Reducing Drinking and Driving in Europe

Institute of Alcohol Studies

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Needless to say, any errors or omissions in the content of the report are the sole responsibility of the author.

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SUMMARY

Although alcohol-related traffic accidents have been decreasing throughout the European Union (EU), driving whilst under the influence of alcohol continues to be an important cause of road traffic crashes, contributing annually to at least 17,000 deaths on EU roads. The EU has the goal of halving the number of people killed on European roads from 50,000 in the year 2000 to 25,000 by 2010, and efforts to curb drink-driving can make a substantial contribution to achieving this objective. Blood Alcohol Level (BAL) in grams per litre of blood is the allowed level of alcohol in blood of drivers. Comparison of BALs of drivers in accidents with the BALs of drivers not involved in accidents find that drivers who had BALs between 0.2g/l and 0.49g/l had at least a three times greater risk of dying in a single vehicle crash. The risk increased to at least 6 times with a BAL between 0.5g/L and 0.79g/L and 11 times with a BAL between 0.8g/l and 0.99 g/L. The Commission's Communication on alcohol calls for an enforced maximum limit of 0.5g/L or less, and notes that effective enforcement of drink-driving countermeasures could substantially reduce traffic deaths, injuries and disability by up to 25% in the case of men, and up to 10% in the case of women. Efficient policies are those that rely on the introduction and enforcement of frequent and systematic random breath testing, supported by education and awareness campaigns involving all stakeholders. The Communication also notes that lower or zero BAL limits should be introduced for young and novice drivers and, for safety reasons, also for public transport drivers and drivers of commercial vehicles. This report will describe the evidence for these policies, placing particular emphasis on the need for lower BAL levels, supported by high visibility random breath testing.

Drinking and driving
Impairment of driving-related skills, including decreased vigilance, increased drowsiness, and impaired vision, psychomotor skills, information processing, and divided attention skills increase in a dose response manner with the level of alcohol in the blood, with no evidence of a threshold effect. The risk of a crash also increases with the level of alcohol in the blood in a dose dependent manner, and, again, there is no evidence of a threshold effect. Infrequent drinkers are at particular risk of an alcohol-related crash at any given blood alcohol level.

Regulating the availability and marketing of alcohol and drink driving accidents
Policies that regulate the alcohol market, including the price of alcohol, the location, density, and opening hours of sales outlets, minimum legal purchase ages, and controls on the availability of alcohol, and on the promotion and advertising of alcohol can all have an impact in reducing drinking and driving and related fatalities.

Drink driving countermeasures
Systematic reviews and meta-analyses have found that the drinking-driving policies that are highly effective include lowered blood alcohol concentration (BAL) levels, unrestricted (random) breath testing, administrative license suspension, and lower BAL levels and graduated licenses for young drivers. Whilst alcolocks can be used as a preventive measure, their use for drink driving offenders lasts for only as long as the device is fitted. Systematic reviews find no evidence for an effective impact from designated driver and safe drive programmes or from school-based education courses. To be effective, drink driving laws must be publicized, and there is evidence for the effectiveness of mass media campaigns. If the public is unaware of a change in the law or an increase in its enforcement, it is unlikely that it will affect their drinking and driving. When incorporated as part of community programmes, drink driving measures appear to have increased effectiveness.

Drink driving and policies in Europe

The 2001 European Commission Recommendation on the maximum permitted blood alcohol content (BAL) for drivers of motorized vehicles called for all Member States to adopt a BAL of 0.5g/L lowered to 0.2g/L for inexperienced, two-wheel, large vehicle or dangerous goods drivers, and random breath testing so that everyone is checked every 3 years on average. Currently, four EU Member States have a BAL of greater than 0.5g/L (Ireland, Luxembourg, Malta, and United Kingdom). The proportion of road traffic fatalities appears to be higher in countries with higher limits. 43% of European drivers admit to driving one day or more per week after having drunk alcohol, and some 5% of European drivers state that they thought they had driven over the legal limit of BAL one day or more in the past week. Drink drivers were much more likely to be men than women, with surprisingly little difference by age, and were more likely to have a lower level of education, to have been previously punished for drinking and driving and to be more frequent drinkers than non-drink drivers. Drink driving accidents are much more common amongst men than women and are particularly common amongst teenagers and young adults, whereas drink driving fatalities are more common amongst a slightly older age group. Enforcement activity seems to be fairly low across Europe, with only 26% of drivers in 23 European countries studied stating that they had been tested for alcohol over the last three years. 86% of drivers in countries where RBT is not allowed declare they have not been checked in the last three years compared with 65% in countries where RBT is allowed. Further, in countries where RBT is not allowed 46% of drivers think they will never be checked, compared to 22% of drivers in countries where RBT is allowed.

Cost effectiveness of drink driving policy measures

Nearly one half of European drivers think that drivers should not be allowed to drink any alcohol before driving. Three quarters of Europeans would agree to a lower blood alcohol level for young and novice drivers of 0.2 g/l, and eight in ten Europeans believe that random police alcohol checks on EU roads would reduce peoples' alcohol consumption before driving. It has been estimated that unrestricted breath testing in Europe, compared with no breath testing, could avoid 111,000 years of disability and premature death at an estimated cost of €233 million each year. A number of criticisms against reducing BAL levels are unfounded, in that there is good evidence that critical driving related skills are adversely affected at BALs below 0.5g/L; there is good evidence that lower BAL levels would save lives; lower BALs would not interfere with social drinking; lowering the BAL limit is likely to increase, rather than decrease, public support for the law; lower BAL levels can reduce 'hard core' drinking drivers; it is unlikely that lower BAL levels would overburden the courts; and the benefits of a lower BAL level would far outweigh any extra enforcement costs.

1. INTRODUCTION

Although alcohol-related traffic accidents have been decreasing throughout the European Union (EU), driving whilst under the influence of alcohol continues to be an important cause of road traffic crashes, contributing annually to at least 17,000 deaths on EU roads. The EU has the goal of halving the number of people killed on European roads from 50,000 in the year 2000 to 25,000 by 2010, and efforts to curb drink-driving can make a substantial contribution to achieving this objective. Blood Alcohol Level (BAL) in grams per litre of blood is the allowed level of alcohol in blood of drivers. Comparison of BALs of drivers in accidents with the BALs of drivers not involved in accidents find that drivers who had BALs between 0.2g/l and 0.49g/l had at least a three times greater risk of dying in a single vehicle crash. The risk increased to at least 6 times with a BAL between 0.5g/L and 0.79g/L and 11 times with a BAL between 0.8g/l and 0.99 g/L. The Commission's Communication on alcohol calls for an enforced maximum limit of 0.5g/L or less, and notes that effective enforcement of drink-driving countermeasures could substantially reduce traffic deaths, injuries and disability by up to 25% in the case of men, and up to 10% in the case of women. Efficient policies are those that rely on the introduction and enforcement of frequent and systematic random breath testing, supported by education and awareness campaigns involving all stakeholders. The Communication also notes that lower or zero BAL limits should be introduced for young and novice drivers and, for safety reasons, also for public transport drivers and drivers of commercial vehicles. This report will describe the evidence for these policies, placing particular emphasis on the need for lower BAL levels, supported by high visibility random breath testing.

Causing 7.4% of all ill-health and premature death, alcohol is the third-leading risk factor for death and disability in the European Union. After alcohol-related neuropsychiatric conditions, the biggest burden arises from injuries (Anderson & Baumberg 2006). In 2005, 41,600 people were killed in road traffic accidents in the EU and more than 1.5 million were injured in accidents recorded in official statistics. The true number of people injured in road accidents is unknown, but it is agreed that it is considerably higher than the officially recorded number (Townsend et al 2006). In 2004, the estimated annual costs, both direct and indirect, of traffic injury in the EU-15 countries exceeded €180 billion (European Transport Safety Council 2007).

Although decreasing throughout Europe, traffic fatalities per million passenger cars remain higher in the newer Member States than in southern Europe, which are higher than in northern Europe, Figures 1-2 (European Transport Safety Council 2006).

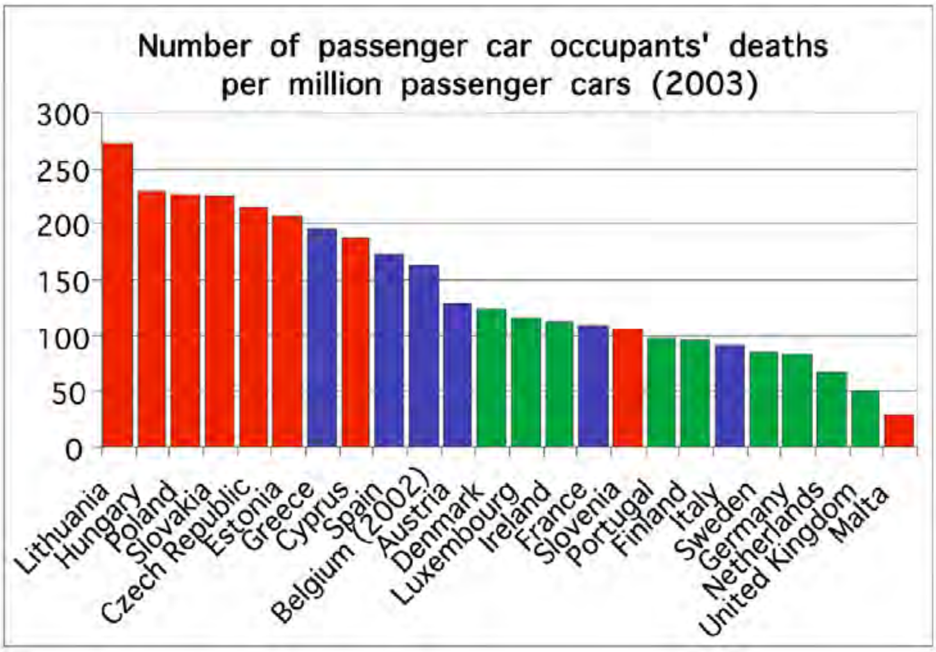

Figure 1. Number of passenger car occupants' deaths per million passenger cars, 2003. Red: newer Member States; Blue: southern European countries; Green: northern countries. Source: (European Transport Safety Council 2006).

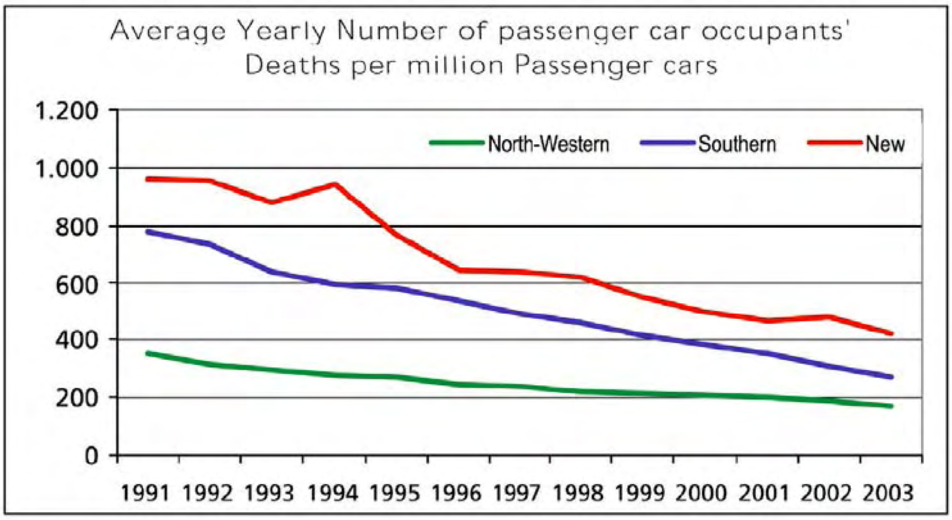

Figure 2. Number of passenger car occupants' deaths per million passenger cars, 2003. Red: newer Member States; Blue: southern European countries; Green: northern countries. Source: (European Transport Safety Council 2006).

1.1. ALCOHOL-RELATED ROAD TRAFFIC ACCIDENTS IN EUROPE

Table 1 summarizes the reported rates of alcohol involvement in fatal crashes as well as the different parameters that are used for measurement in a number of European countries. As can be seen from the table, reported alcohol involvement in fatal crashes varies widely from rates of less than 10 percent (based on either illegal alcohol levels or the detection of any alcohol) to rates of more than twenty per cent.

