazards involved in drinking and driving. Public opinion surveys have shown that when asked to rank the causes of road accidents, the driving public almost always puts drinking and driving at the top of the list (Lennox and Quimby, 1990, Quimby and Glendinning, 1990). Undoubtedly, the strength of the driving public's awareness of the risks of drinking and driving as well as the penalties associated with detected breaches of the law, has been a major factor in the reduction in the number of accidents involving alcohol which has taken place over the last decade or so.

The Transport Research Laboratory has undertaken a considerable amount of research into drinking and driving over the years, and this work together with that of organisations such as the British Institute of Traffic Education Research (BITER), the Portman Group and several market research firms, has resulted in a considerable body of knowledge being available about the characteristics of UK drinking drivers, their offences, and the accidents in which they become involved. This report aims to present an overview of the research relating to drinking and driving which has been undertaken over the last decade or so in the UK, in a way which will help inform future policy on drinking and driving.

The report is structured into 6 sections. Following this introduction, section 2 reviews the availability and reliability of drink-drive data, and section 3 presents the evidence for the decline in drink-drive accidents over the last decade; section 3 also includes an overview of recent data on drinking and driving by time of day, day of week and month of year. Having 'set the scene' in this way, section 4 explores what is known about the characteristics of offenders, and the changes that have taken place over the last few years in the patterns of offending. Section 5 summarises the key results and briefly discusses future possibilities for action. Appendix A discusses the issue of estimating the relative risk of being involved in an accident as a function of alcohol concentration.

2. DATA SOURCES

2.1 INTRODUCTION

Data on drinking and driving in the UK comes from a variety of sources of which the most consistently available are the national personal injury reporting system (STATS19), and data about fatalities received from Coroners in England and Wales and Procurators Fiscal in Scotland. In the following sections of this review, in addition to these continuous data series, data on drinking and driving will be drawn from a variety of other sources.

In order to interpret the results of analyses of the various data sets it is important to be aware of the limitations and the potential biases which may be introduced as a result of the way the data are obtained. It is also important to distinguish between drink-drive data which is derived from drivers involved in accidents and data from other sources in which the drivers are not necessarily accident-involved. Such a distinction is important because the two distributions will be markedly different; in fact, the probability that a driver at a given BAC level becomes involved in a accident will be the product of the probability that the driver has been drinking and the probability that such a driver will be involved in an accident - both these probabilities are critically dependent on the actual blood alcohol level.

This section briefly reviews the sources of drink-drive data and comment on their various strengths and weaknesses.

2.2 CORONERS' DATA

When a road user is killed in an accident the concentration of alcohol in the blood of the casualty will normally be obtained in a postmortem investigation. Coroners in England and Wales and Procurators Fiscal in Scotland are invited to supply the Transport Research Laboratory with details of the BAC levels in those road accident victims who die within 12 hours of the accident. Many - but not all - make such returns. In 1994, a total of 1882 returns were received from Coroners or Procurators Fiscal, the majority of which (86%) included BAC information. These Coroner's returns represent just under 57 per cent of all fatalities aged 16 or over recorded in STATS19, so that in all, the BAC levels are known for just under a half of the fatalities aged 16 or over in the STATS19 database (57% ∞ 0.86). There is some regional variation in these returns; the percentage returns for which BAC levels are available for all road users are respectively, 52 per cent, 55 per cent and 52 per cent from counties in southern, central and northern England, 29 per cent from Wales and 26 per cent from Scotland. Generally speaking, the proportion of returns for *driver* fatalities is rather higher than these overall figures - at least from the Coroners in England - with between 60 and 65 per cent of driver fatalities having the blood alcohol level reported.

This data source, provides the actual levels of BAC at the time of death. However, it needs to be borne in mind that because alcohol will continue to be metabolised in the body until death, the BAC level at the time of the accident of those road users who died some hours (up to 12) after the accident will be underestimated. Quite apart from the fact that Coroners are asked not to provide BAC data for drivers who have died more than 12 hours after an accident even if they had been drinking, it cannot be assumed that the distribution of BAC in fatalities whose blood alcohol concentrations are not reported are the same as those that are. Accordingly, it is not possible to be specific about the extent of any sampling bias in this data. Nevertheless, it seems reasonable to assume that the 'Coroners' data provides a reliable source of time series data about drinking and driving among all road users killed in road accidents in Great Britain, and particularly about those drinking drivers who have themselves been killed in the accident.

Of course, if the focus of interest is the BAC levels of all drivers involved in fatal accidents - not just the BAC levels of those drivers who were themselves killed, then the Coroners data has to be supplemented with data about drivers who survived an accident in which someone else was killed, and about surviving drivers who left the scene of the accident but who would have failed a breath test. Some information about the first of these two additional categories can be obtained from STATS19 as described in the following section.

2.3 STATS19 BREATH TEST DATA

In the case of injury accidents in which the car driver(s) or motorcycle rider survives, STATS19 records whether the driver or rider was subjected to a screening breath test by the roadside, and if tested, whether the test was positive or not. In cases where a breath test was not carried out, the database also records the reason in 4 categories: 'not requested', 'failed to provide', 'not applicable', and 'driver not contacted at the time'. In addition to those cases in which a police officer decides not to breath test, and drivers who simply refuse to give a breath sample, these categories will cover the following situations: accidents (usually the less severe) which have not been attended by the police and for which breath testing will not be an option, surviving drivers/riders who cannot be tested at the time because they are too severely injured, and drivers who legitimately or not, have left the scene of the accident before the police arrive. So, although in principle STATS19 contains data on the involvement of alcohol in accidents, some care is needed in interpreting the data to allow for those classes of driver who, for one reason or another, have not been breath tested. It is important to remember that in the cases where screening breath tests have been administered, STATS19 only records whether the driver passed or failed the test - it does not give the actual level of BrAC or BAC measured. Although the screening breath test is not acceptable for use in evidence, the improvements in breath testing equipment that have taken place over the years has meant that roadside testing is now likely to be very reliable. This fact together with the high screening rates used by most police forces means that STATS19 breath test data may be used with some confidence as an indicator of drinking and driving.

Consider first drivers who leave the scene of an accident before being breath tested. STATS19 shows that between two thirds and four fifths of drivers who leave the scene of the accident are 'hit and run' drivers - between a third and a quarter of whom when traced and breath tested by the police proved to be over the limit. Using this as a guide, Broughton (1993) estimates that in 1991, an additional 23 per cent of serious accidents, and 35 per cent of slight accidents should be included in STATS19 as drink-drive accidents.

As regards the drink-drive accidents that are recorded in STATS19, the national accident database data proves to be a reasonably complete source of pass/fail drink-drive test data for studying ***accident-involved*** drivers, for the following reasons. The amount of breath testing being undertaken by police forces has increased markedly over the years (figures will be given in section 3 below). By analysing breath test data from 50 forces for the years 1985-91, Broughton (1993) has shown that very high detection rates of drinking drivers can be achieved by means of relatively modest rates of breath testing. Broughton estimated an empirical relationship linking the proportion of drink-drive accidents detected (i.e. the number of accidents involving a 'positive' breath test divided by the actual number of accidents in which at least one of the drivers involved was over the legal alcohol limit) and the rate of breath testing (i.e. the number of accidents in which at least one of the drivers was breath tested divided by the total number of accidents). This relationship is shown in Figure 1. Slight accidents involving drinking would appear to be more

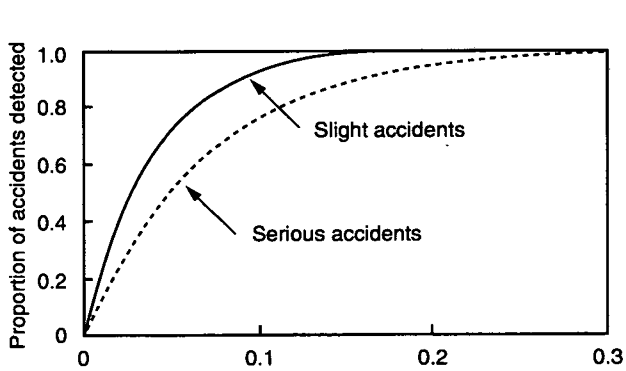

Fig. 1 The relationship between the proportion of drink/drive accidents detected and the test rate

readily detected than serious accidents (see Broughton (1993) for a possible explanation), but the main point illustrated by Figure 1 is that for accidents of all severities, test rates of about 20 per cent (1 in 5 accident-involved drivers tested) will result in the detection of well over 90 per cent of those accidents in which alcohol is involved, and in which the driver has not left the scene - an effect due no doubt to the police officers' skill in targeting drinking drivers.

The fact that the amount of breath testing carried out by the police is now approaching 30 per cent, means that detection rates for accidents involving drinking drivers *in which the driver is available for testing*, are now very high. Broughton estimates that for car drivers in 1991, over 98 per cent of drink-drive accidents (i.e. those in which at least one of the drivers involved has given a positive breath test result) and in which the driver has not left the scene of the accident, will have a breath test result included in STATS19. The methods developed by Broughton have been adopted by the Department of Transport for estimating the number of drink-drive accidents from STATS19 data for publication in Road Accidents in Great Britain (see 3.1).

In summary then, STATS19 data contains a fairly complete source of data relating to whether accident-involved drivers are over the limit for alcohol or not, though it does not include actual values of the breath or blood alcohol levels registered. It is also important to remember that a significant proportion of accident-involved drinking drivers - a quarter to a third - are missing from STATS19, and there is no way of knowing whether the characteristics of these missing drivers are similar to those included in the database or not.

2.4 ROAD SIDE SURVEY DATA

The Coroners data and the STATS19 data, even if these databases were complete, can only provide information about drivers involved in injury accidents. Since most trips will be made without any accident involvement, the number of drink-drive offences (an 'offence' in this context being a trip made when over the legal alcohol limit) will be some multiple of the number of drink-drive accidents. Moreover, if - as the Grand Rapids study suggests (Borkenstein et al, 1974, Allsop, 1966) - the risk of being involved in an accident is far greater at high alcohol levels than at low ones, the value of the multiplier will be higher for drivers who are well over the limit that for those who are close to the limit. Unfortunately, there is no *a priori* way of estimating what these multipliers are likely to be.

In order therefore to obtain an estimate of the actual extent of drink-drive offending and to confirm the relation between accident risk and alcohol levels, it is necessary to measure the BAC or BrAC levels for all drivers making a representative sample of trips. In 1988 random roadside surveys of car drivers were pioneered in Warwickshire and

Sussex to obtain this kind of data. The surveys were extended to Wiltshire in 1989 and to a further 10 counties in 1990 (Sabey et al, 1988, Everest et al, 1990 and Everest et al, 1991). In the 1990 surveys, all drivers driving between the hours of about 7pm in the evening and 2am the next morning on Thursday, Friday and Saturday nights were stopped at 442 selected sites in the 10 areas, and invited to provide a breath sample and to take part in a brief interview. The sites were not announced in advance and were carefully sited so as not to be visible too far ahead so as to prevent drivers re-routing to avoid them.

Some details of the findings of these surveys will be presented later. For the moment it suffices to note that 89 per cent of those over the limit were male, and on average about 1 per cent of drivers were found to be driving over the limit - a figure which varied from just under 0.5 per cent to over 1.6 per cent in the 10 areas surveyed. In terms of the quality of the data obtained in these surveys, it needs to be remembered, that (i) the published results refer to samples taken in the evenings/early mornings of Thursdays, Friday and Saturdays, (ii) some drivers refused to give a breath sample, and (iii) the number of drivers found to be over the legal limit was quite small. In fact, in the 10 counties survey, a total of 138 drivers (1.16%) were found to be over the legal limit and about 0.8 per cent (111 drivers) refused to provide a breath sample.

Although the proportion of drivers refusing to be breath tested in this survey is comparable to the proportion over the limit, there is no reason to believe that refusing drivers were biassed towards high alcohol levels. Most drivers who refused to be tested, refused for reasons unrelated to drinking (such as families in the car and the need to get home). Moreover, drivers were offered an amnesty against prosecution should they be found over the limit (on condition they did not continue to drive), specifically in order to remove any motive drivers might have for not cooperating with the survey on the grounds that they had been drinking. It seems reasonable therefore to assume that the roadside sample is not seriously biased; it is particularly unlikely that the shape of the BAC distribution is unduly distorted by those refusing to provide a breath sample.

Despite the potential difficulties of interpreting the roadside survey findings, they do provide the only 'objective' picture of the alcohol levels in drivers during the 'drinking hours'. The surveys included all drivers - those not over the legal limit as well as those that were - and provide quantified estimates of the BrAC of the drivers tested. In addition, they have given significant insights into the characteristics and drinking habits of drivers who have driven after drinking. No roadside surveys have been carried out since 1990, and no trend information can therefore be inferred from this data source.

2.5 DVLA DRIVER LICENCE FILE

The Driver and Vehicle Licensing Agency maintains a file which contains details of all drivers and riders who have a licence to drive any class of vehicle; the file is indexed by a coded version of the name, sex and date of birth of the licence holder. This file will contain the name and address, postcode, sex and date of birth of licence holders and the class of licence held. In relation to the latter, in addition to the vehicle class or classes for which the licence is valid, the record will show whether the driver has a provisional licence, a full licence or whether the licence has expired or been revoked - with the relevant dates. The driver file will also contain details of any motoring offences committed, including the date of the offence and the sentences imposed.

In the case of drinking and driving offences registered after 1982, the file should contain the actual BAC or BrAC levels recorded if the level exceeded about twice the legal limit (150mg/100ml for blood and 65µg/100ml of breath). In the last two years or so, the courts have been instructed to supply all BAC levels, though there is some uncertainty about how complete this information is. The file will also indicate whether the driver is a 'High Risk Offender'. High risk offenders will be defined and discussed later in the report.

Apart from the concern about the completeness of the blood alcohol information, the main difficulties with using the DVLA file for research purposes relates to the accuracy of the personal information on the file and the completeness of the offence data. Unlike *vehicle* registration, drivers do not have to renew their driving licences each year. The result is that unless drivers (or their relations) advise DVLA of changes to the circumstances of individuals - particularly changes of address or circumstances of the driver (including death) - the data in the driver file will become out of date. With regard to offence data, there is a delay of some months in adding conviction data to the file and in the case of offences other than those involving drinking and driving, offences can be removed from the file after about 4 years or when a new licence is issued following a period of disqualification. Drink-drive offences are retained for a minimum of 11 years (Broughton, 1986).

This means that providing care is taken about the time periods of interest, the DVLA driver file can be used as a reliable source of information about drink-drive offending in general and the High Risk Offenders scheme in particular.

2.6 PROSECUTION DATA

When a driver is prosecuted by the police for a drink-drive offence, details of the offender and the offence are recorded in the relevant police files which are retained for a period of time which can range from a year or two to an indefinite period. In principle, these files contain a great deal of information about drink-drive offences, and a number of studies have been undertaken over the last few years to exploit this data (see the list of unpublished papers given in Section 8). The initial study was a comparison of drink-drive offenders in 10 police force areas over the 1990 and 1991 Christmas periods. In 1991, a systematic attempt was made to access prosecution data over a longer period from files in the Sussex police force area, and the method was subsequently extended to the Lothian and Borders police area and Greater Manchester.

The extraction of the data from the files has to be carried out manually, the data required being transferred from the police files to coding forms designed for the purpose. The data obtained in this way includes, driver name, sex and date of birth (data which provide the link to the DVLA driver file), occupational group of the driver, vehicle type and year letter, location, time and nature of the incident triggering the screening breath test, and the time and result of the evidential breath or blood test. The link with DVLA allows the following information to be added: the status of the driver's licence, details of any convictions with dates and penalties, and alcohol levels if over twice the legal limit. The DVLA record will also show whether the driver was a High Risk Offender or not.

The sample of drivers obtained from police files will be those drink-drive offenders detected by the police and subsequently prosecuted; they are therefore by definition over the legal alcohol limit. It is also important of bear in mind that in tapping prosecution file data there has been some form of selection process involved in choosing the files to be coded. Exactly what the criteria were for this selection process is unclear, but data to be presented later in this report suggests that the resulting selection is biased towards the heavier drinkers. The BrAC distributions will be presented later, but in the prosecution data obtained from the three police force areas, 92 per cent of the offenders were male and 92.5 per cent were drivers of cars or light goods vehicles.

All the drivers in this dataset have attracted the attention of a police officer in one way or another, and quite apart from the issue of file selection, they are unlikely to be a random sample of offenders. In fact, the probability that a drinking driver will be prosecuted will depend on the probability that such an offending driver will be detected, and on the probability of the court being willing to convict - both probabilities are likely to depend on the level of the offender's BAC. The probability of being detected will depend on the police enforcement strategy and the detection skills of individual officers, which may well vary depending on the circumstances in which the offender is apprehended. Table 1 illustrates the point by showing the proportions of offences at 2 levels of BrAC identified in the 3 police force areas as a result of three types of incident: accidents, traffic offences and suspicion of alcohol when driving.