The best estimate from the Global Burden of Disease study of the World Health Organization suggests that more than 1 in 3 road traffic fatalities in the European Union are due to alcohol (Anderson & Baumberg 2006). These 17,000 alcohol-related traffic deaths are not equally split between genders, with 15,000 male deaths compared to 2,000 deaths for females. It has also been estimated that 2%-3% of all journeys in the older EU15 Member States have a driver who has consumed alcohol (European Transport Safety Council 2003), with research consistently showing that the share of alcohol involvement rises with the severity of the problem. For example, alcohol-related accidents were 11% of all traffic accidents in Latvia in 1999, but accounted for 32% of serious and 39% of fatal accidents (Baltic Data House 2001). Looking only at damage to property, the cost of alcohol-related traffic accidents in the EU has been estimated to be €10bn in 2003 (Anderson & Baumberg 2006).

Data from the Health for all database of the World Health Organization (2007) shows that road traffic accidents involving alcohol have decreased in the European Union from some 34 per 100,000 population in 1980 to below 20 in 2004, with at present, very small differences between older and newer Member States, Figure 3.

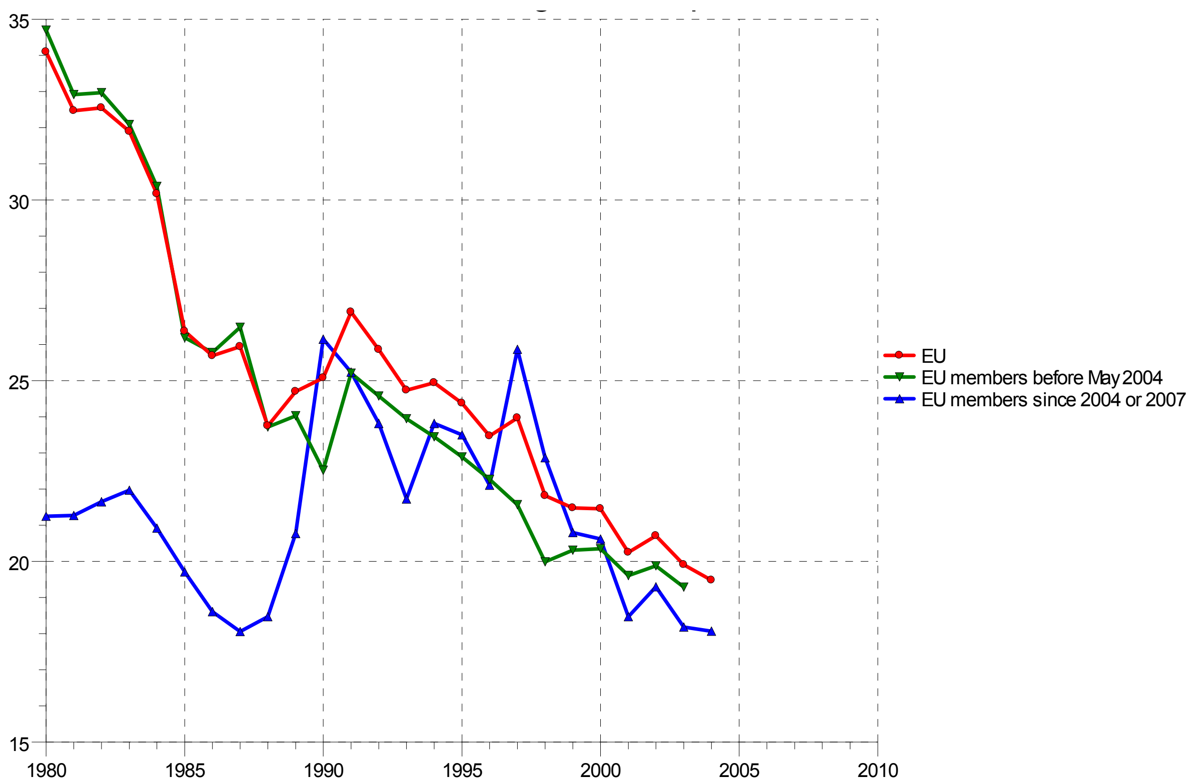

Figure 3 Road accidents involving alcohol per 100,000 population, EU (27 MS), EUMS before May 2004 (15), EU MS since 2004 (12). Source: World Health Organization Health for all Database.

Table 1 Alcohol involvement in fatal crashes in a number of European countries.

Country	Percent of Alcohol Involvement	Definition of Alcohol-Involved	Percent of Drivers Tested	Percent of Pedestrians Tested
Austria	8.5% at 0.5g/L or higher (1998)	▪ Illegal BAC for Driver ▪ Illegal BAC for Pedestrian	Unknown - no systematic testing of drivers	Unknown
Belgium	8.9% had any alcohol (1998). Illegal BAC is 0.5g/L	▪ Any Alcohol in Driver ▪ Any Alcohol in Pedestrian	24.7% of drivers and pedestrians	
Denmark	20.2% (1995) at 0.5g/L or higher	▪ Illegal BAC for Driver	49% of drivers in fatal accidents (1996 data); 75% of fatally injured drivers	47% of pedestrians in fatal accidents; 49% of fatally injured pedestrians. 28% of cyclists in fatal crashes; 31% of fatally injured cyclists
Finland	24% of fatally injured drivers at 0.5g/L or higher	▪ Illegal BAC for Driver ▪ Alcohol Measure Only for Driver Fatality ▪ Alcohol Measure for All Drivers	Compulsory	
France	19% at 0.5g/L or higher (1998)	▪ Illegal BAC for Driver ▪ Alcohol Measure for All Drivers	Approximately 90%	Unknown
Germany	17% at 0.3g/L or higher (1997) The illegal BAC is 0.5g/L.	▪ Alcohol Measure for All Drivers	Unknown - each State may determine testing rules. Testing only takes place if alcohol is suspected by police.	Unknown - not obligatory, State may determine
Netherlands	7.8% had any alcohol (1998) Illegal BAC is 0.5g/L.	▪ Alcohol in Driver ▪ Alcohol Measure for All Drivers	68.3% (mostly non-injured drivers, some injured drivers, very few dead drivers)	Few cyclists; no pedestrians
Spain	41% had any alcohol. 29% over illegal limit (0.8g/L) (Jan. and Feb., 1998)	▪ Any Alcohol in Driver ▪ Any Alcohol in Pedestrian ▪ Illegal BAC for Driver ▪ Illegal BAC for Pedestrian ▪ Alcohol Measure Only for Driver Fatality	17.5%	Unknown
Sweden	3.3% were suspected by police of alcohol involvement (official statistic). 18% had alcohol based on fatally injured drivers autopsied (1998)	▪ Police Suspicion ▪ Alcohol Measure Only for Driver Fatality	> 90% autopsied. Official statistics based on police suspicion only	> 90%
United Kingdom	10% of motorcyclists;, 19% of cars and other motor vehicles at 0.8g/L or higher (1998)	▪ Illegal BAC for Driver	68% (48% by police, 20% by coroner's courts)	39% of pedestrians; 39% of cyclists

Source: US National Highway Traffic Safety Administration, 2001

Data from the United Kingdom suggest that less than half of the people killed or seriously injured in alcohol-related traffic crashes are the alcohol-influenced drivers themselves (Department for Transport 2004), while similar results have been reported in the US (Miller, Lestina, and Spicer 1998). Applying the UK proportion to the Global Burden of Disease figures above gives the estimate that some some three fifths of the 17,000 alcohol-related traffic deaths in the EU each year are deaths to people other than the driver, including pedestrians, passengers and non-drinking drivers(Anderson & Baumberg 2006). Motorcyclists, cyclists and undetermined deaths/serious casualties are not included in these calculations as the division between riders under the influence of alcohol and others is not possible from the data. The UK data includes all crashes involving an alcohol influenced driver, while the mortality estimate is for the smaller number of deaths caused by (not just involving) alcohol-influenced drivers.

1.2. DRINKING AND DRIVING DEFINED

The generally favoured term for the criminal action of driving a vehicle under the influence of alcohol is “drinking-driving” (WHO 2005). Drinking-driving accidents are a problem in any country that makes substantial use of motor vehicles for transportation. For this reason a variety of drinking-driving countermeasures have been developed, and many of them are among the most heavily researched strategies to reduce alcohol-related problems. This report will describe the results of the evaluation of these strategies, placing particular emphasis on legal blood alcohol concentration levels and their enforcement.

1.3. METHOD OF PREPARING THE REPORT

This report is not meant to be a series of new meta-analyses[1] or systematic reviews[2], but rather an expert synthesis of published reviews, systematic reviews, meta-analyses and individual papers. To begin with, source materials were identified from Anderson & Baumberg (2006), as well as the World Health Organization’s World Report on Road Traffic Injury Prevention (Peden et al, Eds., 2004) and the World Health Organization’s report on Injuries and Violence in Europe (Sethi et al 2006), the Motor Vehicle Section of the guide to Community Prevention Services of US Centers for Disease Control and Prevention (Centers for Disease Control and Prevention 2007), with additional source material to update the evidence base identified through literature searches using PubMed,[3] MEDLINE,[4] and PsychINFO[5], with the following search terms:

Alcohol + drinking driving
Alcohol + driving
Blood alcohol concentration + driving

[1] A meta-analysis is the use of statistical techniques in a systematic review to integrate the results of included studies. Sometimes misused as a synonym for systematic reviews, where the review includes a meta-analysis. Glossary of Terms in the Cochrane Collaboration (2005).
[2] A systematic review is a review of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyse data from the studies that are included in the review. Statistical methods (meta-analysis) may or may not be used to analyse and summarise the results of the included studies. Glossary of Terms in the Cochrane Collaboration (2005).
[3] http://www.pubmedcentral.nih.gov/.
[4] http://medline.cos.com/.
[5] http://www.psycinfo.com/.

Blood alcohol levels + driving
Young drivers + alcohol
Inexperienced drivers + alcohol
Unrestricted breath testing + alcohol + driving
Random breath testing + alcohol + driving
License suspension + alcohol
Alcohol locks
Server training + alcohol + driving
Civil liability + alcohol + driving
Designated driver + alcohol
Safe ride + alcohol
Education + alcohol + driving
Mass media + alcohol + driving
Treatment + alcohol + driving
Community programmes + alcohol + driving
Price + alcohol + driving
Tax + alcohol + driving
Availability + alcohol + driving
Advertising + alcohol + driving

The report is dependent on the available published literature, which is not always representative of all countries, cultures and population groups. Although the literature base is growing throughout Europe (Sanchez-Carbonell *et al.* 2005), it is still heavily dominated by North American literature.

The report has followed the definitions of evidence-based medicine modified for the purpose of alcohol policy. This can be defined as 'the conscientious, explicit and judicious use of current best evidence in informing decisions about alcohol policy' through an approach that 'promotes the collection, interpretation, and integration of valid, important and applicable research-derived evidence that can support alcohol policy' (adapted from Sackett *et al.* 2006). In adopting an evidence-based approach, it is relevant to note the importance of doing this pragmatically and realistically. As Gray (Gray 2001) states, *'The absence of excellent evidence does not make evidence-based decision making impossible; what is required is the best evidence available, not the best evidence possible'.*

1.4. STRUCTURE OF THE REPORT

Chapter 2 of the report will describe the relationship between blood alcohol concentrations and the risk of driving accidents. Chapter 3 will describe evidence that regulating the availability and marketing of alcohol can reduce drink driving accidents. Chapter 4 will summarize the evidence for whether or not a variety of drink driving countermeasures can reduce drinking and driving including blood alcohol concentration levels, measures for young or inexperienced drivers, unrestricted (random) breath testing, license suspension, alcohol locks, server training and civil liability, designated driver and safe ride programmes, educational and treatment approaches, and community programmes. Particular emphasis will be placed on legal blood alcohol concentration levels and their enforcement. Chapter 5 will describe the profiles of drink drivers in Europe, and summarize existing drink driving polices in Europe. Chapter 6 will describe cost effective approaches to reducing drinking and driving. Finally, Chapter 7 will list conclusions and recommendations.

2. DRINKING AND DRIVING

Impairment of driving-related skills, including decreased vigilance, increased drowsiness, and impaired vision, psychomotor skills, information processing, and divided attention skills increase in a dose response manner with the level of alcohol in the blood, with no evidence of a threshold effect. The risk of a crash also increases with the level of alcohol in the blood in a dose dependent manner, and, again, there is no evidence of a threshold effect. Infrequent drinkers are at particular risk of an alcohol-related crash at any given blood alcohol level.

2.1. ALCOHOL AND IMPAIRED DRIVING

A systematic review of 109 studies on the effects of low doses of alcohol concluded that there is strong evidence that impairment of some driving-related skills begins with any departure from a zero BAL (Moskowitz & Fiorentino 2000). Moreover, those skills and abilities considered to be most important for driving were among the most sensitive to alcohol (Chamberlain & Solomon 2002).

Vision
BALs between 0.3g/L and 0.5g/L interfere with voluntary eye movements and impair the eyes' ability to rapidly track a moving target (National Institute on Alcohol Abuse and Alcoholism 1994). The ability to track objects is critical to driving, as drivers must be able to focus on objects and track them as they move in relation to their own vehicle. A driver's ability to focus is impaired by alcohol's relaxing effect on the muscle that controls the shape of the eye's lens (American Automobile Association 1994). In addition, drivers who have been drinking move their eyes less frequently and fixate on one area for longer periods of time. Drinking drivers may also suffer from double vision, which affects the driver's ability to judge distance, which has been found to be impaired at BALs of 0.47g/L (Moskowitz & Fiorentino 2000). As a result of this decreased depth perception, drivers may have difficulty changing lanes, passing other cars, or determining whether a vehicle is moving toward or away from them (American Automobile Association 1994).

Alcohol can also affect a driver's night vision (Institute of Alcohol Studies 2000). Drivers who have been drinking have a slower recovery rate from headlight glare, as it takes longer for their pupils to enlarge again after being exposed to bright light (American Automobile Association 1994). Finally, drivers who have consumed relatively moderate amounts of alcohol have reduced peripheral vision, and are less likely to perceive or recognize objects and signals outside the central visual field, with a deficit in peripheral detection ability of 6% at a BAL of 0.2g/L, and 20% at BALs between 0.5g/L and 0.8g/L (Beirness (1995).

Vigilance and drowsiness
Low doses of alcohol have a negative effect on vigilance and drowsiness (Moskowitz & Fiorentino 2000), with impairment of vigilance tasks at BALs of 0.3g/L and above. Further, drivers with BALs as low as 0.1g/L are likely to fall asleep faster than sober drivers (Moskowitz & Fiorentino 2000). Even small amounts of alcohol can enhance the effects of drowsiness, and the risk patterns for drowsy and drinking drivers often overlap (NCSDR/NHTSA 1997). As with alcohol related crashes, driver fatigue crashes most often occur during late night hours (NCSDR/NHTSA 1997; Haworth &

Rechitzner 1993) or on the weekend (Fell & Black 1996), involve a single vehicle (NCSDR/NHTSA 1997), and cause serious injuries or death (Hartley & Mabbott (1998). Alcohol related and driver fatigue crashes are also more likely to involve young male drivers than other types of crashes (NCSDR/NHTSA 1997).

Psychomotor skills
Low doses of alcohol can adversely affect the psychomotor skills related to driving, especially steering and braking. One study indicated that significant impairment of steering ability begins with BALs of 0.35g/L (Linnoila et al 1980). Similarly, a Canadian study conducted on closed roads and airport taxiways found that subjects with a mean BAL of 0.6g/L had significantly impaired performance in steering accuracy (Smiley et al 1995). In another study, drivers with a mean BAL of 0.42g/L hit substantially more cones in an evasive manoeuvre at 50 km per hour (Laurell 1979). Finally, an American experiment, which tested impairment at various BALs on a closed driving course, found that braking ability was decreased by approximately 30% at BALs of 0.3g/L (Cormier 1995).

Information processing
Alcohol consumption adversely affects the brain's ability to process information. Drivers who have been drinking take longer to respond to stimuli like road signs and traffic signals. As a result, they tend to take notice of fewer sources of information than drivers with zero BALs (National Institute on Alcohol Abuse and Alcoholism 1994). Alcohol also affects the ability to reason and form a decision, which results in drivers taking longer to respond to road hazards (Barzelay 1986). The risk of an inappropriate or inaccurate response occurs at BALs as low as 0.21g/L. Thus, drivers who have consumed even small amounts of alcohol are less likely to respond as quickly or appropriately when confronted by a hazard requiring a quick decision.

Divided attention skills
In addition to information processing, drivers' ability to recognize and respond appropriately to dangerous situations is also dependent on the ability to divide their attention between or among tasks. Experimental studies have reported that small amounts of alcohol have their greatest effects on divided attention skills, which may be impaired even at BAL levels below 0.1g/L (Moskowitz & Fiorentino 2000). These effects of alcohol were examined in a US study, involving 168 subjects of various ages with different patterns of drinking Moskowitz et al (2000). It required the subjects to perform both divided attention and driving simulator tasks. The divided attention test required the subjects to perform a tracking task in combination with a peripheral search and recognition task. During the divided attention tasks, the researchers measured reaction time, tracking error, and the number and percentage of incorrect responses on the peripheral search and recognition task. The measures most sensitive to low doses of alcohol were tracking error and reaction time, Figure 4. The driving simulator examined speed deviation, lane deviation, the number of times over the speed limit, reaction time, the number of collisions, and the number and percentage of incorrect responses to peripheral road signals. Of these, the most sensitive to small amounts of alcohol were lane deviation, speed deviation, and the number of times the subject exceeded the speed limit, Figure 5.

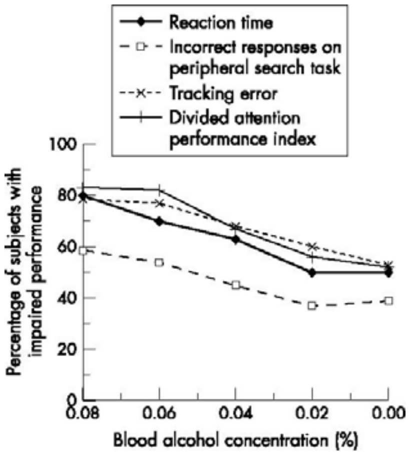

Figure 4 Impairment of selected divided attention tasks at various BALs (0.04%=0.4g/L). Source: Moskowitz et al (2000).

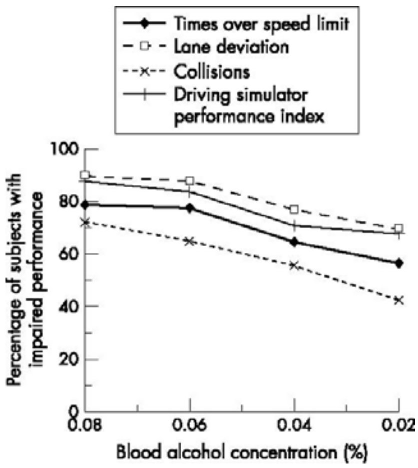

Figure 5 Impairment of selected skills on a driving simulator at various BALs (0.04%=0.4g/L). The last tests on the simulator were conducted when the subjects' BALs were 0.2g/L. Source: Moskowitz et al (2000).

Overall, the study found that, at a BAL of 0.4g/L, more than half of the subjects were impaired in all but two of the 14 response measures. By 0.6g/L, more than half were impaired in all of the responses measured. The individual response measures for each part of the study were added together to produce a composite performance index for the divided attention skills and for the driving simulator tasks. As indicated in the figures above, the majority of the driving population is impaired in some important measures at BALs as low as 0.2g/L BAL.

2.2. RISK OF CRASH BY BAL LEVELS

Beginning with Borkenstein's Grand Rapids Study in 1964 (Borkenstein et al 1964), early studies established that a driver's relative risk of crash is directly related the BAL level. Similar early studies were performed in Vermont (1971) (Perrine et al 1971) and Adelaide, Australia (1980) (Mclean et al 1980). At BALs of 0.7g/L to 0.8g/L, the three studies showed accident involvement ratios of 1.77, 3.2 and 4.1, respectively.

A 1991 American study reported that, for drivers with BALs in the 0.5g/L to 0.9g/L range, the risk of a fatal single vehicle crash for males aged 25 and over was nearly nine times higher than for their counterparts with BALs of 0.1g/L or below (Zador 1991). Updating the 1991 study using 1996 data, it was found that for each 0.2g/L increase in the BAL of a driver with a non-zero BAL the risk of receiving a fatal injury in a single vehicle crash among male drivers aged 16–20 years more than doubled and the comparable risk among the other driver groups nearly doubled (Zador et al 2000). The relative risks rise sharply in the 0.8g/L to 0.99g/L BAL range, Table 2. Canadian research has also found that drivers with BALs of 0.5g/L to 0.8g/L are 7.2 times more likely to be involved in a fatal crash than drivers with zero BALs (Traffic Injury Research Foundation 1996).

The risks are greater for serious and fatal crashes, for single-vehicle crashes, and for younger people. The use of alcohol increases both the possibility of being admitted to hospital from drink-drive injuries, and the severity of the injuries (Borges *et al.* 1998).

Table 2. Relative risk of fatal single vehicle crash for males at various BACS.

	BAC (%)			
Age	0.020–0.049	0.050–0.079	0.080–0.099	0.100–0.149
16–20	4.64	17.32	51.87	240.89
21–34	2.75	6.53	13.43	36.89
≥35	2.57	5.79	11.38	29.30

The study used a baseline relative risk of 1.00 for drivers with 0.00% BACs of the same age and sex as the respective study groups. That is, 16–20 year old males were compared to 16–20 year old males with 0.00% BAC, whose relative risk was taken to be 1.00.
Source: Zador PL, Krawchuk SA, Voas RB. Alcohol-related relative risk of driver fatalities and driver involvement in fatal crashes in relation to driver age and gender: an update using 1996 Data. *J Stud Alcohol* 2000;**61**:387–95.

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Research also shows that the relative risk of crash per trip at low to moderate BALs is much higher for infrequent drinkers than for regular drinkers with the same BAL. For example, an American report indicated that, at a BAL of 0.6g/L, the risk of crash relative to their sober counterparts increases nearly 700% for those who drink on an annual basis, 425% for those who drink monthly and only 50% for those who drink daily (Snyder 1992).

2.3. CONCLUSIONS

The majority of the driving population is impaired in some important driving skills at blood alcohol levels as low as 0.2g/L BAL, and some fourth fifths of the driving population are impaired at blood alcohol levels of 0.5g/L. This is reflected in the relationship between blood alcohol level and the risk of a crash, which increases with increasing blood alcohol concentration, with no evidence for a threshold effect. The relationship is exponential, with huge increases in crash risk at high blood alcohol levels. The evidence leads to the conclusion that there should be no drinking alcohol and driving, and that legal blood alcohol concentrations for driving should be as low as possible, and certainly no greater than 0.2g/L.

3. REGULATING THE AVAILABILITY AND MARKETING OF ALCOHOL AND DRINK DRIVING ACCIDENTS

Policies that regulate the alcohol market, including the price of alcohol, the location, density, and opening hours of sales outlets, minimum legal purchase ages, and controls on the availability of alcohol, and on the promotion and advertising of alcohol can all have an impact in reducing drinking and driving and related fatalities.

3.1. PRICE OF ALCOHOL

A wide range of studies have found that increasing the price of alcohol and beer reduces road traffic accidents and fatalities among people of all ages, but particularly for younger drivers (Saffer and Grossman 1987a, b; Kenkel 1993; Ruhm 1996; Dee 1999; Mast *et al.* 1999; Dee and Evans 2001; Chaloupka *et al.* 2002 Saffer and Chaloupka 1989; Evans *et al.* 1991; Chaloupka *et al.* 1993; Sloan *et al.* 1994a; Mullahy and Sindelar 1994a). For example, it has been estimated that a policy adjusting the US beer tax for the inflation rate since 1951 to the mid-1980s would have reduced total road traffic fatalities by 11.5 percent and fatalities among 18- to 20-year-olds by 32.1 percent (Chaloupka *et al.* 1993).

3.2. AVAILABILITY OF ALCOHOL

Minimum legal purchase age

Although legal restrictions on the age at which young people may purchase alcohol vary widely from country to country, ranging typically from 16 to 21 years of age, almost all countries legally restrict these sales. A review of 132 studies published between 1960 and 1999 found very strong evidence that changes in minimum drinking age laws can have substantial effects on youth drinking and alcohol-related harm, particularly road traffic accidents, often for well after young people reached the legal drinking age (Waagenar and Toomey 2000). Many studies have found that raising the minimum legal drinking age from 18 to 21 years in the United States decreased single vehicle night time crashes involving young drivers by 11% to 16% at all levels of crash severity (Klepp *et al.* 1996; Saffer and Grossman 1987a, b; Wagenaar 1981 1986; Wagenaar and Maybee 1986; O'Malley and Wagenaar 1991; Voas and Tippett 1999). The full benefits of a higher drinking age are only realized if the law is enforced. Despite higher minimum drinking age laws, young people do succeed in purchasing alcohol (e.g., Forster *et al.* 1994 1995; Preusser and Williams 1992; Grube 1997). In most EU countries in the ESPAD study, a majority of 15-16 year old students thought that getting any type of alcoholic beverage was fairly easy or very easy, rising to 70%-95% for beer and wine (Hibell *et al.* 2004). Such sales result from low and inconsistent levels of enforcement, especially when there is little community support for underage alcohol sales enforcement (Wagenaar and Wolfson 1994 1995). Even moderate increases in enforcement can reduce sales to minors by as much as 35% to 40%, especially when combined with media and other community activities (Grube 1997; Wagenaar *et al.* 2000).