TABLE 1

Percentages of drink-drive offences by reason for administering a breath test three police force areas

	Sussex	Manchester	Lothian/ Borders
	%	%	%
Accidents	16.2	8.6	25.0
Traffic Offences	33.6	24.1	17.6
Suspicion of alcohol	50.2	67.3	57.4

The table shows that the proportion of incidents triggering the breath tests are rather different in the 3 areas; as a triggering event, traffic offences would appear to be less significant in the Lothian region than in the other regions, and suspicion of alcohol more significant as a triggering event in Lothian and Greater Manchester than in Sussex. When considering prosecution data therefore, because of the problems of sampling and the apparent variability of detection probabilities, the interpretation of the BrAC distribution of apprehended offenders in relation to the distribution of drink-drive offences is particularly difficult.

2.7 OTHER SOURCES

In addition to the sources of drink-drive data outlined above, a number of studies have collected data using special purpose surveys. It is not appropriate here to detail all such surveys - especially those concerned with the impact of publicity - but the following studies have played an important part in identifying the characteristics of drinking drivers.

(i) Surveys of offenders. In the mid-1970s a study of male drink-drive offenders in the Birmingham area was carried out as part of the Transport and Road Research Laboratory's drink-drive research programme (Clayton et al, 1980). The study involved the analysis of police records, attendance at court over a 10-month period and interviews with both a group of offenders and a control group. A more recent interview survey of offenders (Research Services Ltd, 1992) has allowed a broad comparison of the changes that have taken place in this group of drinking drivers over the intervening 15 years (Portman Group, 1994). The comparison suggests that with the possible exception of a tendency for offenders to have consumed alcohol at home rather than in a pub, the age and social class structure of this particular group has remained largely unchanged over the years. It is important to note however, that the fact that the structure has not changed, does not mean that the absolute level of offending has remained unchanged - it will be demonstrated in section 3 that in absolute terms, the level of offending has declined considerably over this period.

(ii) Accident-involved drivers. With the cooperation of the Nottinghamshire Constabulary, who at the time had a policy of breath testing the majority of drivers involved in accidents, a survey of accident-involved drivers was carried out over a 12 month period commencing February 1986 (Everest and Jones, 1988). The object of the survey was to obtain information about the characteristics of the drinking drivers and their accidents and to see whether these characteristics differed depending on the recorded breath alcohol concentration.

The study sample was drawn from the 5054 accidents which had occurred in the year; 8853 drivers and riders were involved of whom 7864 had been screened at the roadside for alcohol. The subsequent evidential breath test revealed that 325 of these drivers/riders were over the legal limit. If the assumption is made that those 981 drivers not tested were below the legal limit, the percentage of the accident-involved drivers/riders who were above the legal limit was 3.7 per cent - and this can reasonably be regarded as representative figure for the accident-involved driver population as a whole.

The purpose of the accident-involved driver study was not of course, primarily to estimate the proportion of drivers over the legal limit, but to collect data about the times of accidents, the sex, age and socio-economic class of the drivers and the drinking habits of the drivers. For this purpose, the drivers included in an 'in depth' component of the study were selectively sampled so as to include all the drivers with high alcohol levels. Selected findings will be referred to as appropriate in the sections which follow.

(iii) Hospital data. Road users who have been drinking and who become involved in an accident will often end up in hospital. In 1988 and 1989, a study was undertaken with the cooperation of the medical staff, to investigate the characteristics of road accident casualties (vehicle occupants, motorcyclists and pedestrians) attending the accident and emergency department of the John Radcliffe hospital in Oxford (Everest et al, 1991). Because of the pressures of working in an accident unit, not all the casualties admitted could be breath tested and in some cases, breath testing took place some hours after the accident when it might be expected that a significant amount of alcohol would have been eliminated from the body. In fact, 59 per cent of those admitted were tested, amounting to a sample of just under 2000 casualties of whom 916 were drivers, 496 were passengers, 428 were motorcyclists and 115 were pedestrians. Overall, the casualties were equally split between the sexes though in the case of drivers, 624 were men and 292 women.

The detailed distributions of BrAC will be presented in the following section, but overall, the proportion of drivers in the sample who were over the legal limit for alcohol was 5.9 per cent based on a sample ostensibly covering all times of day and all days of the week. This figure is about 5 times the proportion of drivers found in the roadside surveys to be over the legal limit during the drinking hours. Drinking drivers must then be many times over-represented in hospital casualties compared with their exposure on the roads. Of course, as was pointed out in connection with the roadside surveys, the probability of being involved in an accident is higher for a driver under the influence of alcohol, and is probably higher still for the more serious accidents, so it is to be expected that accident-involved drivers will tend to be concentrated in the higher BrAC ranges.

2.8 SUMMARY

Table 2 summarises these various sources of drink-drive information highlighting the kind of information which is available from each source, and providing summary comments on their strengths and weaknesses.

3. DRINK-DRIVE ACCIDENTS: VARIATIONS OVER TIME

3.1 TRENDS OVER THE LAST DECADE

The most compelling demonstration of the decline of drink-drive accidents over the last decade is that contained in the Department of Transport's publication Road Accidents Great Britain 1994 (RAGB) drawing on analyses reported in earlier editions of RAGB and on the work of Broughton (Broughton, 1993 and 1994).

Using data from RAGB 1994, Figure 2 shows a plot of the trends in fatal, serious and slight drink-drive accidents from 1984 to 1994; the accident series are plotted with negative exponential trends superimposed. These negative exponential trends imply a constant proportional decrease in drink-drive accidents year by year over the period. On this basis, for fatal, serious and slight accidents respectively, the reductions in drink-drive accidents are 7.9%, 10.2% and 5.2% per year. The equivalent rates of decline for all fatal and serious accidents over the same period are 5.6%, 5.8% respectively; in the case of slight accidents there has been an increase of 0.1% per year. It is clear from these figures therefore, that accidents of all severities involving drinking and driving have been declining at considerably higher rates than have accidents in general.

In addition to STATS19, Coroners have, over the years, been providing data on the blood alcohol concentrations of road users who have been killed in accidents which enables the fatality trend shown in Figure 2 to be examined more closely. Figure 3 shows the trends in total fatalities and the corresponding trends for car drivers, motorcyclists and pedestrians killed in accidents for the same decade as shown Figure 2 (1984-1994). The trends are expressed in terms of the proportion of all fatalities for which the blood

TABLE 2

Drink-drive data sources

	Sampling frame	Are Br/BAC levels available?	Comments
Coroners data	A proportion of road users in GB who die as a result of accidents	Yes	A consistent source of information about BAC levels in all road user fatalities over many years. Excludes a relatively high proportion of road users for whom the BAC is not known.
STATS19	Breath test results after accidents involving injury	No	A very high proportion of accident-involved drivers who stay at the scene will be included, but 20 - 35% D/D accidents missing due to drivers leaving the scene.
Roadside surveys	All drivers in the drinking hours - 17.00-02.00 Thursdays, Fridays and Saturdays.	Yes	Apart from refusers, a random sample of on-road drinking behaviour during the peak 'drinking hours'. Not a 24 hour sample. Lunch-time and early evening drinkers will be missing.
DVLA driver file	All licence holders	Yes if over twice the legal limit	Contains D/D offence records going back 11 years. Licence file may not be up to date, and non-D/D offence data can be incomplete.
Prosecution data	Sampled from police files	Yes	Data relates to over the limit drivers apprehended after accidents, traffic offences and on suspicion of alcohol. Sampling dependent on file selection and police targeting. Biased towards the heavier drinkers.
Hospital data (e.g. the Oxford study)	Sample of drivers admitted to a hospital following a road accident.	Yes	Continuous sampling over a period of time. Detailed injury data available in principle. Sampling dependent on availability of medical staff.
Special surveys (e.g. the Notts. study of accident-involved drivers).	As required by the survey design.	Yes - usually	Sampling can in principle be controlled. Sample size limited by cost.

alcohol concentration is known which were over the legal limit.

The thick black line in Figure 3 illustrates the overall declining trend in fatalities over the period, and corresponds to the 'fatal' curve in Figure 2. This overall decline however, conceals the fact that whereas car driver and motorcyclist fatalities have been declining over the decade, accidents involving drinking pedestrians have not. Although accidents involving drinking pedestrians contribute significantly to the road accident 'problem' (Everest, 1992b), this is not a topic which is pursued further in this review. Instead, the review will specifically focus on the drinking driver or rider.

That the accident reductions shown in Figures 2 and 3 have arisen from an actual reductions in the amount of drinking and driving taking place is evident from the trends in breath test results over the same period of time for those drivers involved in accidents. Figure 4 (compiled from Table 2c in RAGB 1994) shows that over the last decade there has been a considerable increase in the percentage of drivers in-

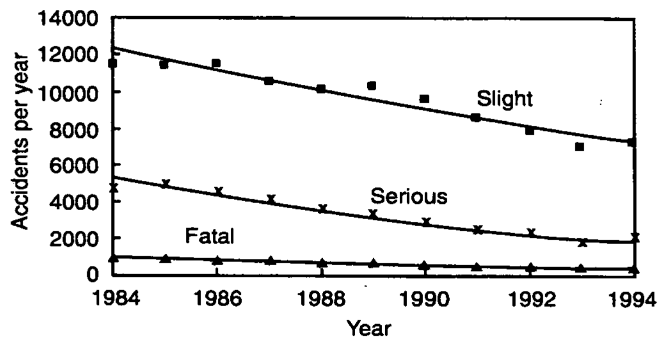

Fig. 2 Drink-drive accident trends 1984-1994

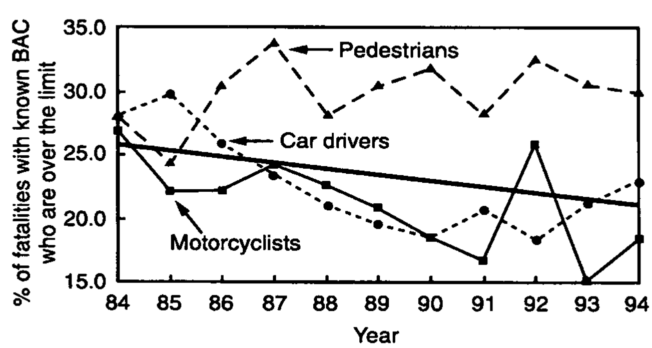

Fig. 3 Trends in fatalities for three road user groups (Coroners data 1984-94)

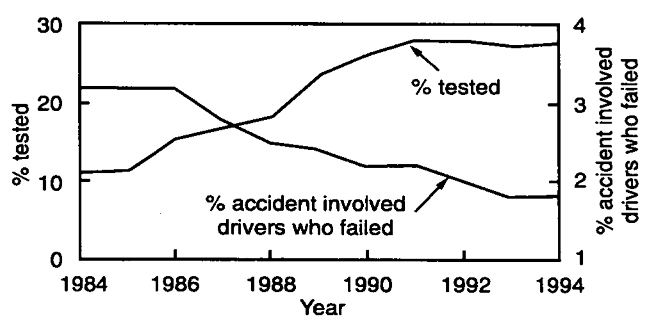

Fig. 4 Accident involved drivers: breath test rates

volved in injury accidents who are breath tested by the police (the rising curve). (Note: from now on, the term 'driver' will be assumed to include riders of 2-wheeled motor vehicles.) This increase in breath testing has been accompanied by a reduction in the percentage of drivers who are found to be over the legal limit for alcohol (the falling curve). Of course, the numbers of drivers breath tested after accidents will depend on the breath testing policy of individual police forces and on the strategies used by individual police offices when targeting offenders, but the trends shown in Figure 4 provide a convincing demonstration that there has been a marked reduction in the actual amount of drinking and driving over the past decade.

With just over 10 years of data since the introduction of evidential breath testing, the falling trends in drinking and driving illustrated in the forgoing paragraphs seem clear and convincing. Needless to say, it has not always been easy to demonstrate the benefits of drink-drive measures, and for completeness two earlier attempts to assess the trends are worthy of mentioned here. Broughton et al (1986) attempted to assess the impact of the provisions of the 1981 Transport Act (including those relating to drinking and driving); they showed that reductions in drink-drive accidents of up to 12 per cent had been achieved at those times of day most affected (10pm-4am). Again at a later stage, by comparing accident trends in the 'drinking hours' to those at other times of day, Broughton (1990) demonstrated that by 1988 the number of drink-drive accidents had fallen to about a half of their 1979 level. Both results are broadly consistent with the trends shown in Figure 2.

3.2 PATTERNS OF DRINKING AND DRIVING IN TIME

It is common knowledge that the prevalence of drinking and driving reaches a peak in the late evenings and early mornings, especially at weekends, when people are returning from pubs and other social engagements. As a background to the identification of the characteristics of people who drink and drive, it is useful to have a general picture of when drinking and driving takes place by hour of day, day of week and month of the year, and to be aware of whether these temporal patterns of drinking and driving have changed over the last decade. Since the only data source which provides such comprehensive coverage over time is the STATS19 database, the distribution of positive breath tests after an accident - as recorded in STATS19 - will be used as an indicator of the patterns of drinking and driving over time.

The distribution of positive breath tests by hour of day, day of week and month of year for the years 1985, 1989 and 1994 are shown in Figures 5-7. Of course, the distribution of positive breath tests is not the same as the distribution of accidents involving drivers over the alcohol limit, still less does it reflect the distribution of drivers who are actually driving whilst over the limit. However, in view of the result reported in 2.3 above, providing the rate at which breath tests are administered by the police hour by hour is greater than 0.15 to 0.2 (which it is for all hours of the day in both 1989 and 1994), and assuming that the distribution of the 23% - 35% of drinking drivers who left the scene of the accident is similar to the majority who remained at the scene, then the distribution of positive breath tests should be reasonable indicator of the distribution of accident-involved drinking drivers.

Figure 5 illustrates the pattern of drinking and driving during the day in terms of the numbers of positive breath tests, showing the expected peak in drinking and driving in the late evening and early mornings. It is clear also from

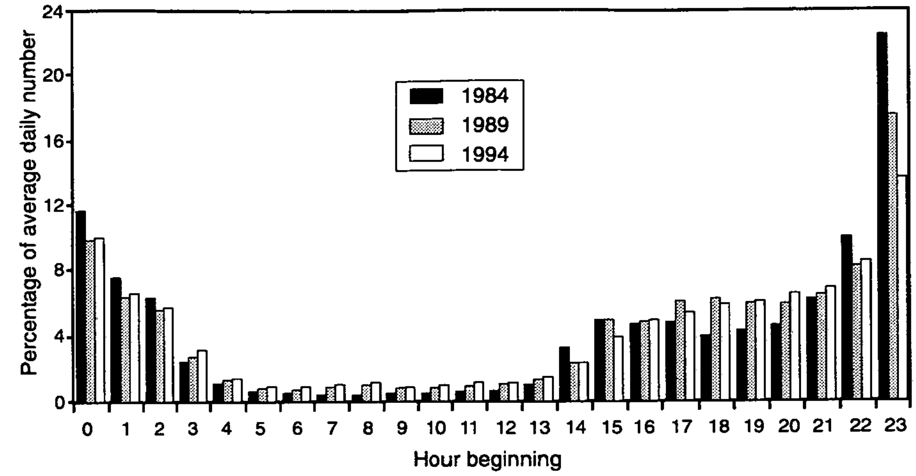

Fig. 5 Distribution of positive breath-tests by hour of day (1984, 1989, 1994)

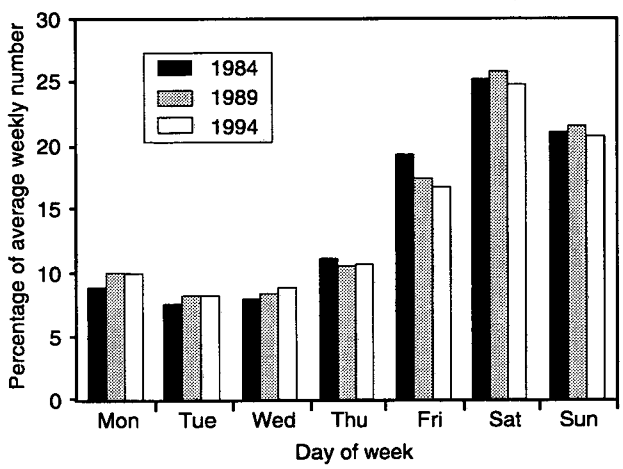

Fig. 6 Distribution of positive breath tests by day of week (1984, 1989, 1994)

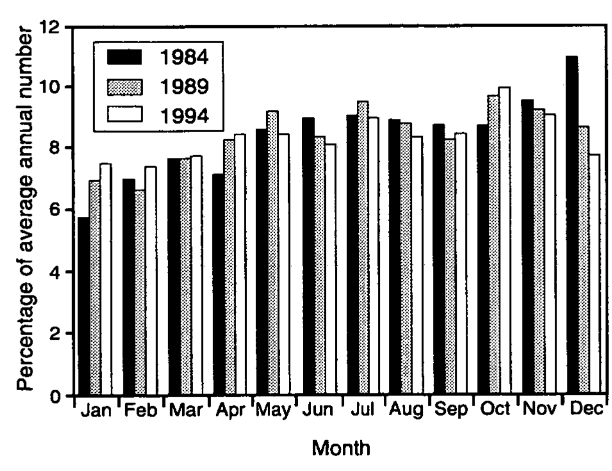

Fig. 7 Distribution of positive breath-tests by month of year (1984, 1989, 1994)

Figure 5 that there is a significant element of drinking in the late afternoon and early evening. The 1984 distribution tends to show rather higher percentages of drinking drivers in the evening and early morning peak at the expense of the numbers detected during the middle of the day. This shift in the distribution may be influenced to some extent by the fact than in 1984 the police test rate for drinking after an accident was high in the drinking hours (between 0.3 and 0.4) but relatively low during the day (0.02 -0.1). However, it is also the case that the law relating to licensing hours was relaxed in 1988 allowing public houses to remain open during the afternoon and more recently to allow them to close later in the evening. The increase in the number of positive breath tests during the evening hours (17.00 to 20.00) may therefore be a reflection of this change in pub opening hours.