A systematic review of minimum legal drinking age (MLDA) laws in the United States found that among 14 studies looking at the effects of raising the MLDA, crash-related outcomes *declined* a median of 16% for the targeted age groups, and that among 9 studies looking at the effects of lowering the MLDA, crash-related outcomes *increased* by a median of 10% within the targeted age groups, Figure 6 (Shults et al

2001). The effects were stable over follow-up times ranging from 7 months to 9 years.

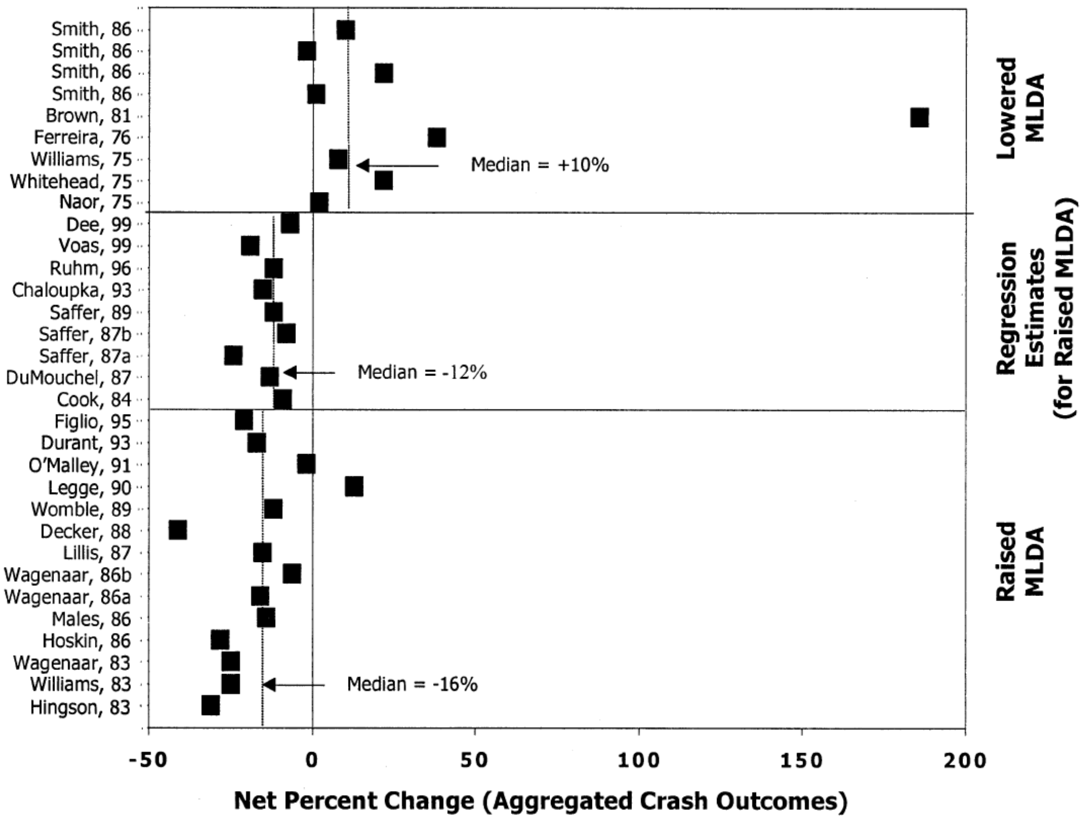

Figure 6 Net change in crash related outcomes for studies in which minimum legal drinking age laws were raised and in which minimum legal drinking age laws were lowered in the United States. For references to individual studies, see source: Shults et al (2001).

Outlet density

Outlet density refers to the number of outlets available for the retail purchase of alcohol. The smaller the number of outlets for alcoholic beverages, the greater the difficulty in obtaining alcohol, a situation that is likely to deter alcohol use and problems (Gruenewald *et al.* 1993). This can be seen in practice in Finland, Sweden, Britain and North America.

Swedish studies found an overall impact on alcohol consumption and alcohol-related harm from changes in the number of outlets (Noval and Nilsson 1984; Hibell 1984). A time-series analysis found that motor vehicle accidents were significantly reduced in three of four age groups when the right to sell 4.5% beer in groceries was retracted (Ramstedt 2002).

North American studies have looked at the association of outlet density with rates of drinking driving collisions (Blose and Holder 1987; Gruenewald *et al.* 1993). Four studies report no impact of outlet density on drinking-driving or collision measures (Gruenewald and Ponicki 1995; Kelleher *et al.* 1996; Meliker *et al.* 2004; Lapham *et al.* 2004). However, a larger number of studies (eight) have reported a significant impact of outlet density on alcohol consumption and drinking driving collision

(Scribner, MacKinnon and Dwyer 1994; Gruenewald *et al.* 1996; Gruenewald *et al.* 1999; Gruenewald et al 2002; Jewell and Brown 1995; LaScala *et al.* 2001; Treno, Grube and Martin 2003; Escobedo and Ortiz 2002; Cohen, Mason and Scribner 2002), and assaults, particularly in high population density areas (Gruenewald *et al.* 1996). On balance, the research indicates that increasing numbers of outlets will increase alcohol-related collisions and fatalities (see Mann *et al.* 2005 for a more detailed description). Outlet density has also been associated with an increased risk of pedestrian injury collisions (LaScala *et al.* 2000).

The distribution of alcohol-related crashes (single-vehicle night-time crashes) is also related to the distribution of on-premise outlets and rates of these crashes decrease with greater distance from concentrated areas (Gruenewald *et al.* 1996). Further, greater outlet concentrations have a greater impact on alcohol-related crashes in areas with greater amounts of highway traffic (Gruenewald and Johnson 2000), and in lower income areas (LaScala, Gruenewald and Gerber 2000).

The impact of changes in availability will depend on local circumstances (Abbey, Scott and Smith 1993). Thus, whereas changes occurring across a country have an impact (Gruenewald, Ponicki and Holder 1993; Wagenaar and Holder 1996), when changes in availability are more local, there may be no impact (Gruenewald *et al.* 2000b). In the first case, it is difficult to avoid the effects of reduced availability. In the local case, it is possible to travel outside the local geographic area to obtain alcohol. Further, equivalent reductions in local areas can have different effects. A 10% reduction in the number of outlets in high density areas will have negligible effects on the distances between people and outlets. A 10% reduction in the number of outlets in low density areas may result in the elimination of the only outlets easily accessible by drinkers.

Hours and days of sale

A number of studies have indicated that although changing either hours or days of alcohol sale can redistribute the times at which many alcohol related crashes and violent events related to alcohol take place (e.g., Smith 1988; Nordlund 1985), it does so at the cost of an overall increase in problems. Around-the-clock opening in Reykjavik, for instance, produced net increases in police work, in emergency room admissions and in drink-driving cases, Figure 7. The police work was spread more evenly throughout the night, but this necessitated a change in police shifts to accommodate the new work (Ragnarsdottir *et al.* 2002).

A study in Western Australia showed that extending opening hours from midnight to 1.00am increased violent incidents at the later night venues by 70% (Chikritzhs, Stockwell and Masters 1997; Chikritzhs and Stockwell 2002). The increased problems associated with the late trading venues appeared to result from increased alcohol consumption rather than increased opportunity for crime to occur, since there was no apparent difference between the two groups after controls for alcohol sales. The blood alcohol levels (BALs) of drivers in road crashes, who had been drinking at the extended trading premises, were significantly higher than those drinking at the control premises. Similar studies have also found that assaults at licensed premises are much more likely to occur during extended trading periods, with the most frequent time being midnight to 3am (Briscoe and Donnelly 2003a).

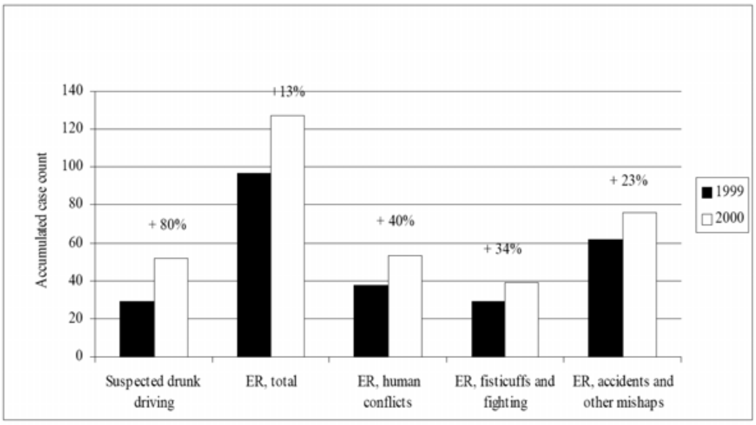

Figure 7 Iceland: impact of 24 hour opening of bars and restaurants. Source: Ragnarsdottir *et al.* (2002).

3.3. MARKETING OF ALCOHOL AND DRINK DRIVING

One way to study the impact of commercial communications on alcohol is to consider the relationship between expenditure on commercial communications, or whether or not there are bans on alcohol advertisements in a jurisdiction and drinking by young people. There have been different findings from such studies (see Calfee and Scheraga 1994; Saffer 1995 1996). Some studies have suggested significant effects of alcohol advertising on alcohol-related problems (Saffer 1991 1997; Saffer and Dave 2004). Countries with partial restrictions had 16% lower alcohol consumption rates and 10% lower motor vehicle fatality rates than did countries with no restrictions, and countries with complete bans on television alcohol advertisements had 11% lower consumption rates and 23% lower motor vehicle fatalities rates than did countries with partial restrictions (Saffer 1991 1993). After accounting for regional price differences and population variables such as income and religion, increases in alcohol advertising were found to be significantly related to increases in total and night time vehicle fatalities across US states (Saffer 1997). It was estimated that a total ban on alcohol advertising might reduce motor vehicle fatalities by as much as 5,000 to 10,000 lives per year.

One US study that used longitudinal data showed that market-level alcohol advertising expenditures were related positively to self-reported exposure to alcohol advertising and to individual-level alcohol consumption among youth and young adults, although the effects were small (Snyder *et al.* 2002). Amongst American 15-26 year olds (who at baseline, on average, saw 23 advertisements per month, were exposed to $3.4 per adult worth of advertisements per year, and who consumed 38.5 drinks per month), 21 months after baseline, for every 4% more alcohol advertisements seen on TV, radio, billboards and in magazines at baseline, they drank 1% more drinks per month, and for every 15% more exposure in their media market on alcohol advertising, they drank 3% more drinks per month (Snyder et al 2002).

Amongst US 12 to 16 year-olds, the elasticity of advertising expenditure with respect to past month alcohol use was estimated at about 0.08 and with respect to past month binge participation at about 0.14 (Saffer and Dave 2003). The data suggested that the complete elimination of alcohol advertising could reduce adolescent monthly alcohol use by about 24% and binge participation by about 42%. The size of the effect was similar to a doubling of the price of alcohol, which was estimated to reduce adolescent monthly alcohol use by 28%, and binge drinking by 51%.

Econometric studies of the impact of advertising have a number of weaknesses that stem from the fact that they are dependent on the construction of complex equations to model an extremely sophisticated social phenomenon (Smart 1988; Godfrey 1989; Harrison and Godfrey 1989; Saffer 1996); data on key variables, most notably advertising expenditure, are often missing; advertising spending is assumed to be an accurate marker of advertising effectiveness, whereas content is also important (Strickland 1982); models do not account for consumers' active involvement in the communication process (Casswell 1995), leading to more effective advertisements (Casswell and Zhang 1998); complications such as feedback, the potential reciprocity of advertising and consumption levels, and advertising wear-out are frequently ignored; and they focus on advertising and ignore the integrated nature of marketing. Not surprisingly, therefore, other studies have concluded that a total ban on broadcast alcohol advertising has no measurable effects on alcohol consumption, probably and largely due to substitution effects (Nelson 2003).

3.4. Conclusions

Jurisdictions that implement effective and comprehensive alcohol policies to reduce the harm done by alcohol, including policies that manage the price of alcohol, that regulate the availability of alcohol, and that regulate the marketing of alcohol, will also benefit from reduced drink driving accidents and fatalities. With regard to legal minimum ages to purchase alcohol, which are effective in reducing alcohol related road traffic crashes, these only work if they are adequately enforced.