Figure 6 illustrates the relative magnitude of the week-end drink-drive effect by showing the patterns of drinking and driving in terms of positive breath tests by day of the week. There is little evidence for a change in this pattern over the last decade.

Figure 7 shows the distribution of drinking and driving by month of the year. Although Christmas is traditionally thought to be a time when drinking and driving reaches a high level, Figure 7 shows that the drinking and driving is an all year round practice with rather lower levels during the cold months of January to March. Once again, it is possible that the relatively low levels of breath testing in 1984 has distorted the distribution slightly in that the December 1984 test rate averaged about 0.17 compared to just over 0.1 for the other months - so that for 1984 the December effect is exaggerated. However, even allowing for this, there remains a consistent reduction in December drinking and driving over the decade which may be due to the impact of the Department of Transport's Christmas drink-drive campaigns - an effect which is apparently reversed in January. In fact, if the December and January figures are combined, there would appear to be little change over the decade.

In summary therefore, Figures 2-4 show the total amount of drinking and driving and the number of accidents involving drinking drivers has been falling consistently over the last decade. In contrast, the evidence from figures 5-7 is that with the exception of some increase in drinking and driving in the evening as a result in changes in the licensing laws and possibly some shift from December to January, the pattern of drinking and driving by hour of day, day of week or month of year has not changed over this period.

It is important to remember that Figures 5-7 represent the proportion of drivers who failed a breath test after an accident - they give no indication of whether or not the distribution of alcohol concentration among drinking drivers differs from period to period. It will be shown in later in this report that the difference in the distribution of alcohol in drivers over the limit between the peak drinking hours as defined in the roadside survey and the non-drinking hours is relatively small - certainly small compared to the variations shown in Figures 5 and 6. This implies that the major difference between drink-drive behaviour from one time period to another is not the distribution of alcohol among drivers who have chosen to drink and drive whilst over the limit, but in the proportion of such 'over the limit' drivers compared to drivers not over the limit. It is actually quite difficult to estimate these proportions, because with the exception of the roadside survey, the relevant data is not available. The roadside surveys (1990) indicate that during the period of that survey (19.00h to 02.00h Thursday to Saturday) the overall proportion of drivers who were over the limit was about 1 per cent. At other times of day, the proportion would be much smaller.

4. CHARACTERISTICS OF DRINKING DRIVERS

4.1 INTRODUCTION

In order to obtain an understanding of the characteristics of drinking drivers and to target drink-drive countermeasures it is important to be able to identify or classify offenders and potential offenders in some meaningful way. Much of the research that has been carried out in the drink-drive field has been aimed at this kind of understanding.

One obvious and basic classification would be in terms of the amount of drinking and driving individual drivers are prepared to engage in as reflected in the resulting alcohol levels detected on the road. In terms of alcohol consumption, four practical categories of driver may be defined - (i) drivers who never drink and drive, (ii) drivers who are prepared to drink and drive but who attempt to control their drinking so as to keep below the legal limit, (iii) drivers who don't feel the need to conform to the legal limit, and (iv) habitual heavy drinking drivers - drivers who regularly drink to excess and drive when well over the limit.

Demographic distinctions often used in research studies to identify drinking drivers are sex, age, and Occupational Group (or Socio-Economic Group). Drinking drivers have also been classified in terms of the kind of drinks they consume (beer, strong beer, wine or spirits) and the location of their drinking (pubs, restaurants, home or a friend's home). Most of these factors need no definition, but for completeness, Table 3 defines the Occupational Groups normally used.

In the RSL study already referred to (Research Services Ltd, 1994), an attempt was made to classify male drink-drive offenders according to the demographic, behavioural and attitudinal factors involved in their offending. Five groups were identified (see the Portman group report, 1994):

(i) Persisters (23% of the sample) - aged 25-44, C2DEs, drinking beer in a pub or at home before offending, often with previous convictions,

(ii) Refuters (19% of the sample) - aged 25-54, C2DEs, beer drinkers who do not believe that drinking and driving is wrong and who think that their driving is unaffected by alcohol,

(iii) Devastated professionals (19% of the sample) - aged 25-44, ABC1s drinking beer or wine/spirits, felt competent as drivers and were shocked at being treated as criminals,

TABLE 3

Definition of Occupational Groups

Occupational Group	Definition
A or B	Senior managerial, professional or administrative
C1	Supervisory and clerical, junior managerial, professional or administrative
C2	Skilled manual workers
D or E	Semi-skilled and unskilled manual workers, casual workers and the unemployed

(iv) Young irresponsibles (17% of the sample) - aged 25-35, C1C2s drinking beer at home before offending, knew that their driving was impaired, but were easily influenced,

(v) One-offs (7% of the sample) - aged 35-54, C1C2DEs who drank beer at home on a special occasion and were reformed by receiving a drink-drive conviction.

Clearly no system will provide a mutually exclusive classification of drinking drivers, and there will be a considerable degree of overlap between alternative ways of attempting to identify who offends. In the following sections a summary of some of the principal factors relevant to the classification of drivers will be presented.

4.2 OCCUPATIONAL GROUP

Table 4 shows the proportions of drinking drivers by Occupational Group and gender obtained for different samples of drivers from five studies: a public opinion survey (1988 data), the roadside surveys (1988-90 data), the Nottinghamshire study of accident-involved drivers (1986 data), hospital data (1988-89), and the data extracted from police prosecution files (1990-92). Unfortunately the Socio-Economic Groups used in the Nottinghamshire accident-involved driver study, though superficially similar to the Occupational Groups used in the other studies, clearly gives a classification which is not comparable.

To interpret the relative involvement of drinking drivers by Occupational Group it is necessary to be able to compare the distribution of drinking drivers to that of all drivers on the roads. The latter distribution is probably somewhere between that obtained for all drivers in the public opinion survey and that of all drivers stopped in the roadside surveys - though of course the latter includes only those drivers driving during the drinking hours on Thursdays, Friday and Saturdays. From these two distributions, the

TABLE 4

Distribution of drinking drivers by sex and Occupational Group for five studies

Survey (Reference) 1	Sample (Date) 2	BrAC level 3	Sample size 4	% Male 5	Occupational group AB (%) 6	C1 (%) 7	C2 (%) 8	DE (%) 9
Public opinion survey (Lennox and Quimby, 1988)	Random - November 1988	All[1]	1521	59%	24	36	25	12
		Admitting to drink-driving	819	65%	31	39	22	8
Roadside survey (Everest et al, 1990)	99% of drivers during the drinking hours at selected sites in 1990	All	13,316	74%	16	32	31	21
		Over the legal limit	129	89%	13	26	40	20
Accident-involved drivers (Everest and Jones, 1988)	Sample structured by BrAC - 1986	All >17µg/100ml + random sample from < 17µg/100ml	1043	95%	3[2]	9[2]	39[2]	49[2]
Hospital data (Everest et al, 1991)	Home interviews of drivers 1988-89	>4µg/100ml	227	68%	1	32	26	28
Police Prosecution data (Everest, 1993)	Drivers prosecuted in 3 police force areas: 1990 - 1992	Over the legal limit[1]	7063	92%	6	18	30	42
		Over twice the legal limit	3554	93%	5	17	30	43

1 The percentages in the Occupational Groups shown do not add up to 100% due to missing data

2 This study used a system of Socio-Economic Groupings which was different from the Occupational Groups used in the other studies.

normal driving population might include about 20 per cent of ABs, 35 per cent of C1s, 30 per cent of C2s, and 15 per cent of DEs. This distribution agrees reasonably well with that obtained in a large driver survey carried out in 1987/88 (Maycock et al, 1991) which included 21 per cent of ABs, 33 per cent of C1s, 30 per cent of C2s and 17 per cent of DEs.

In terms of Occupational Group, the RSL distribution of offenders given in 4.1 above places roughly half of the offenders in the C2DE group with about 10 per cent or so in the AB group and the remainder in the C1 group. Moreover, the RSL classification by Occupational Group is not dissimilar to that found for drivers over the legal limit in the roadside surveys. Thus, the roadside survey result and the RSL classification suggest a rather higher proportion of C2s and DEs among drinking drivers and rather fewer ABs and C1s than there would be in the driving population as a whole.

The hospital data given in Table 4 comes from a relatively small sub-sample who were interviewed in their homes. They represent drivers who when breath tested were found to have been drinking to some extent (BrAC greater than 4µg/100ml) and are thus intermediate between the 'random' driver group and the drink-drive offenders.

The sample of offending drivers drawn from police prosecution files, has a noticeably different distribution by Occupational Group to those found in the other samples. Compared to both the driving population as a whole, and to those found to be over the legal alcohol limit in the roadside surveys, the ABs and C1s are considerably under-represented in the prosecution data, and the C2s and DEs over-represented. It is also noteworthy, that the distribution by Occupational Group in the police prosecution sample, is the same for drivers over the legal limit as for those over twice the legal limit. Bearing in mind that the majority of drivers in this sample are stopped by the police either for a traffic offence or on suspicion of being under the influence of alcohol (rather than by the more objective process of being involved in an accident), the distinctive Occupational Group distribution of this sample seems likely to have arisen from selective police targeting.

The analysis of data from the DVLA file on High Risk Offenders (HROs) also attempted to identify the influence of social background on drink-drive offending. The Occupational Group classification used in the studies reported above was not available for HRO data, and an alternative based on postcodes was used (the ACORN classification). Section 4.6 dealing with High Risk Offenders will briefly review the findings of this approach.

4.3 MALE AND FEMALE DRINKING DRIVERS

Table 4 (column 5) gives the proportion of drivers in the five studies listed who were male. In the Lennox and Quimby postal questionnaire survey, 65 per cent of male respondents and 35 per cent of female respondents admitted to driving after drinking even if only occasionally, though the women in the survey reported drinking fewer units of alcohol than the men. This self-reported sex difference is reasonably consistent with the home interview survey of hospital admissions in which 68 per cent of males were found to have been drinking to some extent (> 4µg BrAC).

In terms of actual drinking and driving 'on the road' as revealed by the roadside surveys (1990), 13.3 per cent of the male drivers stopped in the survey had been drinking to some extent (BrAC >3µg/100ml) compared to 6.8 per cent of women. However, in terms of overall numbers, because men are more likely to be driving than women, of those detected in the survey driving after drinking some alcohol, 74 per cent were men, and of those driving whilst over the limit, 89 per cent were men. Four years later in 1994, data in RAGB (Department of Transport) shows that of the 6149 drivers who failed a breath test after an accident, 87.6 per cent were men - a proportion which is slightly lower than the roadside survey data, whilst four years earlier than the roadside survey in 1986, the Nottinghamshire study found that the proportion of drivers over the limit after an accident who were male, was higher at 95 per cent.

These figures suggest that the proportion of drinking drivers who are male has been falling over the years. This trend has been confirmed by an analysis of STATS19 data since

TABLE 5

Distribution of breath alcohol concentrations for drivers prosecuted in three police force areas (1990-92)

BrAC Levels (µg/100ml)	MALE	FEMALE
36-50	19.3%	16.6
51-65	25.1%	26.6
66-87	29.9%	30.3
Over 87	25.7%	26.4
Total numbers of drivers	5873	511

1990 when the breath test rate for both men and women has exceeded 0.2 and it may be safely assumed (see section 2.3) that the positive breath test figures will provide comparable estimates of the trends in drinking and driving for both sexes. Over the years 1990-94, the annual reduction in positive breath tests for male drivers has averaged 8.3 per cent while the comparable reduction for women is only 2.2 per cent; these differential trends have had the effect of increasing the proportion of drinking drivers who are female from 9.8 per cent in 1990 to 12.4 per cent in 1994. The relatively small annual fall in the numbers of women drink-drive offenders may have arisen because the decline has been offset to some extent by the increase in the number of women drivers on the roads.

Of those drivers who are prosecuted for drinking and driving, 92-93 per cent are men - a figure which is somewhat higher than the roadside survey result (1990) and which probably reflects the finding of the Lennox and Quimby survey that men are heavier drinkers than women and thus more likely to be detected as offenders. Data is also available from a recent analysis of the DVLA file which has illustrated the differences between the current populations of male and female High Risk Offenders (Broughton, 1996); these findings will be reviewed briefly in the later section on HROs.

Apart from giving the overall proportions of male and female drinking drivers, the published reports of the four studies of actual drinking and driving behaviour listed in Table 4 include some information about the distribution of alcohol levels for men and women separately. However, with the exception of the prosecution data, the actual numbers of women drivers involved in the BrAC sub-categories are too small to make any meaningful comparisons possible between the breath alcohol distributions for male and female drivers. As far as the prosecution data is concerned, Table 5 shows the aggregated BrAC distributions for male and female drivers prosecuted in three police force areas - Sussex, Greater Manchester and Lothian - for drink-drive offences. The difference between the male and female distributions shown in Table 5 is not statistically significant (χ_3^2=2.34, p=0.50).

The Coroners data, of course, includes information about the BAC levels of fatalities by age and sex of the driver, and Table 6 shows the distribution of driver fatalities who were over the limit by gender aggregated over the five years 1990-94.

Table 6 shows that the distribution of women who are involved in fatal accidents as drinking drivers, is very similar to that of the men - in fact, the two distributions are not significantly different (χ_5^2=2.1, p=0.84). Although neither the prosecution data nor the Coroners data is representative of the 'on-road' drink-drive population, it seems reasonable in view of the similarity of the distributions shown in Figures 5 and 6, to conclude that the distribution of alcohol in those who exceed the legal limit is much the same for men and women.

4.4 AGE

This section uses data from STATS 19 (accident-involved drivers) and Coroners (fatalities) to examine the age distribution of drivers who are over the legal limit for alcohol; the interactions between age and alcohol concentration (BrAC or BAC levels) will be considered in section 4.5.

Figures 8 and 9 illustrate the age distribution of male and female drivers who are over the legal limit for alcohol taken from these two sources. Figure 8 shows the age distribution of drivers from STATS19 who were involved in injury accidents in 1994 and who failed the screening breath test. In order to compensate for the fact that the age bands are of differing widths (3, 5 and 10 years), Figure 8 presents the percentages of drivers *per year of age* - for example, the percentage plotted in the figure for the 17-19 year old group is the percentage of all drivers in this group divided by 3 (years); the 70+ band is arbitrarily assumed to have a bandwidth of 10 years. In considering this figure it should be remembered that the STATS19 data will underestimate the total number of drink-drive accidents by up to a third for the reasons given earlier - though this omission is unlikely to influence the age distribution greatly.

TABLE 6

Distribution of blood alcohol concentrations for drivers killed in accidents over the legal limit (1990-94)

BAC Levels (mg/100ml)	MALE	FEMALE
81-120	16.3%	14.3%
121-160	21.4%	15.9%
161-200	23.5%	28.6%
201-240	17.8%	20.6%
241-320	16.5%	17.5%
320-400	4.4	3.2
Total numbers of drivers	667	63

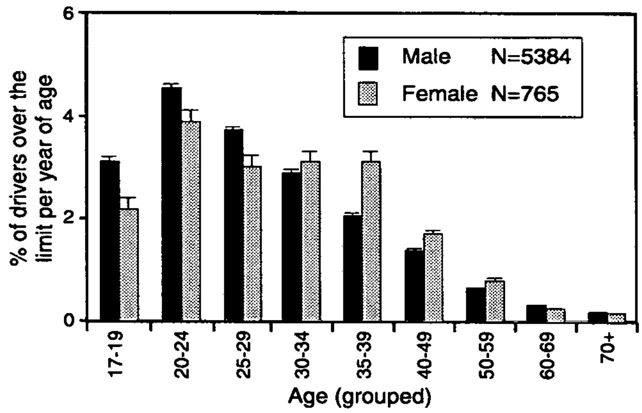

Fig. 8 The age distribution of accident-involved drivers who failed the breath test - by gender (STATS19 data 1994)

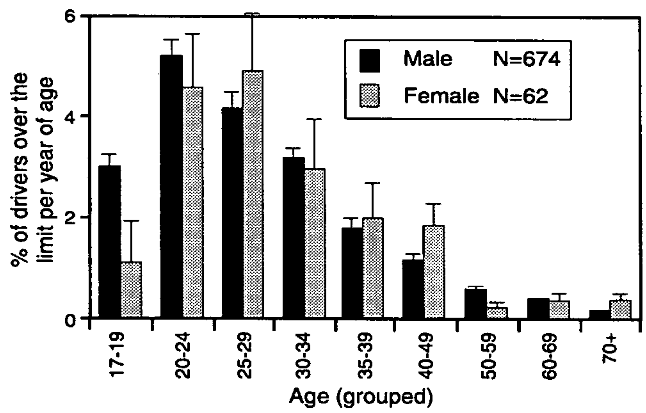

Fig. 9 The age distribution of drivers killed in accidents over the legal limit - by gender (Coroner's data 1990-94)

Figure 8 shows that for male drivers, the peak age group for drinking and driving is 20-24 with the younger drivers offending rather less and the amount of offending declining steadily with age for the older age groups. The difference between the sexes in the STATS19 data illustrated in Figure 8 is significant, as is clear from the small error bars shown in the figure (χ_8^2=43.9, p<0.001). In the case of accident-involved drinking and driving therefore, whereas the age distribution of male drivers is quite sharply peaked in the 20-24 age band, the distribution for women drinking drivers is rather broader so that the women drivers are somewhat older on average.

Figure 9 shows the corresponding age distributions for male and female drivers who are killed in accidents whilst over the legal limit for alcohol (Coroners data, 1990-94). The figures show that the age distributions of male and female drinking drivers involved in all injury accidents (Figure 8) and in fatalities (Figure 9) are very similar. In fact, there is no statistically significant difference between the Coroners data (male drivers) and the STATS19 data (χ_8^2=10.21, p=0.25), nor between the male and female age distributions from the Coroners data (χ_8^2=8.68, p=0.37). The lack of statistical significance in the latter case is undoubtedly due to the small numbers of female fatalities rather than the absence of a real difference.

Clearly, the number of drink-drive accidents in any age band is likely to depend on the number of drivers of that age on the road, their exposure to the risk of having an accident of any kind and their individual accident liabilities - all of which will vary with age. For example, fewer drink-drive accidents are to be expected in the youngest age band because there will be fewer licensed drivers in the 16-19 age band. Similarly, fewer drink-drive accidents might be expected in the older age bands because these drivers will be driving fewer miles annually than drivers in the mid-age bands. Moreover the expected number of accidents of all kinds drivers will have each year will be high for the younger drivers and fall monotonically with increasing age (Maycock et al, 1991). In order to identify 'problem' drinking drivers therefore, it seems desirable to attempt to relate the number of drink-drive accidents in a specific age group to some measure of exposure to the risk of accidents in general for that particular group. A number of 'rates' seem in principle to be possible. The simplest would be to estimate the number of accidents per licensed driver within a particular age group - though this would take no account of the different mileages covered by drivers of different ages. Conventionally, correction for exposure is attempted by estimating the number of accident per 100 million miles - though there are problems with this approach due to the fact that accidents are not proportional to mileage (Maycock et al, 1991). For the present purpose, it seems more appropriate to calculate the 'relative risk' of being involved in a drink-drive accident as the number of drink-drive accidents per 1000 injury accidents.

Accordingly, the solid line in Figure 10 shows the relative risk by age (both sexes combined), estimated as the number of drivers in a particular age group who failed a breath test divided by the total number of accident involvements for that age group (RAGB, 1994, Department of Transport). The unadjusted distribution of drink-drive accidents per

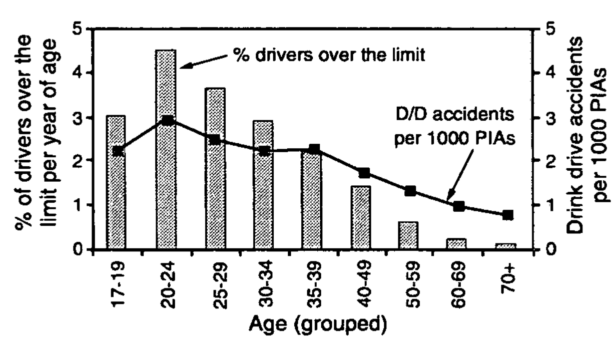

Fig. 10 Drink-drive accidents per year of age compared to an exposure adjusted rate (male and female combined - STATS19,1994)

year of age (the vertical bars) is shown for comparison. It will be seen that compared with the distribution by year of age, the use of injury accidents as a measure of exposure to risk has had the effect of reducing the variation between the age groups. In particular, the difference between the first two age groups (17-19 and 20-24) is smaller in terms of relative risk, due to the fact that although the younger drivers have higher accident liabilities, there are fewer of them and they drive fewer miles annually than their older counterparts. Over 40 years of age, a driver's risk of involvement in a drink-drive accident relative to their involvement in accidents in general, declines with age, though not nearly as rapidly as the distribution of drink-drive accidents by year of age. This is presumably because older drivers drive rather fewer miles and have lower accident liabilities than younger drivers, but have relatively more accidents involving alcohol than the numbers by year of age would suggest.

In view of the figures in Figures 8-10, it is perhaps surprising, that in the RSL classification of offender types, all the age groups start at 25. In terms of sheer accident numbers and relative risk, the 20-24 would seem to be the highest priority as a target group with both younger drivers and those in the 25-40 year old group being not far behind.

Data from police files in the three areas studied (Sussex, Greater Manchester and Lothian) also contain age information relevant to drinking drivers - in this case those who have been detected and prosecuted by the police for a variety of reasons. These distributions will be illustrated in section 4.5.5 in the context of blood alcohol levels.

Analysis of offence data from the DVLA file can also provide age and sex distributions for both 'ordinary' offenders (those offending for the first time) and for High Risk Offenders. These distributions, which generally confirm the findings already given in this section, will be considered later in the context of High Risk Offenders (HROs).

4.5 LEVELS OF ALCOHOL

4.5.1 Introduction

A crucial aspect of classifying drivers into identifiable groups is the amount of alcohol drivers are prepared to drink prior to driving, and their resulting blood or breath alcohol levels. Tables 5 and 6 have already given some distributions by alcohol level for drivers over the limit. This section will examine these distributions in greater detail, including interactions with age.

Non-drinking drivers will obviously have very low levels of alcohol in their bodies; because there is a possibility of some alcohol being normally present in the body, the usual cut-off for a 'negative' alcohol result is taken to be 3 or 4µg of alcohol per 100ml of breath or a BAC of 9mg per 100ml. Coroners returns distinguish fatalities with a zero BAC level as distinct from those with some alcohol in their bodies, and the actual blood alcohol concentrations for the latter are reported at levels ranging from 1 to 999mg of alcohol per 100ml of blood. Drinkers who are basically law abiding could be expected to have BrACs (or BACs) up to the legal limit, whilst those with no such scruples and drivers with an alcohol problem will be found with BrAC levels well above the limit. An issue of some importance is the question: does the breath or blood alcohol distributions found among drivers help in any meaningful way to classify them into identifiable groups, or are we dealing with a continuum as far as BAC or BrAC levels are concerned?

To explore the distribution of alcohol in drivers, four sources of information will be considered in this section. The roadside surveys will give a picture of the distribution of BrACs for those drivers who gave a breath sample in this survey - i.e. 99 per cent of the drivers stopped during the drinking hours (19.00h to 02.00h on Thursdays, Fridays and Saturdays) at selected sites. Since the sample was drawn during the drinking hours, it will over-sample drinking drivers compared to a continuous survey. The earlier survey of accident-involved drivers (1986) and the hospital sample (1988-89) were both effectively continuous samples in time, and both relate to road accident casualties. The most comprehensive sample covering both time and location is the Coroners data - a survey which also has the advantage of covering many past years - but it relates only to road users killed in accidents. High risk offenders form a separate legally defined category and will be considered separately in section 4.6.

4.5.2 The Roadside Surveys

First consider the roadside survey results. Although it is clear that the BrAC distributions varied significantly from one area of the country to another (Everest et al, 1991) there is no reason to believe that the earlier surveys (1988 and 1989) are atypical compared with the later ones, so for the present purpose data from all the surveys will be combined to represent a 'national average'. Table 7 shows the distribution of breath alcohol concentrations obtained in the roadside surveys broken down by urban and rural areas. There is little difference in the average distributions for urban and rural areas - in fact the distributions for drivers over the limit for these two areas are not statistically different (χ_4^2=3.18, p=0.53).

Figure 11 shows the distribution of drivers in the combined roadside survey dataset (Table 7) plotted on a logarithmic scale and normalised as the number of drivers per µg/100ml BrAC - the error bars are 95% confidence intervals. The width of the band and the band mid-point for the 'over 95µg/100ml BrAC' point (the open circle in the Figure) cannot be easily determined from the roadside survey data - an arbitrary (but reasonable) value of 45µg/100ml BrAC has been used for the bandwidth of this

TABLE 7

Roadside Surveys: Distribution of breath alcohol concentration for car drivers.

Area type	Total Number	Below the legal limit			Above the legal limit				
		0-2 %	3-17 %	18-35 %	36-50 %	51-65 %	66-80 %	81-95 %	Over 95 %
Urban	10106	87.2	9.2	2.3	0.72	0.33	0.14	0.05	0.08
Rural	6816	88.0	8.6	2.4	0.54	0.31	0.09	0.01	0.03
All sites	19337	87.5	9.0	2.3	0.65	0.32	0.12	0.04	0.06
Numbers for all sites combined		16922	1733	453	126	62	23	7	11

point. It will be seen from Figure 11 that the roadside survey values fall very close to the regression line given in the figure, and indicate that for those drivers who have been drinking, the BrAC distribution is very close to being negative exponential in form. However, the lowest and the highest points in Figure 11 would appear to be departures from this simple distribution. As has already been pointed out, the exact position of the highest point plotted in the figure is difficult to determine with any accuracy, but as the Coroners data will show, there is every reason to believe that this point does represent a group of high BrAC drivers who because of their high alcohol levels and the consequent risk of injury, are over-represented in the fatality data. As Table 7 shows, the main contributor to this elevated level in the roadside survey comes from a few drivers in the urban areas with BrACs over 3 times the legal limit.

The other important departure in Figure 11 from the negative exponential distribution, is the point which corresponds to drivers with BrAC levels less than 3µg/100ml; there are far more drivers in the low and zero BrAC category that would be expected by simply extrapolating

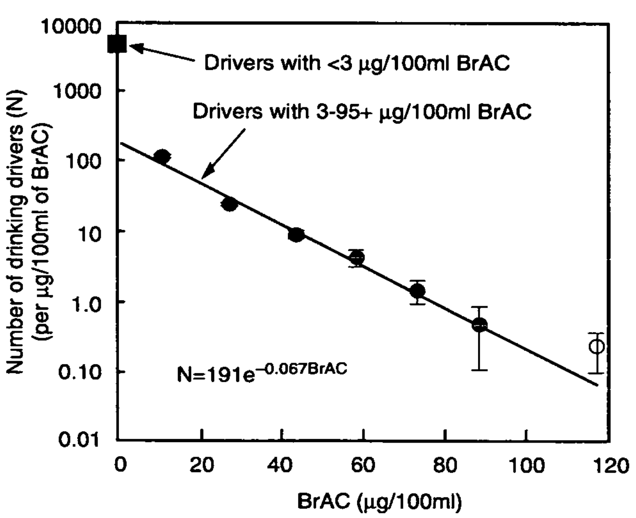

Fig. 11 Roadside surveys: Distribution of BrAc

the drink-drive population to zero BrAC. This effect no doubt arises from the fact that the population of drivers on the road during the roadside survey 'drinking hours' consists of at least two different groups - drivers who are alcohol free, and who represent about 85 per cent of the population, and the drinking drivers (all levels) who make up the remaining 15 per cent; of these drinking drivers, just over 1.5 per cent were over the limit. These figures relate to the roadside survey period, which was carried out during the heaviest drinking periods of the week. The proportion of drinking drivers averaged over a full week, would be much smaller.

4.5.3 Accident-involved drivers

Table 8 compares the BrAC distribution obtained in the roadside surveys for drivers who are over half the legal limit (i.e. drivers with BrAC levels over 18µg/100ml), with those obtained in the accident-involved driver study and in the sample admitted to the John Radcliffe Hospital in Oxford. The accident-involved driver study included about 10 per cent of motorcycle riders and the data for the two road user groups was not available separately. On the other hand, in the case of the hospital data, the distribution of drivers and riders was available separately and both distributions are given in the Table.

Consider first the BrAC distributions for car drivers and motorcyclists given in Table 8 for hospital admissions (male and female drivers combined). The motorcyclists would appear to have rather lower BrAC levels than the drivers, and this difference approaches significance (χ_5^2=10.8, p=0.06). However, since the accident-involved drivers study also included some motorcyclists, it seemed appropriate to combine the hospital data for drivers and motorcyclists. When this was done, the difference between the distributions for the hospital and the accident-involved data was not statistically significant (χ_5^2=0.85, p=0.97). The final row in the Table thus combines the data for drivers and riders from both studies. Although strictly speaking it is inappropriate to compare the mixture of drivers and motorcyclists from the accident-involved driver studies

TABLE 8

Distribution of Breath Alcohol Concentration (mg/100ml)
for accident-involved drivers who are over half the legal limit.

	Total Number	Drivers in a specific BrAC band as a percentage of those over half the legal limit					
		18-35	36-50	51-65	66-80	81-95	Over 95
Roadside surveys (Table 7)							
Drivers	682	66.4	18.5	9.1	3.4	1.0	1.6
Accident-involved Drivers (1986)							
Drivers and riders	264	28.4	22.0	18.6	12.9	9.8	8.3
Hospital admissions (1988-89)							
Drivers	73	26.0	21.9	11.0	15.1	13.7	12.3
Motorcyclists	41	22.0	29.3	29.3	12.2	4.9	2.4
Accident-involved drivers and hospital admissions combined							
Drivers and riders	378	27.2	22.8	18.3	13.2	10.1	8.5

with the drivers in the roadside survey, the combined data will only contain about 15 per cent of motorcyclists, so that the comparison will give a reasonable indication of how the two distributions compare.

There is a clear difference between the distribution of BrAC for the accident-involved drivers (the final row of Table 8) and the drivers surveyed at the roadside (the first row of Table 8) which is illustrated in the bars shown in Figure 12. Whereas the roadside survey distribution, as we have seen, closely approximates to a negative exponential, the distribution of BrAC among accident-involved drivers is almost linear. In fact, Appendix A shows that a negative exponential fits this distribution adequately also.

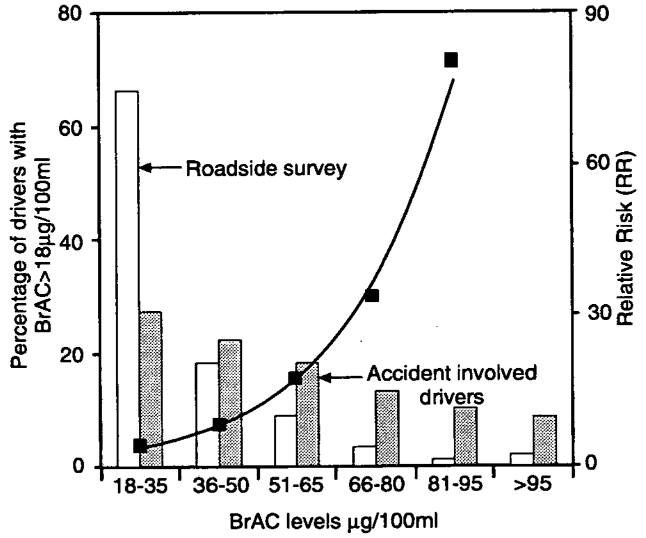

Fig. 12 BrAC distributions: roadside survey and accident involved driver data

These data provide an opportunity of assessing the relative risk of being accident-involved if under the influence of alcohol. In order to estimate the relative risk it is first necessary to test the assumption that the distribution of BrAC obtained during the roadside surveys for drivers who are drinking and driving to the extent that their BrAC levels are over half the legal limit (on which the subsequent estimates are based), is reasonably representative of a full 24 hour distribution. The only data readily available which can provide alcohol distributions for different times of day is the Coroners data. Using Coroners data, Table 9 compares the distribution of drivers who were over half the legal limit during the 'peak' drinking hours used in the roadside surveys (1988-1990) - 19.00h to 02.00h on Thursdays, Fridays and Saturdays - with the distribution for all other hours combined. It will be seen that the distributions are quite similar, in fact, they are not statistically different (χ_5^2=1.24, p=0.94)

Accepting then that for drivers over half the legal limit the roadside survey distribution is reasonably representative of the 24-hour distribution, and that the motorcyclists in the accident-involved study data are not excessively distorting the distributions from those studies, the ratio of the two distributions shown in Figure 12 will reflect the relative risks of being involved in an accident at a given level of BrAC. The risk curve shown is intended to be illustrative only. It has been calculated by assuming that it is a positive exponential function, and the parameters of this function have been estimated by regressing the ratios of the two distributions and scaling the resulting expression so that the relative risk is 1 at the zero BrAC level. The process is discussed in Appendix A with reference to the more conventional approach used in the re-analysis of the Grand

TABLE 9

Distribution of blood alcohol concentrations in fatalities 1988-90 by 'drinking' and 'non-drinking hours' as defined in the roadside survey.