4. DRINK DRIVING COUNTERMEASURES

Systematic reviews and meta-analyses have found that the drinking-driving policies that are highly effective include lowered blood alcohol concentration (BAL) levels, unrestricted (random) breath testing, administrative license suspension, and lower BAL levels and graduated licenses for young drivers. Whilst alcolocks can be used as a preventive measure, their use for drink driving offenders lasts for only as long as the device is fitted. Systematic reviews find no evidence for an effective impact from designated driver and safe drive programmes or from school-based education courses. To be effective, drink driving laws must be publicized, and there is evidence for the effectiveness of mass media campaigns. If the public is unaware of a change in the law or an increase in its enforcement, it is unlikely that it will affect their drinking and driving. When incorporated as part of community programmes, drink driving measures appear to have increased effectiveness.

A variety of drink driving countermeasures have been introduced in an attempt to reduce drinking and driving including blood alcohol concentration levels, measures for young or inexperienced drivers, unrestricted (random) breath testing, license suspension, alcohol locks, server training and civil liability, designated driver and safe ride programmes, educational and treatment approaches, and community programmes. This chapter will review the evidence for their effectiveness, placing particular emphasis on legal blood alcohol concentration levels and their enforcement.

4.1. BLOOD ALCOHOL LEVELS

Effects of introducing a legal limit

Studies evaluating the impact of introducing laws that set a legal BAL limit are summarised in Table 3 (Mann et al 2001). Beneficial effects were usually found when legal limits were introduced, although the magnitude of these effects varied considerably. For example, the impact of introducing a 0.8g/L limit appeared to be much stronger in the UK than in Canada. Beneficial effects often appeared to decrease over time, perhaps due to declining perceived risk of apprehension (Ross, 1973). This variability could depend on many factors, such as differences in the measures used (e.g. collision measures specific to alcohol vs. total collisions) and in the historical and social contexts of the countries involved. Differences in the methodologies used in these studies likely contributed to differences in findings. The range in methodological rigour is substantial, going from description of trends in a limited number of measures (e.g. Van Ooijen, 1977) to sophisticated and comprehensive regression and time series analyses (Ross, 1973; Voas et al., 2000). Many studies have been simple pre–post comparisons (e.g. Carr et al., 1974; Van Ooijen, 1977; Noordzij, 1977, 1994), and, therefore, subject to many potential sources of bias such as historical confounding and changes in broader social context (Campbell and Stanley, 1967). The strongest evidence for the impact of introducing a BAL law is observed in studies employing the most rigorous designs and analytical procedures (Ross, 1973; Phillips et al., 1984; Zador et al., 1989; Voas et al., 2000).

Table 3 Summary of research evaluating the introduction of a legal BAL limit (from Mann et al 2001).

Location	Authors	Measures	Design/analysis	Impact
United Kingdom, introduction of 80 mg% per se law in 1967	Ross (1973)	Various indicators of total and alcohol-related collisions	Time series analysis	Introduction of the per se law had a significant and in some instances dramatic impact which appeared to decrease over time
United Kingdom, introduction of 80 mg% per se law in 1967	Phillips et al. (1984)	Various indicators of total and alcohol-related collisions	Time series analysis	Analyses focused on whether there was any effect maintained over time (see above) and concluded that there was
Canada, introduction of 80 mg% per se law in 1969	Carr et al. (1974)	Various indicators of total and alcohol-related collisions; BAL levels of fatally injured drivers	Pre–post comparisons	Non-significant reductions in collision measures observed in the year after introduction; no changes in BAL levels of fatally injured drivers
Canada, introduction of 80 mg% per se law in 1969	Chambers et al. (1974)	Collision injury and fatality rates	Time series analysis	Significant reductions in injury rates; reductions in fatality rates marginally significant (P=0.11)

Japan, introduction of 0.5 mg% per se law in 1970	Deshapriya and Iwase (1996)	Fatal collisions	Pre–post comparisons	Alcohol-related and total fatalities declined after the law was introduced—no statistical analysis reported
Netherlands, introduction of 50 mg% per se law in 1974	Noordzij (1977, 1994)	Roadside survey data, indicators of alcohol-involved and total collisions	Pre–post comparisons	Substantial reduction in numbers of drinking-drivers and alcohol-related fatalities; effects on total fatalities less clear
Netherlands, introduction of 50 mg% per se law in 1974	Van Ooijen (1977)	Alcohol-injury collisions	Pre–post comparisons	Immediate and substantial impact on alcohol-related collisions, some of which appeared to wear off with time
United States, introduction of 100 mg% per se laws in 41 states between 1975 and 1985	Zador et al. (1989)	Fatal collisions with varying probabilities of alcohol involvement	Time series analysis	Significant reductions in fatal collisions with a low and medium likelihood of alcohol involvement
United States, introduction of 100 mg% per se laws in states between 1982 and 1997	Voas et al. (2000)	Fatal collisions involving drinking-drivers with low BALs (10–90 mg%) and fatal collisions involving drivers with high BALs (100 mg% and above)	Weighted least squares regression analyses	Significant reductions in drivers with low BALs and with high BALs involved in fatal collisions

Effects of reducing a legal limit

Reduced legal limits have been introduced and evaluated in parts of Canada, the United States, Australia and Europe. In the large majority of cases, the reduced limit introduced and evaluated is either 0.5g/L or 0.8g/L. Evaluations of these initiatives are summarised in Table 4 (Mann et al 2001).

Canada In 1981, the province of Ontario in Canada introduced a 12 hour roadside licence suspension for drivers who registered 0.5g/L or more on a roadside screening device (Vingilis et al., 1988). Introduction of the measure suggested a significant reduction in alcohol-involved fatalities. Further confirmation of a beneficial effect specific to the introduction of the law was obtained from an analysis of a control time series from Saskatchewan and Manitoba in which no significant effects were observed. Many of the preconditions for a successful deterrent effect were only partially met: there was no organised public education campaign, media coverage was limited, and many police forces were not equipped to enforce the new law until a substantial length of time after it was introduced, and the impact appeared to be short-lived, and had largely disappeared after several months.

Australia Several states in Australia have reduced their legal BAL limit to 0.5g/L. Queensland lowered the legal limit from 0.8g/L to 0.5g/L in 1983. There were significant reductions in the numbers of collisions that involved drivers who had been drinking, which were higher at higher BALs (reduction of 12% at BALs above 1.5g/L) than at lower BALs (reduction of 8% at BALs between 0.8g/L and 1.5g/L) (Smith 1986).

In South Australia, the legal limit for all drivers was lowered from 0.8g/L to0.5g/L in 1991. Overall, a decline of 14.1% in the proportion of drivers who were BAL positive from the 1991 pre-test to the 1993 post-test was found (Kloeden and McLean 1994). Interpretation of the data could not be conclusive, because of the possible operation of other factors such as the introduction of random breath testing or general changes in social attitudes towards drinking-driving.

Brooks and Zaal (1993) evaluated the reduction of the legal limit in the Australian Capital Territory from 0.8g/L to 0.5g/L in 1991. Comparing data from the year prior to the introduction of the law to data from the year following its introduction, BALs of tested drivers declined significantly. This effect became more pronounced as BAL levels increased; the declines among drivers with BALs below 1.5g/L (−9 and −11% for drivers in the ranges 0.8-0.99g/L and 1.0-1.49g/L respectively) were not statistically significant, while the declines among drivers at higher BALs were highly significant (−34 and −59% for drivers in the ranges 1.5-1.99g/L and 2g/L and above, respectively). The data suggest that the effects of the law were not restricted to drivers in the narrow BAL range affected, but instead exerted a very substantial effect for drivers at the highest BALs.

Table 4 Summary of research evaluating a reduction of the legal BAL limit (from Mann et al 2001)

Location	Authors	Measures	Design/analysis	Impact
Canada, introducing the 50 mg% 12-h suspension provision of the Ontario Highway Traffic Act in 1981	Vingilis et al. (1988)	Proportion of fatal collisions involving alcohol, plus various secondary measures of awareness, impact and enforcement of the law	Time series analysis	Introduction of the 50 mg% HTA provision had significant but apparently temporary impact on alcohol-related collisions, perhaps due to lack of awareness and enforcement
Australia, reduction of the legal limit in Queensland from 80 to 50 mg% in 1983	Smith (1986)	Collisions involving drinking-drivers	Pre–post comparisons	Reduction of the limit to 50 mg% resulted in a significant reduction in numbers of collision-involved drivers who had been drinking
Australia, reduction of the legal limit in the Australian Capital Territory from 80 to 50 mg% in 1991	Brooks and Zaal (1993)	Several indicators of drinking-driving and alcohol involvement in collisions	Pre–post comparisons	Reduction of the limit to 50 mg% resulted in a significant reduction in the BALs of collision-involved drivers who had been drinking, and in the BALs of drivers breath-tested by police
Australia, reduction of the legal limit from 80 to 50 mg% in 1991 in South Australia	Kloeden and McLean (1994)	Distribution of BALs among drivers in Adelaide	Pre–post comparisons	Reduction of the limit to 50 mg% resulted in a significant reduction in the BALs of drivers breath-tested in roadside surveys
Australia, reduction of the legal limit from 80 to 50 mg% in 1991 in South Australia	McLean et al. (1995)	Distribution of BALs in fatally-injured drivers and drivers tested in roadside surveys in Adelaide	Pre–post comparisons	Reduction of the limit to 50 mg% resulted in a temporary reduction in the BALs of night-time drivers and a reduction in the proportion of fatally injured drivers with BALs over 80 mg% — no statistical analyses reported
Australia, reduction of the legal limit in New South Wales and Queensland from 80 to 50 mg% between 1982 and 1992	Henstridge et al. (1997)	Numbers of serious collisions, fatal collisions and single vehicle night-time collisions	Time series analysis	Reduction of the limit to 50 mg% resulted in significant reductions in all collision and fatality measures in both states
United States, reduction of limit to 80 mg% in five states between 1983 and 1990	Johnson and Fell (1995)	Fatal collisions involving alcohol (six measures)	Pre–post comparisons	Significant reductions in nine of the 30 comparisons. Only one state (Maine) had no significant effects on any measure
United States, reduction of limit to 80 mg% in five states between 1983 and 1991	Hingson et al. (1996)	Fatal collisions involving alcohol	Pre–post comparisons, with matched control states	Significant reductions (16%) in proportion of collisions involving a driver with a BAL of 80 mg% or higher
United States, reduction of limit to 80 mg% in five states between 1983 and 1991	Scopatz (1998)	Fatal collisions involving alcohol	Pre–post comparisons, with matched control states	Significant reductions in proportion of collisions involving a driver with a BAL of 80 mg% or higher, but the magnitude varies

				depending on which states are used as comparisons
United States, reduction of limit to 80 mg% in North Carolina in 1993	Foss et al. (1999)	Various measures of alcohol involvement in collisions; BAL levels of fatally injured drivers	Multiple time series analysis with comparison states	Significant reductions in police-reported alcohol fatalities; no other significant effects observed
Location	Authors	Measures	Design/analysis	Impact
United States, reduction of limit to 80 mg% in 11 states between 1983 and 1994	Apsler et al. (1999)	Various measures of fatal collisions involving alcohol	Multiple time series analysis	Significant reductions in alcohol-related fatalities in nine out of 33 analyses
United States, states that reduced the legal limit to 80 mg% by 1997	Voas et al. (2000)	Fatal collisions involving drinking-drivers with low BALs (10–90 mg%) and fatal collisions involving drivers with high BALs (100 mg% and above)	Weighted least-squares regression	Significant reductions in drivers with low BALs and with high BALs involved in fatal collisions
Sweden, reduction of the lower legal limit from 50 to 20 mg% in 1990	Norstro¨m and Laurell (1997)	Numbers of fatal collisions, single vehicle collisions and total collisions	Time series analysis	Reduction of the lower limit to 20 mg% resulted in significant reductions in all collision and fatality measures
Sweden, reduction of the upper legal limit from 150 to 100 mg% in 1994	Borschos (2000)	Number of fatal collisions and severe injury collisions	Time series analysis	Reduction of the upper limit to 100 mg% resulted in significant reductions in fatal collisions; the impact on severe injury collisions was similar but more variable
France, reduction of the legal limit from 80 to 50 mg% in 1996	Mercier-Guyon (1998)	Numbers of fatalities involving a drinking-driver in Haute-Savoie	Pre–post comparisons	Reduction of the limit to 50 mg% was associated with a decline in the numbers of fatalities involving a drinking-driver; no analyses reported
Denmark, reduction of the legal limit from 80 to 50 mg% in 1998	Bernhoft (2000)	Proportion of injury and fatal collisions classed as DUI	Pre–post comparisons	Reduction of the limit to 50 mg% was associated with a decline in the proportion of injury collisions and an increase in the proportion of fatal collisions classed as DUI; no analyses reported
Austria, reduction of the legal limit from 80 to 50 mg% in 1998	Bartl and Esberger (2000)	Proportion of collisions involving personal injuries classed as drunk driving	Pre–post comparisons	Reduction of the limit to 50 mg% was associated with a significant decline in alcohol involvement in personal injury collisions; statistical analyses not described

The impact of several drinking-driving countermeasures, including the introduction of 0.5g/L limits, has been evaluated for the Australian states of New South Wales and Queensland (Henstridge et al., 1997). Time series analyses controlled for seasonal effects, daily weather patterns, indices of economic and road use activity, alcohol consumption and day of the week. In New South Wales, the 0.5g/L law was estimated to have reduced all serious collisions by 7%, fatal collisions by 8% and single-vehicle night-time fatal collisions by 11%. Similarly, in Queensland the 0.5g/L limit was estimated to reduce all serious collisions by 14% and fatal collisions by 18%. In these analyses the impact of other legislative initiatives, such as the introduction of random breath testing, were statistically controlled.

Sweden has two BAL limits, a lower one for drunken driving and a higher one for aggravated drunken driving (Borschos, 2000). The lower legal limit was reduced from 0.5g/L to 0.2g/L in 1990. Time series analysis, controlling for alcohol consumption and miles driven found significant reductions in fatal collisions, single vehicle collisions and all collisions of 9.7%, 11% and 7.5%, respectively (Norstrom & Laurell 1997; Norstrom 1997), Figure 8.

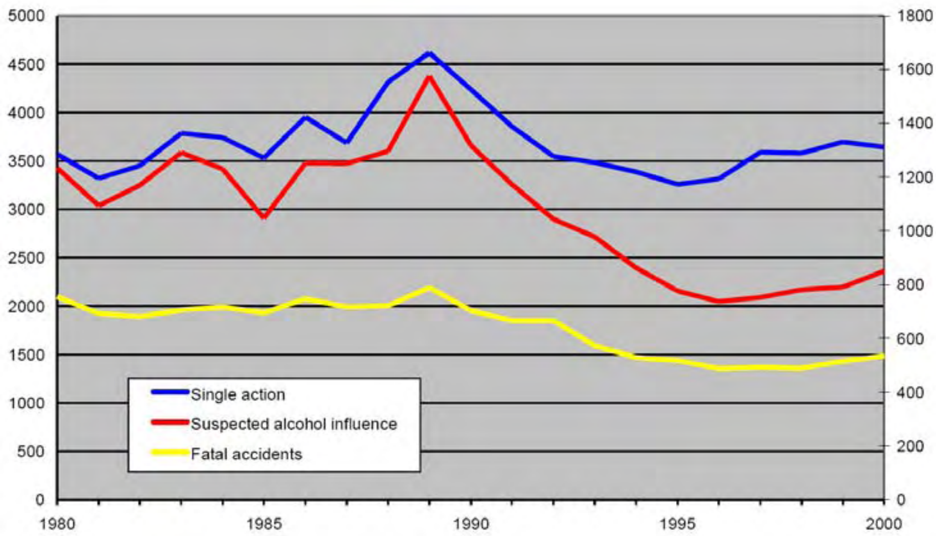

Figure 8 Reductions in single accidents (left axis, n), suspected driving under the influence of alcohol and fatal accidents (right axis, n) following the reduction of the BAL from 0.5g/l to 0.2g/L in Sweden in 1990. Source: Sporre (2001)

The age distribution of drivers had changed somewhat, and this could have accounted for about a third of the reduction in fatal collisions. This would reduce the impact on fatal collisions to about 6%. The average BAL of those convicted declined significantly from 0.168g/L before to 0.154g/L after the 0.2g/L limit was introduced, with the largest reductions appearing at the highest BAL levels.

The limit for aggravated drunken driving was reduced from 0.15g/L to 1g/L in 1994. Time series analyses controlling for the effects of alcohol sales and gasoline sales, and incorporating the reduction of the lower limit in 1990 as a control variable demonstrated a significant intervention effect of the 1994 law on fatal collisions, with reductions of about 13% being observed (Borschos 2000). The effects on severe injury collisions appeared somewhat more variable but in the same direction. The 1994 law also introduced other changes including an increase in the maximum term of imprisonment for the aggravated drunken driving offence, and thus it is not possible to ascribe the traffic safety effects of the 1994 law exclusively to the reduced legal limit.

France reduced its legal limit from 0.8g/L to 0.5g/L in 1996. Total fatalities involving a drinking-driver declined from about 100 per year in the years preceding the introduction of the law (1993 - 1995) to 64 in 1997 (Mercier-Guyon 1998). However, the effect seems to have been delayed for unknown reasons or may have involved factors additional to the introduction of the 0.5g/L limit, since the first year of operation of the new law seemed to be unaffected (111 deaths). The impact of new law was more pronounced for drivers at higher BALs (over 0.8g/L) than for drivers in the range 0.5g/L to 0.8g/L.

Denmark reduced its limit from 0.8g/L to 0.5g/L in 1998. Survey data indicated that drivers reduced the amount of alcohol consumed before driving with the new law, and that these reductions were attributed to the changed legal limit (Bernhoft 2000). Inspection of collision data suggested that while the proportion of injury collisions involving a drinking-driver (BAL of 0.5g/L or more) appeared to decline with the introduction of the law, the proportion of fatal collisions involving a drinking-driver appeared to increase. It is possible that the follow-up period of 10 months may have been too short to assess the impact of the change accurately.

Austria reduced its limit from 0.8g/L to 0.5g/L in 1998. There appeared to be declines in both the numbers of drivers with BALs over 0.8g/L and the numbers of drivers with BALs between 0.5g/L and 0.8g/L, although statistical tests were not reported (Bartl & Esberger 2000). The absolute numbers of drunk driving collisions with personal injuries appeared to decline with the introduction of the law.

Several states within the United States have reduced their legal limits to 0.8g/L. A study of the impact of lowering the legal limit to 0.8g/L in five states which had the law in place for at least 2 years (California, Maine, Oregon, Utah and Vermont) found that nine of the 30 pre–post comparisons (including fatalities that involved any alcohol, fatalities that were intoxicated (BAL>1g/L), police-reported alcohol involvement, single vehicle night time fatalities, single vehicle night time male driver fatalities, and estimated alcohol involvement (based on police reports, positive BAL tests, and recorded alcohol violations)) revealed a statistically significant drop in alcohol-related involvement (Johnson & Fell 1995). Only one state (Maine) had no significant reductions in any indicator of alcohol-related fatalities.

A study of the impact of lowering the limit from 1g/l to 0.8g/L in five states (Oregon, Utah, Maine, California and Washington) matched each state with a neighbouring state that kept a 1g/L limit over the same time period to control for regional factors that might influence road safety (e.g. economic factors local to specific areas) (Hingson et al. 1996). There was a significant reduction, across all States, in the proportion of crashes with a fatally injured driver who had a BAL of 0.8g/L or higher. In comparison to states that maintained a legal limit of 1g/L, those that introduced the 0.8g/L limit experienced a reduction of 16% in the proportion of crashes involving a fatally injured driver whose BAL was 0.8g/L or higher. This effect was not limited to drivers at the BALs affected by the law (i.e. those in the 0.8-1g/L range). The reduction was even larger (18%) for drivers with higher BALs (1.5g/L or higher), This observation suggests that reducing the legal limit by 0.2g/L to 0.8g/L had a general deterrent effect which influenced drivers at all BAL levels, although some of this effect may have been due to other factors acting to reduce impaired driving, such as the introduction of Administrative Licence Revocation in some of the states over the time period examined.

Another study of the impact of lowering the limit from 1g/l to 0.8g/L in the same five states (Oregon, Utah, Maine, California and Washington), but this time not restricting comparison states to those that were geographically contiguous found an overall reduction in the proportion of drivers over 0.8g/L of between 4% and 14% (Scopatz, 1998) in comparison to the above 16% (Hingson et al. 1996).

An examination of the impact of the reduction of the legal limit to 0.8g/L in North Carolina in 1993 employed several measures of alcohol involvement in collisions, including alcohol-related total, injury and fatal collisions based on a combination of police reported and medical examiner evidence, and surrogate measures of alcohol involvement (single vehicle night-time crashes) (Foss et al. 1999). Additionally, similar data from 11 states were aggregated for comparison purposes. Time series analyses revealed significant intervention effects only for police-reported measures of alcohol involvement in fatalities for North Carolina. Although there were general downward trends in alcohol-related collision measures, these were similar for all states and no evidence of an intervention effect was observed (with the exception of the police-reported measure). The apparent lack of effect of the new law might be related to several factors, including a true lack of impact, lack of public awareness of the law, and the state's history of vigorous enforcement of drinking-driving laws over the years.

A multiple time series investigation, examined the effects of introducing a 0.8g/L limit in 11 states (California, Florida, Kansas, Maine, New Hampshire, New Mexico, North Carolina, Oregon, Utah, Vermont and Virginia) on fatal collisions involving drivers with a BAL over 0.1g/L, those involving drivers with a BAL over 1g/L, and the ratio of fatalities with BALs over 1g/L to those with a zero BAL found significant intervention effects on at least one measure in five of the 11 states, and significant intervention effects overall for nine of the 33 analyses reported (Apsler et al. 1999).

Weighted least squares regression analyses were used to examine the effects of several legal measures (including reducing the limit to 0.8g/L) on low BAL (0.1-0.9g/L) and high BAL (1g/L or greater) driver for the 50 states plus DC from 1982 to 1997 during which the proportion of the US population covered by 0.8g/L laws increased from zero to 28% (Voas et al. 2000). The 0.8g/L laws were found to be associated with significant reductions in drivers with both low and high BALs involved in fatal collisions.

A meta-analysis of nine research studies that had sufficient design quality and implementation found that 0.8g/L BAL laws resulted in a median reduction of 7% in alcohol related motor vehicle fatalities (Shults et al 2001). Eight of the nine studies reported the percent change in alcohol-related fatalities (post-law period vs. pre-law period) or provided the data needed to calculate the measure. Seven studies provided state specific percent change values, and the remaining study provided a summary percent change value for all 16 states that enacted 0.8g/L BAL laws before 1998 (Figure 9).

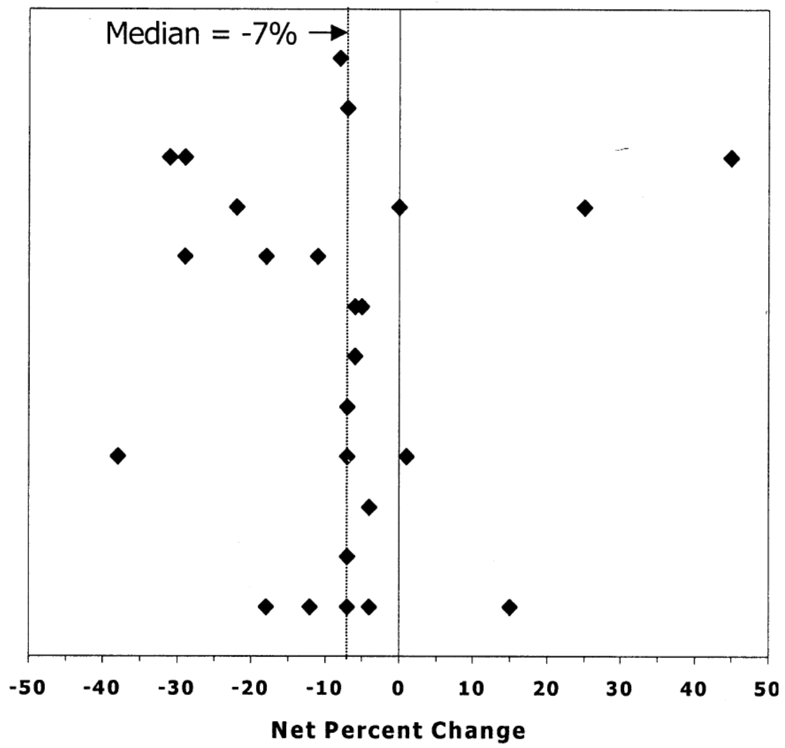

Figure 9. A summary percent change value for all 16 states that enacted 0.8g/L BAL laws before 1998. Source: Shults et al (2001)

Although some of the earlier American research has been questioned, the overall weight of evidence suggests that lowering the legal BAL limit has positive effects on alcohol related fatal crashes. The lower limit is particularly effective when combined with administrative licence revocation laws, but is also beneficial when introduced independently of such laws. Moreover, the studies indicate that the lower limit reduced both the number of fatally injured drivers who had been drinking and the number who had BALs above 1g/L, suggesting that it helped to reduce drinking and driving among drivers at various BAL levels.