	Total number killed/ number with known BAC	Drivers in a specific BAC band as a percentage of those over half the legal limit					
		41-80	850-114	115-149	150-183	184-217	>217
Peak drinking hours	712/474	15.6%	11.5%	14.8%	15.1%	15.6%	27.4%
All other times	3415/2150	13.0%	10.6%	15.7%	14.4%	17.1%	29.2%
Total Numbers		89	68	92	90	98	170

Rapids data (Allsop, 1966). The solid squares in Figure 12 are the values of the scaled 'Relative Risk' at the mid-points of the BrAC bands from which the relative risk curve has been estimated. It is clear that the relative risk increases exponentially with the level of alcohol in the blood. According to the risk curve shown in Figure 12, the average risk of being involved in an accident at alcohol levels of half the legal limit, the legal limit and twice the legal limit are respectively 2.4, 5.6 and 31 times the risk encountered by a driver who has not been drinking.

4.5.4 Drivers killed in road accidents

Table 10 shows the distribution of blood alcohol concentrations by age group for those drivers who were killed in road accidents in the five years 1990-94.

The distribution of fatalities for all ages for the five years 1990-94 is shown in Figure 13 as the lower solid line. The distribution is plotted on a log scale to match the roadside survey distribution shown in Figure 11, and for comparison, the corresponding distribution 10 years ago (1980-84) is also shown (the upper broken line). The two 'open' points plotted at BAC = 440 mg/100ml correspond to the BAC band 400-999 mg/100ml. The effective width of this band

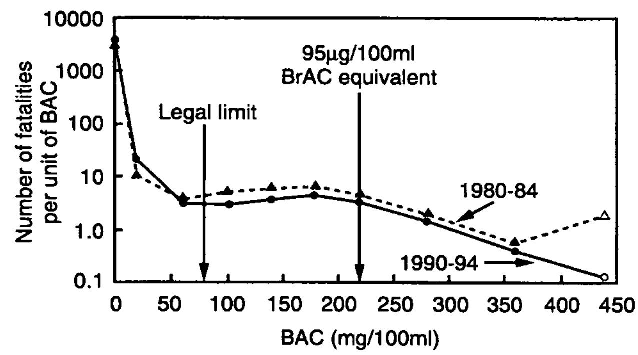

Fig. 13 Coroners data: Distribution by BAC for drivers of all ages

is not easy to determine and a value of 80mg/100ml has been arbitrarily assumed.

It is clear from Figure 13 that the distributions of fatalities are not simple negative exponentials. As with the roadside survey data, there is a high 'peak' at zero BAC corresponding to the population of non-drinkers, but in addition there is a clear secondary peak between 150 and 200 mg/100ml BAC. Moreover, as indicated in the Figure, the range of

TABLE 10

Distribution of blood alcohol concentrations in car driver fatalities 1990-94

Age Group	Total number killed/ number with known BAC	Drivers in a specific BAC band as a percentage of all drivers with known BAC									
		0	1-40	41-80	81-120	121-160	161-200	201-240	241-320	321-400	>400
17-24	1752/1139	54.5	21.7	2.9	4.7	5.5	5.8	4.0	1.2	0.44	0.09
25-34	1377/890	46.1	19.9	3.8	3.8	6.5	7.1	5.7	5.7	1.0	0.34
35 +	2862/1600	61.4	22.0	3.0	1.8	1.9	2.9	2.2	3.4	1.1	0.44
All ages	5991/3629	55.5	21.1	3.2	3.2	4.2	4.8	3.6	3.3	0.85	0.30
Number		2013	765	115	117	151	175	132	119	31	11

BAC values for which the distribution can be reasonably determined, extends to much higher levels of alcohol concentration than was possible from the roadside survey (indicated by the 'flag' at 95µg/100ml in the Figure). The reason for this is that the probability of being involved in a fatal accident increases dramatically with blood alcohol levels. Figure 13 therefore, though it only relates to just over 3,600 fatalities compared to the 19,000 or so drivers observed in the roadside surveys, provides a considerably 'magnified' view of the distribution of drinking drivers in the higher BAC ranges. Comparing the plots for 1980-84 and 1990-94 in Figure 13 shows that the number of drivers killed in road accidents with blood alcohol levels below the legal limit has increased over the decade, whilst the number over the limit has decreased - in line with the falling number of drink-drive fatalities (Figure 2).

The relative risk of being involved in a fatal accident as a function of BAC can be estimated in a similar way to that described earlier for the accident-involved drivers. In this case, the roadside survey distribution (up to the 81-95µg/100ml BrAC category) has been compared with the corresponding ranges of BAC for Coroners data extracted for periods corresponding to those used in the roadside survey (19.00h - 02.00h, Thursdays, Fridays and Saturdays, 1988-1990). The ratio of these two distributions has been scaled so that the relative risk is 1 at zero BAC (see Appendix A). The result is shown in terms of BrAC equivalents in Figure 14. It will be seen that as with the accident curve shown in Figure 12, the relative risk increases dramatically with blood alcohol level. Moreover, although the actual relative risk values should not be regarded as definitive, the risk of being killed is almost an order of magnitude larger than the risk of being involved in an accident - as a comparison of the right hand scales in Figures 12 and 14 will show. With scaling factors as great as those suggested by Figure 14, it is perhaps not surprising that in a roadside survey, the

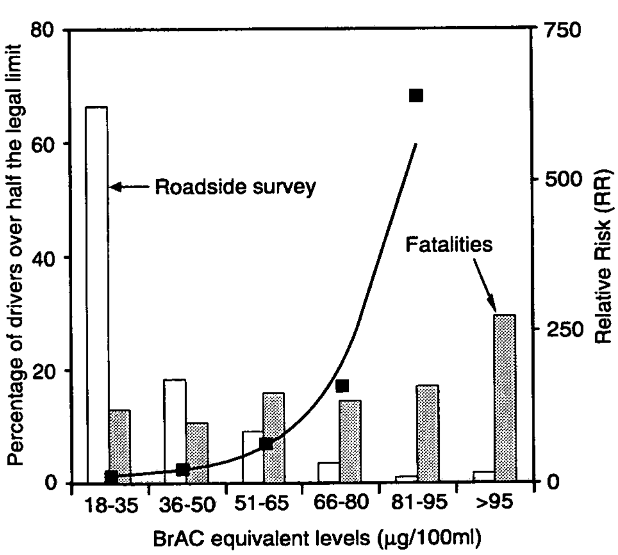

Fig. 14 Alcohol distributions: roadside survey and fatality data (1988-1990)

likelihood of sampling a driver with a BAC in the range above twice or three times the legal limit is very low - and yet, such drivers run high risks of becoming involved in an accident often with fatal consequences.

Table 10, as well as giving the 1990-94 BAC distribution for all ages, gives the distribution for three age groups - 17-24, 25-34, and 35 and over. The proportion of fatalities with blood alcohol concentrations less than half the legal limit (<40mg/100ml) for these age groups in the last five years are respectively 75.2, 66.0 and 83.4 per cent. Thus, in relation to fatalities, the age group in which the highest proportion of drivers have been killed with BACs over half the legal limit is the 25-34 year olds - rather older drivers than those failing a breath test after an accident (Figure 8 - section 4.4). To explore the BAC distribution by age group further, Figure 15 shows the distribution of fatalities who were over half the legal alcohol limit by age group.

Although the distributions shown in Figure 15 are not particularly well defined, it can be seen that the youngest group peaks in the 161-200 mg/100ml band and then declines quite sharply, whilst the blood alcohol levels for the older groups extend well into the 241-320 mg/100ml band. This pattern will undoubtedly be reflected in the population of drinking drivers in that there will be a tendency for the heavy drinkers to be in the older age groups. It is an effect which can be clearly seen in the age distribution of High Risk Offenders (Section 4.6).

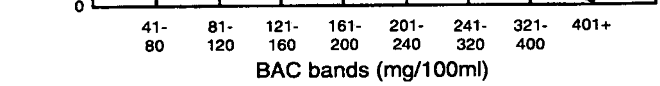

Fig. 15 The distribution of BAC among car driver fatalities by age group (Coroner's data 1990-94)

For comparison with the figures given in the previous paragraphs, the Coroners returns relating to drivers killed in road accidents a decade ago - during the five year period 1980-84 - show that the proportion of fatalities with blood alcohol concentrations less than half the legal limit (<40mg/100ml) for the age groups 17-24, 25-34 and 35 and over, were respectively 53.3, 43.4 and 67.7 per cent. These figures are considerably lower than they were in the more recent five year period 1990-94. The distribution of those above half the legal limit a decade ago for comparison with Figure 15 is shown in Figure 16. It is clear from this

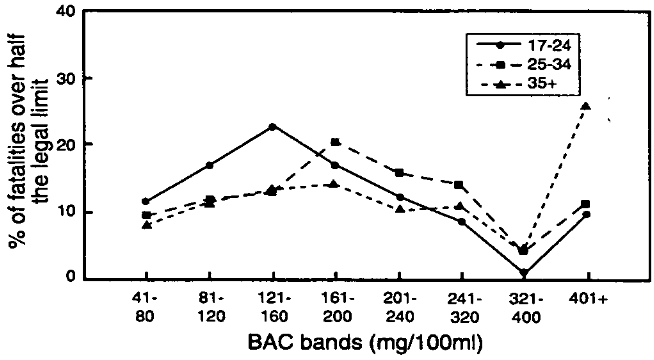

Fig. 16 The distribution of BAC among car driver fatalities by age group (Coroner's data 1980-84)

comparison that over the past decade, the numbers of drivers exceeding 4 times the legal limit have been drastically reduced, but that the shape of the distribution below this level has changed little.

4.5.5 A sample of drinking drivers from police prosecution files

As described earlier, data relating to drinking drivers were obtained from a sample of police prosecution files in three police force areas (Sussex, Greater Manchester and Lothian and Borders). Table 11 shows the total number of prosecution cases included in the sample from each area, and the resulting evidential BrAC distribution. The Table also shows the proportion of drivers who refused a breath test.

Table 11 shows that the BrAC distributions in Sussex and Greater Manchester are surprisingly similar in view of the very different character of the two areas, whilst the Scottish sample tends to have a higher percentage of drivers refusing to give a breath sample, and rather higher levels of alcohol in the breath of those providing samples. However, the distributions are not so disparate, that it would be unreasonable for the present review to combine them. Accordingly, Figure 17 shows the combined age distributions in four BrAC bands - 35-50, 51-65, 66-87 and over 87µg/100ml.

It will be seen that the peak of the age distribution for drivers in the lowest BrAC category is in the 20-24 year old group, as it was for the STATS19 data relating to all drivers who failed a breath test (Figures 8 and 10). However, in the higher BrAC categories, the peak of the age distribution has moved upwards; for the highest BrAC category, the peak age is on the borderline between the 25-29 and the 30-34 year old groups. Such an alcohol-age interaction is consistent with that observed in the Coroners data (Figure 15), in which the older driver groups included the heavier drinkers. It is also consistent - as will be seen in section 4.6 - with a higher 'peak' age for High Risk Offenders compared to 'ordinary' offenders.

In extracting data from the prosecution files, the reasons why the police administered the screening breath test was also obtained (see Table 1) . These reasons were categorised in terms of a triggering incident which was either an accident, a traffic offence, or because the police had reason to suspect that the driver had been drinking. The proportions of these triggering events are given in Table 1; for the three regions combined they average 15.4 per cent for accidents, 27.6 per cent for traffic offences, and 57 per cent for suspicion of alcohol. Although the uncertainties associated with the way the prosecution files have been selected

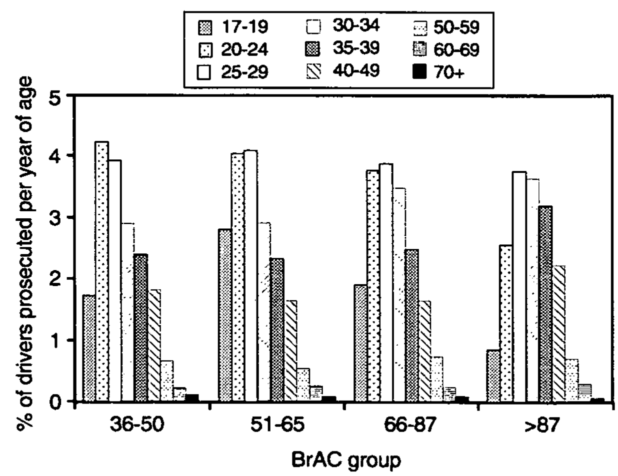

Fig. 17 Age distributions by BrAc group for drivers sampled from prosecution files

TABLE 11

Distribution of BrACs among offenders being prosecuted.

Area	Total Numbers	36-50 %	51-65 %	66-87 %	Over 87 %	Refused %
Sussex	3385	18.6	24.0	27.6	23.0	6.7
Greater Manchester	2273	18.5	23.8	26.2	21.3	10.3
Lothian/Borders	1407	12.0	18.5	26.9	27.1	15.5

makes the interpretation of this data problematic, it is informative nevertheless to compare the BrAC distributions in terms of these triggering incidents.

For those prosecutions arising from accidents, Figure 18 compares the distributions obtained from the prosecution file sample (1990-92) with the corresponding distribution obtained from the study of accident-involved drivers carried out four years earlier (1986) in cooperation with the Nottinghamshire police. It will be seen that the two distributions are very different. If the Nottinghamshire study is taken to be a fair representation of the distribution of alcohol in accident-involved drivers, then that obtained from the prosecution files is heavily biassed towards the heavy drinkers. There is no clear explanation for this bias. It may be that in the sampling of prosecution data, the files selected (or available) were those which were more comprehensively documented, and therefore probably those involving high BrAC drivers. It is also possible that there is some strategic element involved in the selection of cases for prosecution which might bias the selection towards those cases in which a conviction was more likely to be secured. Whatever the reason, it is necessary when considering the data from the prosecution files to be aware of the fact that the data is significantly biassed towards the more severe offenders.

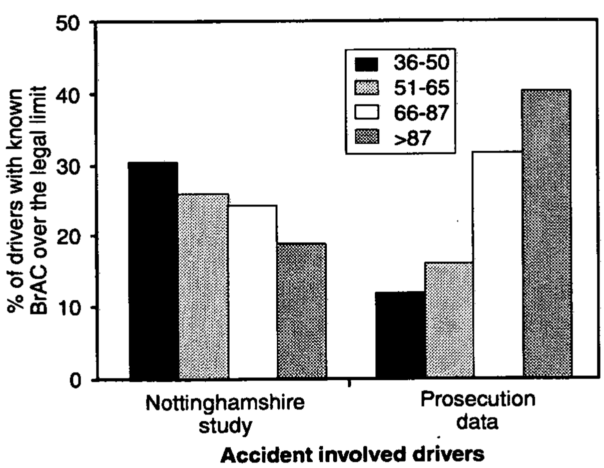

Fig. 18 BrAc distributions from prosecution files compared to those from other accident involved drivers

Figure 18 showed the BrAC distribution for those for whom the triggering event was an accident. Figure 19 illustrates the breath alcohol distributions for the other two trigger events - committing a traffic offence and being suspected of alcohol. In this case the roadside survey distribution for drivers over the limit is given for comparison. Clearly the 'risks' of detection and prosecution increases considerably with BrAC levels, though in view of the potential selection bias detected in the case of accident-involved drivers, it is not very useful to attempt any detailed analysis or interpretation of the figures illustrated in Figure 19.