Summarizing the evidence of lowering BAL levels it appears that reductions in alcohol-related collisions, injuries and/or fatalities have been observed in most jurisdictions in which the legal limit has been reduced. The findings are not all consistent (cf. Kloeden and McLean, 1994; McLean et al., 1995; Bernhoft, 2000) which may be related to methodological differences between studies, as well as to differences in measures used and the specific social and historical context. In some cases, it appears that beneficial effects may decline over time (Vingilis et al., 1988; McLean et al., 1995), but lasting reductions in alcohol-related collisions and fatalities have also been reported (Henstridge et al., 1997; Norstrom & Laurell, 1997).

Most studies that have examined the impact of a lowered legal limit on measures of driver BALs, or BAL levels in arrested or fatally injured drivers, have observed a substantial impact on BAL levels other than those specifically affected by the change in limits. This effect has been observed when limits have been reduced to 0.8g/L (Transportation Research Board, 1987; Hingson et al., 1996) and when they were reduced to 0.5g/L or lower (Brooks and Zaal, 1993; Kloeden and McLean, 1994; Norstrom & Laurell, 1997). The evidence suggests that a reduction of the legal limit acts at all BALs, including the proportion of drivers with the highest BALs, such as

1.5g/L or more. However, one study (McLean et al., 1995) suggested that some of these effects wore off with time and one study (Foss et al., 1999) failed to observe any shift in BAL levels of fatally injured drivers when the limit was lowered.

The major impact desired with a new or reduced BAL limit is a general deterrent effect, where people who might otherwise drink and drive are deterred from doing so by knowledge of the law and the consequences of violating it (Homel, 1990; Vingilis, 1990). Studies have demonstrated that the introduction of new drinking-driving laws or policies can have a substantial general deterrent effect if they are introduced under certain conditions. A classic example is the impact of the British Road Safety Act in 1969 which initially led to a significant and marked decline in collisions most influenced by alcohol (single vehicle night-time collisions), although the collision rate appeared to return to pre-law levels after about 1 year (Ross 1973). This initial impact maybe due to an increase in perceived risk of being caught that is caused by the high level of publicity associated with new legal sanctions, while the subsequent reduction in impact is due to the realization that the actual risks of apprehension are not as high as initially believed (e.g. Ross, 1973; Vingilis and Salutin, 1980; Homel, 1990; Vingilis, 1990).

Homel (1990) has argued that continued high publicity and public education efforts and high levels of enforcement by police will maintain the public's perceived risk of apprehension and thus result in a more pronounced deterrent effect of such laws. He evaluated this hypothesis in examining the effects of Random Breath Testing (RBT) in Australian states (Homel, 1990). In New South Wales, RBT was introduced under high impact conditions, i.e. with sustained public education and high profile enforcement efforts. Under these conditions, alcohol-related collisions were reduced by 30% on what appeared to be a permanent basis. However, in other states RBT was not introduced with such intensity in either education or enforcement efforts, and similar sustained collision reductions were not observed (Homel, 1990).

The general deterrent impact of new laws and other countermeasures appears to depend on the public's awareness of them as influenced by a variety of factors including the visibility with which they are enforced (Ross, 1973; Mercer, 1985; Homel, 1990; Vingilis, 1990; Vingilis and Salutin, 1980; Voas and Lacey, 1990). In at least one instance, the evidence suggests that the collision-reducing potential of a new drinking-driving law was muted by low levels of public awareness (Vingilis et al., 1988). That is, in order for drivers to modify their behaviour, they must be made aware of the new law through public education and high-visibility enforcement.

A further point to keep in mind is that changes in blood alcohol concentration laws have been implemented at a time when both alcohol consumption levels and general collision rates have been demonstrating long term declines. These broader social changes could be influencing at least some of the effects observed in some of the reported studies. In efforts to control for these effects the more well-designed studies have included measures reflecting alcohol use and vehicle use (e.g. Norstrom and Laurell, 1997). Analyses incorporating these control measures allow for much stronger conclusions, even though the possibility that broader social factors are responsible for at least some of the changes observed cannot be entirely ruled out.

Impact on public attitudes and driving behaviour

Lower BAL limits may contribute to positive changes in public attitudes toward drinking and driving. For example, roadside surveys in Germany indicated that the impending introduction of a 0.5g/L limit contributed to positive changes in the BAL distribution of drinking drivers (Vollrath & Krueger 2000). The anticipatory effect may have resulted from the enhanced police patrols and publicity that preceded the legal change. Moreover, some drivers erroneously believed that the 0.5g/L BAL limit had already been enacted.

It has also been suggested that lower BAL limits encourage drivers to keep a better count of the drinks they consume in order to stay within the limit (Transport Bureau 1998). In this way, a lower BAL limit can have a strong preventive impact. For example, a study of the Danish 0.5g/L law, introduced in 1998, found that the legal change motivated Danes to reduce their alcohol consumption before driving (Bernhoft (2000). The number of drivers who abstained before driving rose from 37% to 41%, and the number who drank one drink or less increased from 71% to 80% between 1997 and 1998. The top two reasons given for the change in drinking behaviour were that the legal limit had been lowered, and that the respondent's attitude toward drinking and driving had changed.

The preventive impact of a lower BAL limit was also illustrated by an Australian survey of drinking behaviour (Loxley et al 1992). It suggested that the lower limit helped to make people more aware of the need to control their drinking before driving. Those who planned to drive home drank less than those who were not driving. Moreover, a large majority felt it was wrong to violate the legal BAL limit.

Lower limits for young and beginning drivers

Zero and low BAL restrictions have consistently been shown to reduce alcohol related traffic deaths among youth (Shults et al 2001). A study of the American states that introduced these limits for young drivers between 1983 and 1992 found a 16% decrease in single vehicle night time fatal crashes among affected drivers, while such crashes in control states increased by 1% (Hingson et al 1994). The largest improvement, a 22% decrease in fatal single vehicle night time crashes, occurred in states that implemented a zero BAL limit. When Maine introduced a zero BAL restriction for all drivers under the legal drinking age in 1995, the number of night time single vehicle injury crashes among such drivers fell by 36% (Lacey et al 2000). Similarly, when Oregon extended its zero BAL restriction to include all drivers less than 21 years of age, it experienced a 40% reduction in night time single vehicle crashes among affected drivers. A national study of US states found a net decrease of 24% in the number of young drivers with positive BALs as a result of lower BAL limits for young drivers (Voas et al. 1999). In Canada, an evaluation of Ontario's graduated licensing program attributed a 27% decrease in alcohol related collisions to the zero BAL restriction (Boase & Tasca 1998). A systematic review of the impact of lower BAL laws for young or inexperienced drivers found that the three studies that examined fatal crash outcomes reported declines of 24%, 17%, and 9%; the two studies that examined injury crash outcomes reported declines of 17% and 4%; and the one study that examined crashes in which the investigating police officer believed that the driver had been drinking alcohol reported a decline of 11% (Shults et al 2001).

A combination of raising the minimum legal drinking age to 21 years and establishing zero tolerance (<0.2g/L BAL) for drivers younger than age 21 years are associated with substantial reductions in alcohol-positive involvement in fatal crashes in drivers younger than age 21 years in the United States from 1982 to 1997 (Voas *et al.* 2003). Graduated driver licence programmes place restrictions on the circumstances under which young or novice drivers are allowed to drive, such as prohibiting driving during certain hours or driving with other young people in the vehicle. Such programmes, which frequently have BALS of <0.2g/L, are effective in reducing motor vehicle fatalities among 15-17-year-old drivers by up to 19% (Morrisey *et al.* 2005).

As Table 5 illustrates, the relative risk of crash for young drivers at low BAL levels is lower than that for older drivers at moderate BAL levels. If policy makers consider these relative risks sufficiently compelling to introduce zero or low BAL restrictions for young drivers, then risks of this magnitude should also be sufficient to warrant a 0.5g/L limit for all drivers.

Table 5. Relative risk for young and older male drivers at different BAL levels.

	Fatal single vehicle crash	All fatal crashes
Age 16–20 (0.020%–0.049% BAC)	4.64	3.44
Age 21–34 (0.050%–0.079% BAC)	6.53	3.76
Age ≥35 (0.050%–0.079% BAC)	5.79	3.70

Source: Zador PL, Krawchuk SA, Voas RB. Alcohol-related relative risk of driver fatalities and driver involvement in fatal crashes in relation to driver age and gender: an update using 1996 data. *J Stud Alcohol* 2000;**61**:387–95.

4.2. UNRESTRICTED BREATH TESTING

The importance of roadside breath tests is illustrated in Figure 10, which shows an inverse relationship between the number of road side breath tests in England and the number of road accident casualties involving illegal alcohol. As the number of road side breath tests decreased or increased, so the number of road accident casualties involving illegal alcohol increased or decreased.

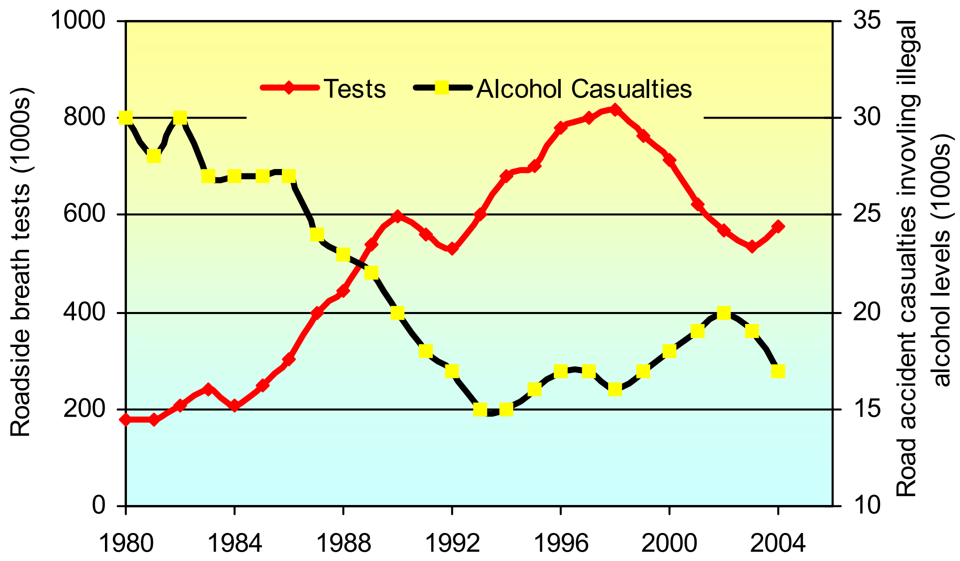

Figure 10 Inverse relationship between number of roadside breath tests and number of roadside casualties involving illegal alcohol levels, England. Source: The Information Centre (2006).

Unrestricted or random breath testing (RBT) means that motorists are stopped with no restrictions by police and required to take a breath test, even if they have not been suspected of having committed an offence or been involved in an accident. Any motorist, at any time, may be required to take a test, and there is nothing that the driver can do to influence the chances of being tested. Testing varies from day to day and from week to week, and refusal to submit to a breath test is equivalent to failing.

Selective breath testing (SBT) refers to checkpoints in which police must have reason to suspect the driver has been drinking. SBT is the only type of checkpoint used in the United States.

Australia is one of the countries with the most experience of random breath testing. In 1999, 82% of Australian motorists reported having been stopped at some time, compared with 16% in the UK and 29% in the US (Williams *et al.* 2000). The result was that fatal crash levels dropped 22%, while alcohol-involved traffic crashes dropped 36%, and remained at this level for over four years (Homel 1988; Arthurson 1985). A time series analysis for four Australian states found that unrestricted breath testing was twice as effective as selective checkpoints (Henstridge *et al.* 1997). For example, in Queensland, unrestricted breath testing resulted in a 35% reduction in fatal accidents, compared with 15% for selective checkpoints, at which only motorists who were judged by police to have been drinking were asked to take a breath test. Since their implementation, the drink driving enforcement and publicity campaigns in Victoria have persisted in their effectiveness in reducing serious crashes during peak alcohol consumption times (Tay 2005a; 2005b).