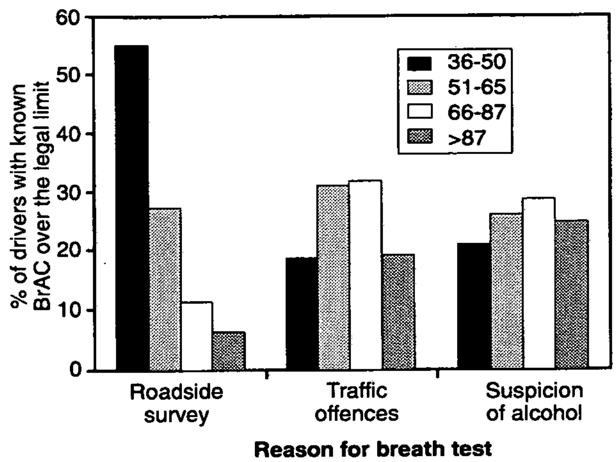

Fig. 19 BrAc distributions from prosecution files compared to those from the roadside survey

4.6 HIGH RISK OFFENDERS

4.6.1 Categories of offenders and trends since 1990

As outlined in the introduction to this report, the 'High Risk Offender' (HRO) scheme came into effect in May 1983. Originally, a 'high risk offender' was a driver who had been convicted of two drink-drive offences in a 10 year period in which he or she was found to be over 2.5 times the legal alcohol limit. In June 1990 revised criteria were introduced, and currently a high risk offender (sometimes referred to as a 'new style' high risk offender) is defined as: (i) a driver who has been disqualified once for driving with an alcohol level in excess of 2.5 times the legal limit, or (ii) a driver who has been disqualified twice within a 10-year period for any drink-drive offence, or (iii) a driver who has been disqualified for failing to provide a sample for analysis. High risk offenders will be disqualified from driving and will be required to undergo a medical assessment by a doctor appointed by DVLA before getting their licence back. The purpose of disqualification is to keep habitual drinking drivers off the road until they no longer pose a threat to the safety of themselves and others, and the medical assessment is intended to provide some check as to whether this is the case or not.

Broughton (1996), extending the earlier work of Everest has analysed the characteristics of high risk offenders in the three categories defined above from data available in the DVLA driver licence file up to the end of 1995. This section summarises Broughton's analysis. In the first full year of the HRO scheme (1991), there were just over 39,000 new HROs and the number has been consistently declining over the years since then at a rate of between 4 and 5 per cent per year; in 1995 the number was approximately 33,200. About 45 per cent of HROs fall into the first category (1 offence > 2.5 times the legal limit), 35 per cent into the second, (2+

offences), and the remaining 20 per cent refused to give an evidential sample. The proportion of HROs in the first category has been increasing slightly over the 1990-95 period whilst those in the second have been declining. The proportion of drivers refusing to give a sample has remained virtually static over this period.

Since the new HRO scheme began in June 1990, 39 per cent of drink-drive offenders in Great Britain, have qualified as an HRO - a proportion which varies from 43 per cent in Scotland to 37 per cent in Eastern England. Just over 7 per cent of HROs are women.

4.6.2 Characteristics of offenders

Figure 20 shows a comparison of the age distribution for the three types of male HROs with that of 'ordinary' drink-drive offenders. 'Ordinary' offenders are defined as drivers who were convicted in 1992 of their first drink-drive offence by being over the legal limit for alcohol, but less than 2.5 times the limit.

The age distributions shown in Figure 20 are consistent with those illustrated earlier in this section. The distribution for 'ordinary' offenders is very similar to that shown in Figure 8 and 10 based on 1994 STATS19 data, peaking at age 20. Moreover, in conformity with the age distributions for drivers in the higher BAC levels in both the Coroners data and the prosecution data, Figure 20 shows that the HRO age distribution has a broad peak in the older age range (25-30 years of age). The age distribution for the first category of offender (one offence over 2.5 times the legal limit) and those who refused an evidential sample are very similar, whilst the age distribution for HROs who qualified by having 2 or more offences in 10 years, has a rather higher proportion of drivers in the peak and consequently marginally fewer drivers in the age ranges either side of this peak. The peak age for female offenders (both 'ordinary' offenders and HROs) is about 6 or 7 years older than that of the males shown in Figure 20 as it was for the Coroners data shown in Figure 9.

In section 4.2 of this report the Occupational Groups of drink-drive offenders from four studies were compared with those in the driving population as a whole (Table 4). For HROs, the Occupational Groupings defined in Table 3 were not available, so in order to examine social effects, an alternative system of classification known as the ACORN directory (CACI, 1993) used for market research purposes and based on postcodes, was used instead. At its simplest level of disaggregation the ACORN system uses 6 categories described as 'thriving' - affluent suburban, rural and retirement areas, 'expanding' - affluent family areas, 'rising' - affluent city areas, 'settling' - mature home owning areas, 'aspiring' - mature and multi-ethnic areas and 'striving' - less prosperous areas including council estates. Because postcode data was incomplete for the DVLA sample of HROs, not all HROs could be classified using this system, though in fact 81 per cent were assigned an ACORN classification.

Despite the difficulties in interpreting this type of data, the analysis by ACORN groupings suggested a strong social influence on the likelihood that a driver would be an HRO. This effect is illustrated in Figure 21. The figure shows the relative density of HROs in each ACORN category in relation to the population - that is the ratio of the percentage of HROs in each category divided by the percentage of the population in that category. Although such a ratio does not take into account differences in the demographic make up of the various ACORN groups, nevertheless Figure 21 shows clearly that the relative density of HROs increases from category A to category F. A driver in the affluent 'thriving' group (A) is about one third less likely than the average driver to be an HRO, whilst a driver in the less prosperous 'striving' group (F) is about 40 per cent more likely to be an HRO. This view of the social structure of HROs is consistent with that emerging from the prosecu-

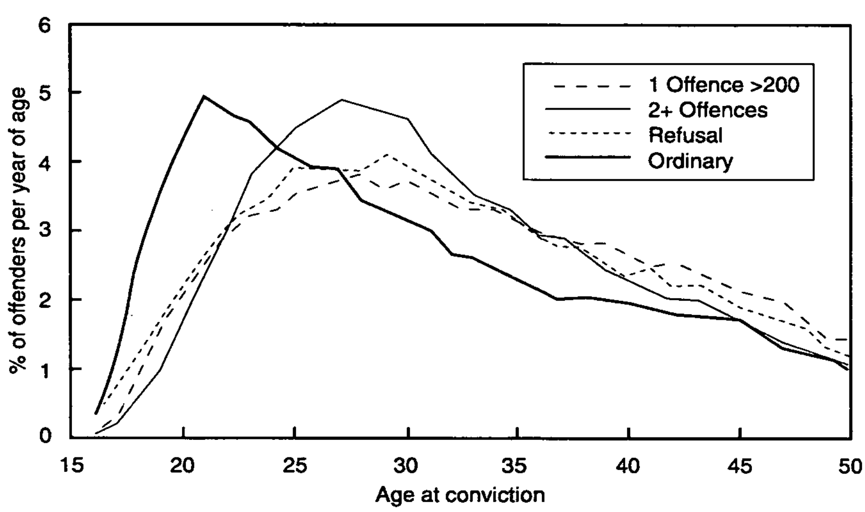

Fig. 20 Age distribution of three categories of male HRO compared with 'ordinary' offenders

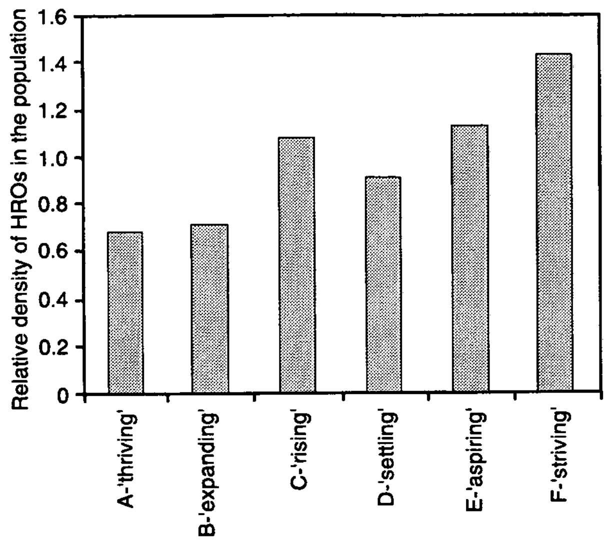

Fig. 21 The relative density of HROs by ACORN 'social' classification

tion data analysis using the more conventional Occupational Groups (Table 3). Section 4.2 above, shows that drivers in Occupational Groups AB and C1 (managerial, professional and administrative) tend to be under-represented in the drink-drive statistics, whilst Occupational Group C2 (skilled manual workers) and Groups DE (semi-skilled, unskilled manual workers and the unemployed) are over-represented.

4.6.3 Reconviction rates

The purpose of the HRO scheme in the short term is to remove from the road drivers who present a significantly greater accident risk to themselves and to other road users, and in the longer term to deter such drivers from engaging in drinking and driving. The studies by Broughton (1996) and Everest, have used data from the DVLA files to quantify the drink-drive conviction rates of HROs - both whilst they are still disqualified, and after the end of the period of disqualification. The conviction rates for the offence of driving whilst disqualified have also been examined. These analyses show that in any year, between about 1 in 25 and 1 in 40 HROs will be convicted of drinking and driving whilst still disqualified from a previous offence, and between 1 in 10 and 1 in 20 male HROs will be convicted of driving whilst disqualified. No doubt, others will offend but escape detection.

Two key questions arise: (i) does the HRO scheme identify drivers who on average offend more often than 'ordinary' offenders? and (ii) does the HRO scheme have any long term effect on the re-offending rates of those involved? At the present time, only the first of these questions can be convincingly answered. Figure 22 shows for male drivers who became HROs in 1991-92, the number of convictions for drink-drive offences after the original conviction (and excluding that conviction) averaged over the 4-5 year period since 1991-92. The Figure also includes 'ordinary' offenders as defined earlier for comparison.

Figure 22 demonstrates that the HRO scheme does indeed identify drivers at greater risk of committing drink-drive offences. Not surprisingly, those HROs who have qualified as a result of multiple offences have the highest re-offence rates, whilst those who have qualified as a result of a single offence of being more than 2.5 times the legal limit have the lowest. All HROs have a significantly higher offence rate than the 'ordinary' offenders. The HRO procedure is thus successfully identifying drivers with relatively high offence rates.

The question relating to long term effects is more difficult to answer. Nevertheless it is important to know whether being 'stigmatised' as a High Risk Offender and all it entails in terms of the disqualification and the sometimes lengthy procedures involved in recovering a licence, re-

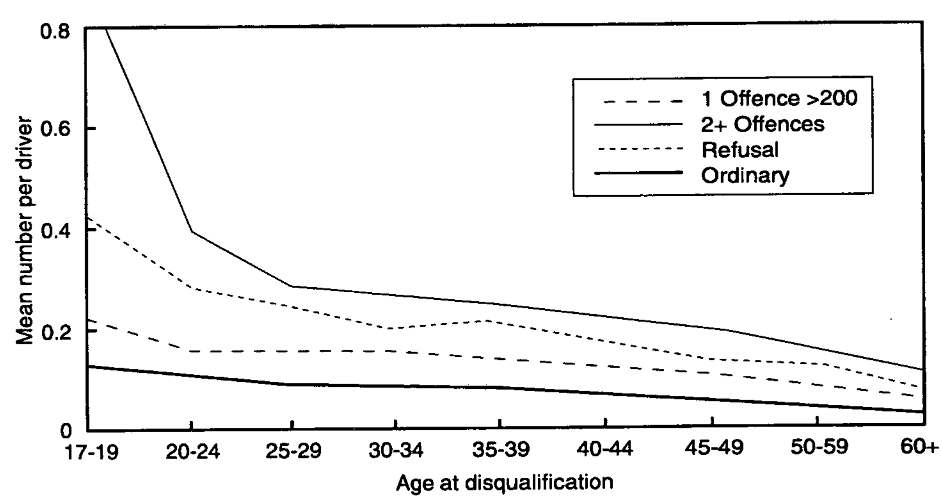

Fig. 22 Mean number of drink-drive convictions for male drivers originally convicted in 1991-92

duces subsequent offence rates. It is clear from Figure 22 that HROs continue to offend after becoming an HRO, but it is not yet possible to demonstrate convincingly whether the offence rate of HROs has been reduced as a result of their entering the HRO scheme or not.

Further work evaluating the HRO scheme is planned. In particular, a surprisingly high proportion of HROs do not re-apply for their licences; by 1 March 1996, only 56 per cent of those drivers whose period of disqualification had ended (some up to 3 years or so earlier) had regained their licences. Little is known about the reasons for this delay and in making an appraisal of the scheme, it is important to understand how it is functioning. It is planned also to find out more about the social backgrounds and attitudes of HROs and to assess the public's knowledge of the scheme and their response to it. It seems clear that high risk offenders represent a significant component of the residual drink-drive problem, and it is important to explore the ways by which the behaviour of such offending drivers can be influenced, in the interests of greater road safety.

5. SUMMARY

5.1 INTRODUCTION

The Road Safety Act 1967 made it illegal to drive with a blood alcohol concentration of more than 80mg per 100ml and introduced roadside screening for alcohol for the first time. The 1981 Transport Act introduced additional measures to curtail drinking and driving including evidential breath testing and stiffer penalties. The High Risk Offender scheme was introduced at about this time. The publicity about the dangers of drinking and driving have over the years increased the public's awareness of the road safety risks involved, with the result that the extent of drinking and driving has fallen considerably over the last decade or so.

This report has attempted to provide an overview of the research that has been undertaken by various agencies into the patterns of drinking and driving and the characteristics of drinking drivers. This section of the report attempts to summarise the key findings of the research reviewed.

Whether the objective is to monitor trends in drinking and driving or to attempt to understand the nature of the problem, accurate and reliable data are essential. The report has described a number of data sources which fall into the categories of national monitoring (STATS19 and Coroners data), data assembled principally for administrative purposes (the DVLA Driver licensing database and Police prosecution data) and special surveys - of which the roadside surveys carried out during the years 1988-1990 have played a key part in understanding the patterns of drinking and driving. Table 2 in the main report summarises these data sources.

5.2 VARIATIONS OF DRINK-DRIVE ACCIDENTS OVER TIME

The amount of drinking and driving that has been taking place and the number of accidents that have resulted, have changed considerably over the last decade or so. Moreover, drink-drive behaviour and the resulting accidents have characteristic patterns by hour of day, day of week and by month of the year. These temporal effects can be summarised as follows:

(i) STATS19 data indicates that accidents of all severities involving alcohol have fallen considerably faster over the last decade than accidents in general (Figure 2). Thus, fatal accidents involving alcohol have fallen about 2.3 per cent per year faster than fatalities generally, serious accidents at a rate of 4.4 per cent per year faster than all serious accidents, and slight accidents at a rate of 5.3 per cent per year faster than all slight injury accidents.

(ii) The Coroners data relating to road users involved in fatal accidents shows that for the decade 1984-94 the proportion of drivers/riders with known BAC who are over the limit has fallen from about 27 per cent in 1984 to just over 20 per cent in 1994 (Figure 3). By comparison, the proportion of fatalities involving pedestrians who are over the legal alcohol limit has remained at about 30 per cent for much of the decade.

(iii) The hourly pattern of drinking and driving revealed by STATS19 breath test data (Figure 5) shows the expected high incidence of drinking and driving between the hours of 22.00h and 02.00h, though there is a substantial amount of drinking and driving taking place during the late afternoon and early evening - say from 15.00h to 22.00h. The latter has increased in recent years relative to that at other times of day, due probably to the relaxation of the licensing hours in 1988. The peak days for drinking and driving (Figure 6) are Saturdays, Sundays and Fridays (in that order), and there is little difference in drink-drive patterns between any of the months from May to December (Fig. 7).

5.3 CHARACTERISTICS OF DRINKING DRIVERS

5.3.1 Introduction

Much of the research relating to drinking and driving has been aimed at understanding the characteristics of offending drivers so that countermeasures may be effectively targeted. A variety of driver classifications have been put forward, but in practice the research has focused on a limited number of key characteristics. Those covered in this review are social or occupational group, sex and age effects, the distribution of alcohol in the blood or breath and the interactions between these variables. The main findings are summarised below.

5.3.2 Social background

(i) Among drivers who were over the legal alcohol limit, the roadside survey found rather higher proportions of drivers in Occupational Groups C2 (Skilled manual workers) and DE (Semi-skilled, unskilled workers and the unemployed) - 40% and 20% respectively - than would be expected in the population as a whole, and rather fewer in Occupational Groups AB (Senior managerial, professional or administrative) and C1 (Supervisory and junior managerial) - 13% and 26% respectively. The distribution by Occupational Group found among those prosecuted for drink-drive offences (biased it would seem in favour of the heavy drinkers) had even fewer ABs (6%) and C1s (18%) and considerably more DEs (42%).

(ii) The distribution of High Risk Offenders (HRO) by a social grouping based on the ACORN classification of home locations, showed that there is a strong socio-economic influence on the likelihood of a driver being an HRO. A driver in the more affluent 'thriving' group of the ACORN classification is about one third less likely than a typical driver to be an HRO, whilst a driver in the least prosperous 'striving' group is about 40 per cent more likely to be an HRO.

5.3.3 Gender differences

In many respects drinking and driving is male dominated. Nevertheless, a number of significant findings relating to gender differences have emerged from the review; they are summarised in the following paragraphs.

(i) The roadside survey showed that 13.3 per cent of the male drivers stopped in the survey had been drinking to some extent (BrAC >3µg/100ml); this is about twice the proportion of women (6.8%) found in the survey to have been drinking.

(ii) Because a higher proportion of men are likely to be driving, the numbers of men found to be drinking and driving in most of the surveys reviewed in this report far exceeded the numbers of women. In the roadside surveys (1990), of those detected driving after drinking some alcohol, 74 per cent were men, and of those driving whilst over the limit, 89 per cent were men. In the prosecution data which is weighted towards the heavier drinkers, 92-93 per cent of those prosecuted were men.

(iii) The proportion of drinking drivers who are male is falling slightly over time. Over the years 1990-94, the annual reduction in positive breath tests for male drivers has averaged 8.3 per cent while the comparable reduction for women is only 2.2 per cent. These differential trends have had the effect of increasing the proportion of drinking drivers who are female from 9.8 per cent in 1990 to 12.4 per cent in 1994.

(iv) Based on Coroners data and data from the prosecution files, the distribution of blood or breath alcohol concentration found in male drivers is little different from that found in women (Tables 5 and 6).

(v) There are significant differences between the age distributions of male and female drivers who have failed a breath test. In both STATS19 and DVLA databases there is a higher proportion of older women in the population of offenders than is the case for men (Figure 8). Moreover, women HROs are on average about 6-7 years older than their male counterparts.

5.3.4 The ages of drinking drivers

Because there are far more male drink-drive offenders than there are women offenders, this summary of the age distribution of drinking drivers will be confined to males. The following summarises the key findings relating to age effects for male drivers.

(i) The peak age for being accident-involved whilst over the limit occurs in the 20-24 year old group (Figure 8); the distribution declines uniformly with age for older drivers. Thus whereas 23 per cent of drivers failing a breath test are in the 20-24 year old group, the corresponding figure for the 60-70 year old group is only 2.6 per cent (a ratio of nearly 9).

(ii) When the relative risk of being involved in a drink-drive accident is expressed in terms of the number of 'over the limit' accidents per 1000 injury accidents (Figure 10), variations with age are rather smaller. For example, whereas the relative risk of drivers in the 20-24 year old group is just under 3 drink-drive accidents per 1000 injury accidents, the corresponding figure for the 60-70 year old group is 0.8 (a ratio of slightly under 4).

(iii) Coroners data, prosecution data and the DVLA file (High Risk Offenders) show that heavier drinkers tend to be rather older than those whose blood alcohol concentration is nearer to the legal limit. Thus for example in the prosecution data (Figure 17), the peak age for drivers just over the legal limit is about 23-24 age group whilst for drivers over 2.5 times the legal limit the peak age is about 29-30.

5.3.5 Alcohol distributions

A crucial aspect of classifying drivers into identifiable groups is the amount of alcohol drivers are prepared to drink prior to driving, and their resulting blood or breath alcohol levels. The main findings of the review relating to alcohol distributions may be summarised as follows.

(i) The roadside survey, though it only sampled drivers in the 'drinking hours', is the best representation available of the alcohol distributions in the driving population as a whole. This survey showed that in these hours, about 85 per cent of drivers were driving with little or no alcohol in their blood. The proportion of drivers over the legal limit averaged just under 1.2 per cent. The distribution of BrAC in those who had been drinking approximated very closely to a negative exponential (Figure 11).

(ii) The distribution of BrAC in drivers who had been involved in accidents can also be approximated by a negative exponential distribution, but one which declines with BrAC level at a rate which is much less marked than that observed among drivers in the roadside surveys (Figure 12). The ratio of these two distributions shows that the relative risk of being involved in an accident increases exponentially with the level of alcohol in the body.

(iii) The blood alcohol concentrations for drivers killed in road accidents is a compound distribution (Figure 13). It consists of a high peak of drivers who had not been drinking, and a secondary peak for drivers whose BAC was between 200 and 250 mg/100ml at the time of the accident. A comparison of the BrAC distribution observed in the roadside survey with the BAC distribution in driver fatalities over the same time period (Figure 14), shows that the relative risk of being involved in a fatal accident also increases exponentially with the level of alcohol in the body, but at a rate which is much more rapid than is the case for injury accidents.

(iv) The Coroners data also allows the changes in the blood alcohol distribution in fatalities over a ten year period to be observed. Comparing the five year period 1980-84 with 1990-94, shows that the proportion of drivers below half the legal limit has increased from 58 per cent in 1980-84 to 77 per cent in 1990-94 with corresponding reductions in the proportions of drinking drivers over half the limit. However, the shape of the BAC distribution for drivers killed in accidents whilst over the legal limit has remained much the same over this 10 year period, with the significant exception that the fatalities involving drivers over 5 times the legal limit 10 years ago, have virtually disappeared in the most recent period.

(v) The BAC distribution of drivers killed in accidents whilst over half the legal limit by age group (Figure 15) shows that drivers who have high BAC levels tend to be older. For example, the BAC for the youngest group (17-24) peaks in the 161-200 mg/100ml band and then declines quite sharply, whilst the blood alcohol levels for the older groups extends well into the 241-320 mg/100ml band.

5.3.6 Prosecution data

A number of the findings arising from the analysis of the prosecution data obtained from police forces in Sussex, Greater Manchester and Lothian and Borders, have already been summarised above. However the following additional findings have emerged from an examination of this dataset.

(i) The police administer a screening breath test as a result of a 'triggering incident'. The proportions of these triggering incidents for the three police force regions combined averaged 15.4 per cent for breath testing after an accident and 27.6 per cent for breath testing following a traffic offence; the remaining 57 per cent were breath tested because the police had reason to suspect that the driver had been drinking.

(ii) A comparison of the distribution of BrAC for accident-involved drivers in the prosecution data with that obtained in an earlier study of accident-involved drivers, showed that the higher BrAC levels were considerably over-represented in the prosecution data (Figure 18) - this bias needs to be borne in mind when interpreting this data.

(iii) A comparison of the roadside survey distribution with that relating to drivers prosecuted for drink-driving as a result of being breath tested following a traffic offence or on suspicion of alcohol suggests that the 'risks' of detection and prosecution increase considerably with BrAC levels (Figure 19).

5.3.7 High Risk Offenders

The 'High Risk Offender' (HRO) scheme came into effect in May 1983. From June 1990, a High Risk Offender (HRO) is defined as: (i) a driver who has been disqualified once for driving with an alcohol level in excess of 2.5 times the legal limit, or (ii) a driver who has been disqualified twice within a 10-year period for any drink-drive offence, or (iii) a driver who has been disqualified for failing to provide a sample for analysis. Some of the results emerging from an analysis of the relevant data in the DVLA driver file have already been included in the sections on social structure and age above. However the following additional findings have emerged from an analysis of the data by Broughton (1996).

(i) In the first full year of the HRO scheme (1991), there were just over 39,000 new HROs and the number has been declining since then at a rate of between 4 and 5 per cent per year. About 45 per cent of HROs fall into the first category of offender (1 offence > 2.5 times the legal limit) and 35 per cent into the second (2 + offences); the remaining 20 per cent refused to give an evidential sample. Since the new HRO scheme began in June 1990, 39 per cent of drink-drive offenders in Great Britain, have qualified as an HRO. Just over 7 per cent of HROs are women.

(ii) Estimates of the re-conviction rates of male HROs for drink-drive offences indicate that in any year, between about 1 in 25 and 1 in 40 HROs will be convicted of drinking and driving whilst still disqualified from a previous offence. Moreover, between 1 in 10 and 1 in 20 male HROs will be convicted of driving whilst disqualified.

(iii) Estimates of the number of convictions for drink-drive offences after the original conviction (Figure 22), shows that the HRO scheme is being successful at identifying drivers at risk of committing drink-drive offences. Those that have qualified as HROs as a result of multiple offences have the highest re-offence rates, whilst those who have qualified as a result of a single offence of being over 2.5 times the legal limit, have the lowest. Re-offence rates decline with age.

6. LOOKING FORWARD

Drinking and driving as an issue has been at the forefront of road safety policy action and research for several decades now, and the reduction in drink-drive accidents documented in this review is clear evidence of the success of the countermeasures which have been implemented over that time. Because of these successes however, the question of what more could or should be done to reduce accidents due to drinking and driving is not an easy one. This concluding section briefly considers the possibilities arising from this review, though it should not be regarded as a comprehensive overview of the potential for future action.

The most striking feature of the changes that have taken place in drinking and driving over the last decade is the impact which the various countermeasures have had in reducing drink-drive accidents of all severities over and above the reduction that has taken place in accidents generally. The risks of drinking and driving have been so well communicated to the driving public - by legislation, by publicity and by enforcement action - that drinking and driving is generally known to be dangerous, and regarded by most people as both risky and unacceptable socially. The driving public has responded to this awareness by curtailing their drinking and driving, with the result that the accident trends have been convincingly downwards for at least the last decade. Moreover, there is at present no indication that this decline - at least in terms of the exponential trends shown in Figure 2 - has come to an end.

Though the heavier drinkers are to be found among older drivers, it is the younger drivers who have numerically dominated the drink-drive statistics - and will do for the foreseeable future. It follows therefore, that the major reduction in the sheer number of drinking drivers that has taken place over the last decade has been among the younger age groups (the under 40s). Consequently, it is the future generations of younger drivers - which includes new drivers - who need to be persuaded of the importance of not combining drinking with driving. If the present downward trend in drinking and driving is to continue, it is crucial that the message concerning the risks involved in this behaviour is passed on to each new generation of drivers as they gain their licences. There is a key role in this process for both educationalists and trainers.

The other group of drivers who are a clear target for potential remedial action are the heavy drinkers, and in particular the persistent heavy drinkers. It has been pointed out that the really excessive levels of blood alcohol (over 5 times the legal limit) have been largely eliminated over the last decade. However, there remains a 'peak' in the BAC distribution or fatalities at about 2-2.5 times the legal limit to which the High Risk Offender scheme is specifically addressed. It was pointed out in the main report that further work directed towards monitoring the HRO scheme is planned. It is important to assess various aspects of this scheme, and the work planned will investigate why some HROs do not re-apply for their licences as well as the public's knowledge of the scheme. Improved knowledge of the social backgrounds and attitudes of HROs will also help in the targeting of publicity and enforcement. It is clear that the HRO scheme has been successful in detecting drivers who are habitual drink-drive offenders or who are at risk of becoming habitual offenders. The real issue however, is whether the scheme contributes to deterring these drivers from re-offending. As difficult as it is, future research should attempt to answer this question. It will be desirable also, to explore the use of compulsory rehabilitation courses as a part of the procedure for restoring the licences of HROs.

The elevated risk that a drinking driver runs of being involved in an accident, particularly a fatal accident, is startling - indeed it is this fact which is the rationale for taking action against drinking and driving. But it is a 'statistic' which is not perhaps as well known or appreciated by the driving public as it might be. It may be worthwhile considering whether obtaining more information about the types and the circumstances of drink-drive accidents might help to bring home the risks run by drinking drivers in a way which could be useful in future publicity campaigns or in driver training courses. Fatal accidents would have to be studied by means of 'in-depth' accident investigation techniques. Non-fatal accidents to drinking drivers might be accessible by means of questionnaire surveys based on samples of drivers from the DVLA licence file. Although self-reported accident information needs to be treated with some caution, the technique has been used with some success in other areas in recent years.

The data from the prosecution files reviewed in this report leave some questions unanswered. The routine breath testing of drivers by the police has now reached a level which means that the great majority of drivers who become involved in an accident after drinking will be breath tested unless they leave the scene of the accident. In view of this, it was puzzling that in the data retrieved from the police files, the drivers in the lower BrAC bands did not feature as strongly as might have been expected. This result may simply be a result of non-random sampling, but it is an issue which seems worth investigating.

The whole question of enforcement is a difficult one. The supporters of more pro-active enforcement measures would no doubt claim significant benefits from such action. This review has offered no information which would help in making a judgement on this issue. Clearly - as with any law enforcement activity - the key elements in deterrence are the probability of detection (which includes the targeting of offenders) and the effect of the penalty. A better understanding of both of these components of deterrence in the case of drinking and driving offences could be of benefit to the police in the formulation of improved enforcement strategies and to those concerned with the provision of public information.

A range of other issues including, lower limits for BrAC or BAC, age related limits, the use of low alcohol drinks, the provision of alternative means of transport during the drinking hours, the development of rehabilitation systems for persistent offenders, and the use of in-vehicle devices have all been canvassed from time to time. These are all major issues in their own right and a detailed discussion of them is outside the scope or this report. The review has also touched upon another issue that although it has not been central to the research results reviewed in this report, is nevertheless an important one - namely, the problem of the drinking pedestrian. It was pointed out in section 3.1 that, unlike fatalities involving motorised vehicle drivers/riders, fatalities involving pedestrians over the legal limit for alcohol have not fallen during the last decade. Although it is not obvious what could be done about drinking pedestrians, it would seem desirable to obtain a better understanding of the problem. Some work looking at the broad determinants of these accidents has already been published (Everest, 1992). It would seem desirable however, to extend this work in order to obtain a better understanding of the circumstances of these accidents and of those involved - both victims and drivers - so that appropriate advice could be given to those at risk.

7. REFERENCES

ALLSOP, R E (1966). Alcohol and road accidents: a discussion of the Grand Rapids study. Report LR 6. Transport Research Laboratory.

BORKENSTEIN, R F, CROWTHER, R F, SHUMATE, W B, ZEIL, R and ZYLMAN, R (1974). The role of the drinking driver in accidents (The Grand Rapids Study). First produced in 1964 - second edition published as a special edition of Blutalkohol Vol 11 (Supplement 1) in 1974.

BROUGHTON, J and STARK, D C (1986). The effect of the 1983 changes to the law relating to drink/driving. *Department of Transport TRL Research Report 89*: Transport Research Laboratory.

BROUGHTON, J (1986). Analysis of motoring offence details from DVLC driving licence records. *Department of Transport TRL Research Report 77*: Transport Research Laboratory.

BROUGHTON, J (1990a). Casualty rates among car occupants. *Department of Transport TRL Research Report 244*: Transport Research Laboratory.

BROUGHTON, J (1990b). Trends in drink/driving revealed by recent road accident data. *Department of Transport TRL Research Report 266*: Transport Research Laboratory.

BROUGHTON, J (1993). The actual number of non-fatal drink/drive accidents. *Department of Transport TRL Project Report 40*: Transport Research Laboratory.

BROUGHTON, J (1994). The actual number of drink/drive accidents. *Department of Transport TRL Annual Review 1994*. Transport Research Laboratory.

BROUGHTON, J (1996). Analyses of high risk offender data from DVLA. (In preparation for the Department of Transport). Transport Research Laboratory.

CACI Ltd. (1993) The ACORN User Guide.

CLAYTON, A B, McCARTHY, P E and BREEN J E (1980). The male drinking driver: characteristics of the offender and the offence. *Department of Transport TRL Supplementary Report SR600.* Transport research Laboratory.

DEPARTMENT OF THE ENVIRONMENT (1976). Drinking and Driving, *Report of the Committee of Inquiry into drinking and driving,* HMSO, London.

DEPARTMENT OF TRANSPORT. Road accidents in Great Britain 1994, The Casualty Report. Government Statistical Service. HMSO.

EVEREST, J and JONES W (1988). The drink/drive characteristics of accident-involved drivers/riders. *Department of Transport TRL Research Report 149.* Transport Research Laboratory.

EVEREST, J T, DAVIES, C H and COFFEY, M G (1990). Roadside surveys of drinking and driving: Wiltshire. *Department of Transport TRL Research REport 285.* Transport Research Laboratory.

EVEREST, J T, BANKS, S, HEWER P A and MINEIRO J (1991). Drinking behaviour and breath alcohol concentrations of road accident casualties. *Department of Transport TRL Research Report 311.* Transport Research Laboratory.

EVEREST, J T, DAVIES, C H and BANKS, S (1990). Roadside surveys of drinking and driving: England and Wales 1990. *Department of Transport TRL Research Report 319.* Transport Research Laboratory.

EVEREST, J (1992b). The involvement of alcohol in fatal accidents to adult pedestrians. *Department of Transport. TRL Research Report 343.* Transport Research Laboratory.

LENNOX, R and QUIMBY, A R (1990). A survey of drink-driving behaviour, knowledge and attitudes. *Department of Transport TRL Contractor Report 147.* Transport Research Laboratory.

MAYCOCK, G, LOCKWOOD, C R and LESTER, Julia, F (1991). The accident liability of car drivers. *Department of Transport. TRL Research Report RR315.* Transport Research Laboratory, Crowthorne.

RESEARCH SERVICES LIMITED (1994). Drink driving: a survey of male offenders. London: The Portman Group.

SABEY, B E (1989). Drinking to your health. Social Affairs Unit publication. Ed. Digby Anderson.

SABEY, B E, EVEREST, J T and FORSYTH, E (1988). Roadside surveys of drinking and driving. *Department of Transport TRL Research Report PR175.* Transport Research Laboratory.

THE PORTMAN GROUP (1994). Drink Drive Seminar: a seminar held in association with the Department of Transport on 6 September 1994. Ed: Andrew Clayton. The Portman Group, London 1994.

QUIMBY, A R and GLENDINNING, R (1990). Perceived effectiveness and favourability towards some road accident countermeasures: a national survey. *Department of Transport TRL Contractor Report 234.* Transport Research Laboratory.

8. ACKNOWLEDGEMENTS

This report was prepared in the Safety and Environment Resource Centre of TRL. The author is particularly grateful to Jeremy Broughton for his valuable suggestions for improvements to the text and for access to the results of his analysis of HRO data (still in preparation). I am also grateful to Fred James for his prompt supply of STATS19 and Coroners data.

Special mention should also be made of a series of unpublished reports by Julian Everest which have provided invaluable sources of information in compiling this review. They are:

(1) Comparison of the characteristics of drink/driving offenders and their offences: Christmas 1990/91.

(2) A comparison of drink/drive offending between three police force areas. This unpublished report summarises reports on individual studies in Sussex, Lothian and Borders, and Greater Manchester.

(3) A sequence of three reports providing analyses of DVLA data on High Risk Offenders up to September 1992, March 1993 and September 1993 respectively. These reports are in the process of being updated by the report referenced as Broughton, 1996 (In preparation).

APPENDIX A: THE ESTIMATION OF RELATIVE RISK

A.1 THE PRINCIPLES

Consider two matched samples drawn from the population of all drivers - samples which will include some drinking drivers; one is a sample of drivers involved in accidents (the 'accident' sample), the other is a random sample of all drivers (the 'comparison' sample). From these samples we need to assess the relative accident risk of drinking drivers compared with that of non-drinking drivers as a function of the level of alcohol (BAC). Accepting for the moment that these are the appropriate samples for our purpose, we may denote the frequency distributions of these samples as shown in Table A1. The numbers of drivers in each cell of the accident sample are denoted by a_i and of the comparison sample by c_i. Since we shall be concerned only with the ratios of the two distributions, the fact that the BAC intervals are not equal is of no significance.

The relative risk of an accident for a drinking driver in the ith BAC interval compared with the risk of an accident for a driver with a BAC less than 9mg/100ml (notionally a driver who has not been drinking) is:

$$RR = a_i/c_i \div a_0/c_0 \qquad (1)$$

where the reciprocal of a_0/c_0 is an overall 'scaling factor'. Estimates of the confidence intervals of this estimate of relative risk can be obtained by noting that the logarithm of RR is approximately Normally distributed, that the variances of ln(a) and ln(c) are approximately $1/a^2$ and $1/c^2$ respectively, and that a and c are Poisson variates whose variance equals the mean. Thus:

$$\mathrm{Var}(\ln RR) = 1/a_0+1/c_0+1/a_i+1/c_i \qquad (2)$$

The 95% confidence intervals on the log scale are thus approximately, $\pm 1.96\sqrt{\mathrm{Var}(\ln RR)}$. In practice, since a_0 and c_0 are usually very large compared to a_i and c_i these terms can be ignored in estimating the confidence intervals.

The general approach described above was used in the Grand Rapids study (Borkenstein et al, 1974) and in Allsop's re-working of the data (Allsop, 1966), though Allsop used an alternative formulation for estimating the confidence limits which gives almost identical results to that described above. In view of the formative nature of this study, and its relevance to the estimation of relative risk in the main report, the Grand Rapids data will be briefly revisited in the following section.

A.2 THE GRAND RAPIDS DATA

The basic data from the Grand Rapids study in the form of Table A.1 is given in Table A.2, together with the relative risk and the confidence limits calculated from equation (2).

The two Grand Rapids distributions (Table A.2) are shown in Figure A.1. Both distributions have been plotted in terms of the number of drivers per unit of BAC bandwidth - i.e. each cell entry in the first two rows of Table A.2 has been divided by the relevant BAC bandwidth in units of mg/100ml. The resulting distribution shown in the Figure for the comparison sample (the square symbols) is very similar

TABLE A.1

Matched driver samples by BAC

BAC:	0-9	10-19	20-39	40-59	60-79	80-119	120-159	160-?
Comparison	c_0	c_1	c_2	c_3	c_4	c_5	c_6	c_7
Accident	a_0	a_1	a_2	a_3	a_4	a_5	a_6	a_7

TABLE A.2

Driver samples by BAC from the Grand Rapids study

BAC:	0-9	10-19	20-39	40-59	60-79	80-119	120-159	160-359
Comparison	6756	276	230	139	76	76	27	10
Accident	4992	188	152	113	82	170	127	154
Relative Risk	1	0.92	0.89	1.13	1.5	3.0	6.4	21.4
Upper 95%CI		1.11	1.10	1.45	2.0	4.0	9.7	40.6
Lower 95%CI		0.76	0.73	0.88	1.1	2.3	4.2	11.3

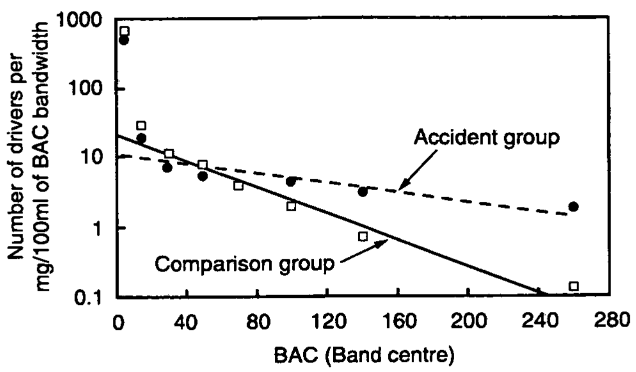

Fig. A.1 Grand Rapids: distributions of accident and comparison groups

to that for the roadside survey shown in Figure 11 in the main report. In particular, the distribution is approximately negative exponential for drivers who have been drinking, but the point representing non-drinkers (the BAC range 0-9), represents a notable departure from this distribution; as a matter of fact, because the majority of drivers in this lowest BAC band are actually non-drinkers at BAC=0 rather than uniformly spread across the band, the effective bandwidth for this point will be nearer to 1 than 10, with the effect that the point should be plotted considerably higher and further off the line than is actually shown in the figure. The accident-involved driver distribution is not dissimilar to that shown in Figure 12 - again with the exception of the lowest point (or perhaps the lowest two points), a negative exponential is a reasonable representation of the distribution.

Figure A.2 shows the ratio of the two distributions plotted against the mid-group BAC level. Since the two distributions of Figure A1 approximate to exponential functions, so does the ratio. The 95% confidence limits for each point is shown in the figure. It is noteworthy that the ratio provided by the data from the lowest BAC category (plotted at BAC=0) is significantly above the line; it is the reciprocal of this ratio however (c_0/a_0), which provides the overall scaling factor for the estimation of the relative risk in equation(1).

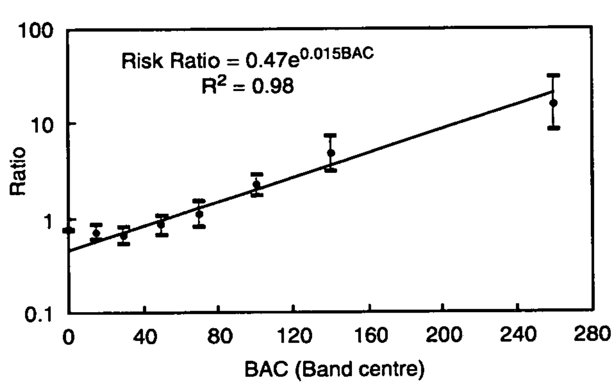

Fig. A.2 Ratio: Accident group/Comparison group numbers against BAC level

In the distributions available for examining relative risk from the GB data presented in the following section, for reasons explained there, the values of a_0 and hence the scaling factor c_0/a_0 cannot be satisfactorily evaluated. As an alternative, the intercept of the log-ratio plot at BAC=0 might be considered. In the case of the Grand Rapids data shown in Figure A.2, this intercept is 0.47 compared with the 'true' value of 0.74. The effect of using the former value rather than the latter would increase the relative risk by a factor of just over 1.5. Whether this approach is a reasonable one or not depends on the assumption that the risk curve is a smooth exponential down to BAC=0. Clearly from Figure A.2, it is very closely exponential above half the legal limit, but the lowest (perhaps the two lowest) points do not conform to this pattern - and perhaps there is no reason why they should. However, in connection with both Figure A.1 and Figure 11 in the main report (the roadside survey distribution), the point has been made that the population of drivers at BAC=0 may be quite different from the distribution of drinking drivers. In particular, this group of drivers will contain a large number of people who do not drink at all, or who never drink and drive. Moreover, since the accident risk of drivers depends on many factors other than the alcohol level - factors such as age, driving experience, annual mileage, social group and so on - it seems likely that the characteristics of the BAC=0 drivers sampled from the whole population will differ in relation their accident involvement from the population of drinking drivers - even when they are not under the influence of alcohol.

Perhaps in studies of relative risk, what is really required to estimate the scaling factor, is not the ratio a_0/c_0 derived from a sample of all drivers, but the ratio a_0'/c_0' where the primes indicate a sample of drivers matched to the characteristics of the population of drinking drivers. Such a value could in principle be extracted as a sub-set of the all-driver values providing the relevant factors were known and available. It is difficult to determine from the Grand Rapids data whether this ratio would be nearer the exponential line in figure A.2 or not, but whether it is or not, it does not seem unreasonable to regard the value obtained by extrapolating the negative exponential relation which holds over most of the BAC range to BAC=0, as being an appropriate estimate of the required ratio.

If the regression equation fitted to a log-ratio plot of the kind shown in Figure A.2 is:

$$\text{Ratio} = k\, e^{bBAC}$$

where k and b are determined from the regression analysis, then 1/k becomes the overall scaling factor, each scaled Relative Risk value is a_i/kc_i, and the Relative Risk curve simply:

$$\text{Relative Risk} = e^{bBAC}$$

This process automatically ensures that the relative risk is 1 at BAC = 0.

A.3 GB DATA

The relative risks of being involved in an accident or in a fatality have been estimated using the method suggested in the final paragraph of 9.2. Figure A.3 shows the ratio plot for the accident involvement data and Figure A.4 for the fatality data. In both cases the relative risk has been estimated by comparing the distribution by BAC or BrAC of accident-involved drivers who were over half the legal limit, with those obtained in the roadside survey. The roadside survey does in fact provide satisfactory estimates of c_0 (if not c_0'). However, in the case of the combined accident-involved drivers data and the hospital data, although the sample of drivers above half the legal limit seems to be robust, the status of the sample of drivers below half the legal limit is unclear - i.e. a_0 was considered to be unreliable. Similarly in the case of the Coroner's data, although the distribution of BAC in those reported by Coroners was considered to be a fair representation of the distribution of BAC in drivers killed in road accidents, because of the relatively high numbers of drivers whose BAC was not reported, it cannot be assumed that the proportion of drivers whose BAC=0 in the sample of Coroner's returns is the same as that in the population as a whole. Thus the number of drivers in the Coroners BAC=0 category, cannot be taken as a reliable estimate of a_0 for all drivers.

Figures A.3 and A.4 show that in the case of both the accident-involved drivers and fatalities, the ratio of those over half the legal limit is a reasonable exponential. The values of k and b (equation 3) in these two cases based on simple regression is shown in the Figures. A more 'refined' estimate could be obtained by carrying out a regression in which the 'observed' ratios were inversely weighted according to their variances. Moreover, the confidence limits of these estimates could also be obtained from the regression results. However, in view of the basic uncertainty about the appropriateness of the definition of the scaling factors, these refinements hardly seem justified.

The Relative Risk curves are as follows:

Drivers involved in injury accidents:

$$[RR]_{AI} = e^{0.049BrAC}$$

Drivers involved in fatalities:

$$[RR]_{F} = e^{0.072BrAC}$$

The values of these two functions at half the legal limit, the legal limit, and twice the legal limit are respectively 2.4, 5.6 and 31 for accident involvement and 3.7, 12.4 and 154 for involvement in a fatality.

For comparison with the above results, the Grand Rapids Relative Risk function converted to BrAC equivalent is:

Grand Rapids data:

$$[RR]_{GR} = e^{0.034BrAC}$$

The value of the exponent of this function is considerably smaller than that estimated for accident involved drivers obtained from the GB data. Since however, 77% of the Grand Rapids accidents did not involve injury, and since as the Grand Rapids analysis itself showed, the risk of involvement in an injury accident at a given alcohol level is higher than for involvement in a damage only accident, the difference in the two sets of results may well reflect the different accident severities being represented by the risk curves.

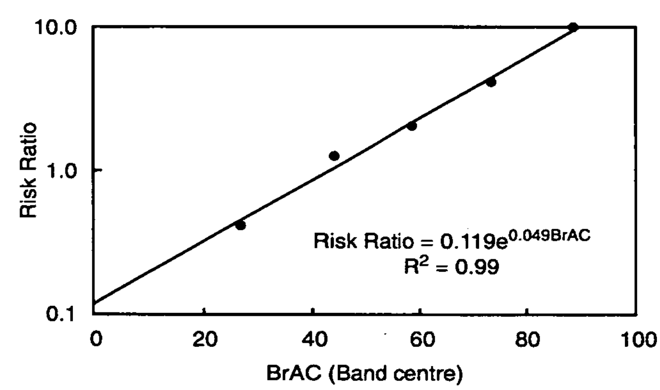

Fig. A.3 Log-ratio plot for accident involved drivers

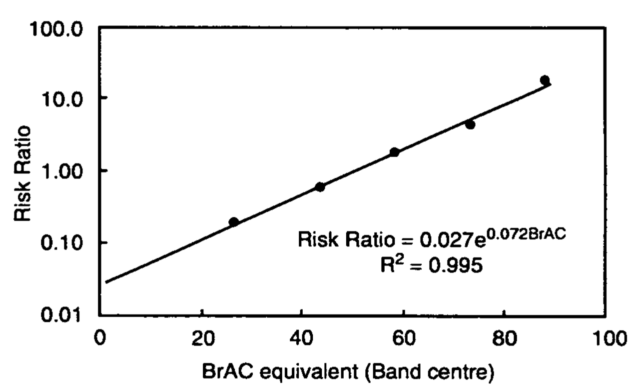

Fig. A.4 Log-plot of risk ratio from fatality data (Coroner's 1988-90 'drinking hours')

MORE INFORMATION

The Transport Research Laboratory has published the following other reports on this area of research:

PR40 The actual number of non-fatal drink/drive accidents by J Broughton. Price code E.

RR319 Roadside surveys of drinking and driving; England and Wales 1990 by J T Everest, C H Davies and S Banks. Price code C

RR343 The involvement of alcohol in fatal accidents to adult pedestrians by J T Everest. Price code E

TRL Annual Review 1994. Free of charge.

RR89 The effect of the 1983 changes to the law relating to drink/driving by J Broughton and D C Stark. Price code B.

If you would like copies, photocopy and fill in the slip below. There is a 20% discount if you take all the reports listed above. Prices include postage and are correct at the time of publication. Please see the enclosed letter for current price code values and handling charge. Enquiries to TRL Library Services, Tel: 01344 770784, Fax: 01344 770193.

To: Publication Sales, TRL Library, PO Box 304, CROWTHORNE, Berkshire, RG45 6YU.
Please send me the following Transport Research Laboratory reports (state report Nos and quantity)

Report no .... *Quantity* .... *Report no* .... *Quantity* ....

Report no .... *Quantity* .... *Report no* .... *Quantity* ....

Report no .... *Quantity* .... *Report no* .... *Quantity* ....

Name ....

Address ....

....

....

Postcode ....

Telephone ....

....

Credit card address (if different from above)......

....

PAYMENT:

- I enclose a cheque for £ ....
payable to TRL Ltd.
- Please debit my Deposit Account
no ....
- Please debit my Credit Card by £...............
- Credit card no ....

Expiry date ....

Signature ....