A meta-analysis of twenty three studies of unrestricted breath testing and selective testing have found that crashes thought to involve alcohol dropped a median of 18% (for RBT checkpoints) and 20% (for SBT checkpoints) following implementation of sobriety checkpoints; fatal crashes thought to involve alcohol dropped a median of 22% (for RBT checkpoints) and 23% (for SBT checkpoints) following implementation of sobriety checkpoints; and crashes declined regardless of the follow-up time of the study, dropping a median of 18% for follow-up times of less than one year and 17% for follow-up times of more than one year (Shults *et al.* 2001), Figures 11-12.

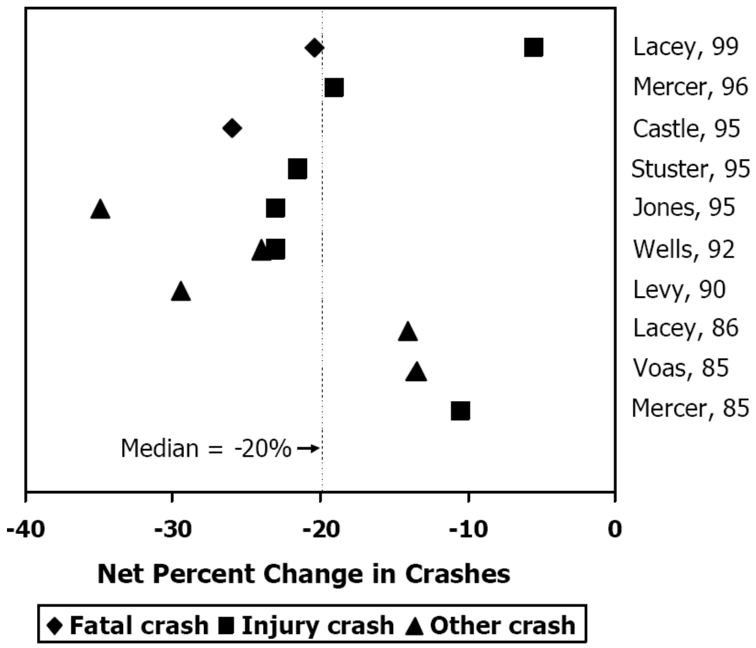

Figure 11. Impact of selective breath testing in reducing alcohol-related crashes. For references to original studies, see source: Shults et al (2001)

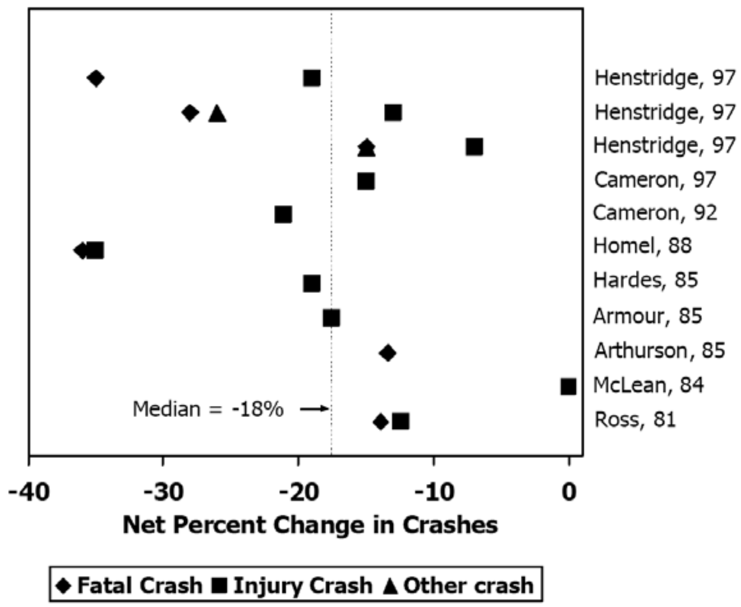

Figure 12. Impact of random breath testing in reducing alcohol-related crashes. For references to original studies, see source: Shults et al (2001)

4.3. LICENSE SUSPENSION

Suspending the license of those convicted of impaired driving is only partially effective as a way to reduce drink driving recidivism and alcohol-related crashes. Without some form of education, counselling or treatment program, the effects of suspension upon alcohol-impaired driving last only as long as the driver is incapacitated by the license suspension, and these periods can be relatively short (McKnight and Voas 1991; Ross 1992). The deterrent effect of any penalty is benefited by certainty and immediacy (Ross 1984; Ross 1992; McKnight and Voas 2001). A review of 46 studies on license suspension found that suspension was followed by an average reduction of 5% in alcohol-related accidents and a reduction of 26% in fatal accidents (Zobeck and Williams 1994).

There is little evidence that prison sentences or fines have a specific deterrent effect by promoting avoidance of future offences (Voas 1986). Nevertheless, the authority to impose a prison sentence may provide the legal basis for referring offenders to treatment programs, which have been shown to reduce recidivism of drink driving in first and multiple offenders (Voas and Tippetts 1990). A meta-analysis of 215 independent evaluations of remedial programs found them to yield an average reduction of 8%-9%, both in recurrence of alcohol-impaired driving offences and in alcohol-related accidents (Wells-Parker *et al.* 1995).

4.4. ALCOHOL LOCKS

One action to prevent drink driving offenders from driving while impaired is to place interlocks in the ignition to prevent an impaired driver from operating the vehicle. To operate a vehicle equipped with an ignition interlock device, the driver must first provide a breath specimen. If the breath alcohol concentration of the specimen exceeds the predetermined level, the vehicle will not start. As a measure to reduce circumvention of the device (i.e. someone else blows into the mouthpiece), random retests are required while the vehicle is running. Interlocks can also be used as a preventive measure, by being fitted to public service and heavy goods vehicles.

One review of eight studies of interlock programs conducted under the authority of a local court or a motor vehicle department found them to be more effective than full license suspension in preventing recidivism among alcohol-impaired drivers (Voas *et al.* 1999). However, seven of the studies found that, once the interlock is removed, offenders have the same recidivism rate as suspended offenders.

A systematic Cochrane review[6] identified one randomised controlled trial (RCT), ten controlled trials, and three ongoing trials (Willis *et al.* 2004). In the RCT, recidivism was lower in the intervention group while the device was still installed in the vehicle, but the benefit disappeared once the device was removed. In all 13 non-randomised controlled trials, interlock participants again had lower recurrence of offences than the controls. However, the favourable results did not extend to the time period after the interlock was removed.

In 2000, a European research consortium explored the feasibility of alcolock programs in EU countries and concluded that impaired driving offences were reduced during interlock program participation and that accident rates were also reduced (Mathijssen 2005). As a result of the feasibility study, alcolock initiatives are being implemented in Belgium, Finland, Germany, Netherlands, Norway, Spain and Sweden. In the Netherlands, the target group will consist of DWI offenders who undergo a medical/psychiatric assessment and are declared “not unfit to drive”, which represents about 10% of the multiple recidivists or those with a BAL above 1.8g/L, who are assessed. The alcolock program will be mandatory under administrative law and will have a duration of two years with the possibility of a six-month extension. It is estimated that the cost per installed alcolock is €2,200. Based on an estimated 65% reduced crash rate for alcolock users, the estimated benefit of the program is an annual reduction of 4-5 fatalities, at an annual program cost of €0.9 million.

Alcolock devices and programs were introduced in Sweden in 1999, with two types of programs (Bjerre 2005). A primary prevention strategy was initiated to prevent alcohol impaired driving in three commercial transport companies (buses, trucks, taxis). A secondary prevention trial was begun as a voluntary 2-year program for drink driving offenders involving strict medical requirements, including counselling and regular checkups by a medical doctor. Alcolocks in commercial vehicles have been well accepted by professional drivers, their employers, and their passengers, and the number of vehicles with alcolocks as a primary prevention measure is rapidly growing in Sweden. Three of 1000 starts in the primary prevention program were blocked by the alcolock after measuring a BAL higher than the legal limit and lock point of 0.2g/L. Only 11% of eligible drink driving offenders took part in the voluntary, secondary prevention program, of whom 60% had a diagnosis of alcohol dependence. During the program, alcohol consumption decreased as measured by five biological alcohol markers, and the rate of drink driving offences fell sharply from

[6] Cochrane Reviews are systematic summaries of evidence of the effects of health-related interventions. They are intended to help people make practical decisions. For a review to be called a ‘Cochrane Review’ it must adhere to a structured format that is described in the Cochrane Handbook for Systematic Reviews of Interventions. Glossary of Terms in the Cochrane Collaboration (2005).

a yearly rate of approximately 5% to almost zero. However, those dismissed from the program appeared to return to their previous drink driving behaviour.

4.5. SERVER TRAINING AND CIVIL LIABILITY

Training programmes for servers and bartenders for preventing impaired driving by identifying impairment, refusing service and providing transportation have been evaluated in North America, Australia, and the Netherlands. These have demonstrated a significant improvement in server knowledge and attitude, as well as discouraging over-consumption and encouraging alternative beverages. This effect is particularly strong when coupled with a change in the serving and sales practices of the licensed place, and with training for managers (Rydon *et al.* 1996; Saltz 1997). Success in reducing the risk of drink-driving has not been found in all studies, even when mandating the training of servers as a condition of licensing (Lang *et al.* 1998). However, when implemented as part of more comprehensive community-based programmes, responsible server programmes have been found to be effective, particularly for night time crashes for young people (Holder and Wagenaar 1994; Wagenaar *et al.* 2000).

A systematic review of server intervention training programs, whilst noting that the evidence reviewed primarily comes from small-scale studies in which the participants may have been unusually motivated and the researchers had a high degree of control over the implementation of the server training identified three qualifying studies which found that server training was associated with decreases in the proportion of intoxicated drinkers ranging from 17% to 100% (median = 33%), and one study assessing a state-wide server-training program found that it was associated with a 23% decrease in single-vehicle night time injury crashes (Shults et al 2001).

The civil liability of alcohol retail establishments, who serve alcohol to intoxicated customers, has been established, particularly in the United States, often based upon common law, with very limited spread to other countries, but including Australia and Canada. This liability has been primarily reactive, that is, as a means of legal redress after service to an intoxicated person resulted in personal loss or injury (Mosher 1979 1987). This may, for instance, occur when an intoxicated driver, served by a retail establishment, crashes and injures or kills an innocent bystander. However, server liability can also be a preventive policy to encourage safer beverage serving practices and to prevent drink driving (Mosher 1983; 1987; Holder *et al.* 1993). States within the US that hold bar owners and staff legally liable for damage attributable to alcohol intoxication have lower rates of traffic fatalities (Chaloupka *et al.* 1993; Ruhm 1996; Sloan *et al.* 1994a) and homicide (Sloan *et al.* 1994b), compared to states that do not have this liability. When one State deliberately distributed publicity about the legal liability of servers, there was a 12% decrease in single-vehicle night-time injury-producing traffic crashes (Wagenaar and Holder 1991), mediated by the effects of legal liability on the attitudes and behaviour of bar owners and staff (Holder *et al.* 1993; Sloan *et al.* 2000).

In many jurisdictions, it is illegal to sell an alcoholic beverage to purchasers considered to be at risk of injury, including the underage and the intoxicated. Violations can result in criminal actions and fines against sellers and administrative action, such as fines and license suspensions, against the establishments. Enforcement of laws prohibiting service to an intoxicated customer is rarer than enforcement of laws prohibiting sales to an underage customer. Most actions against servers appear to occur when the illegal service results in some form of harm, rather than from routine enforcement activity. The efficiency of alcohol-control efforts can be enhanced by focusing enforcement on establishments that are the most persistent violators. Arrested drivers queried for the sources of their last drink can identify the greatest sources of trouble.

4.6. DESIGNATED DRIVER AND SAFE RIDE PROGRAMMES

There is no universal definition of a "designated driver." The most common definition requires that the designated driver abstain from all alcohol, be assigned before alcohol consumption, and drive other group members to their homes (see Ditter *et al.* 2005). Other definitions employ a risk and harm reduction strategy, in which the primary goal is not necessarily abstinence, but to keep the designated driver's blood alcohol content (BAL) at less than the legal limit.

In practice, it appears that only a minority of designated drivers remain completely abstinent, and many people may apply the designated driver concept in ways that are unsafe. In a California survey, only 56% of respondents said that the designated driver should be chosen before drinking begins, and only 64% expected the driver to abstain from alcohol for 4 hours before driving (Lange *et al.* 1998). Also in some cases, the "designated driver" may be chosen based on who in the group is the least intoxicated (Knight *et al.* 1993; DeJong and Wintsen 1999). Timmerman *et al.* (2003) found that the mean BAL for 66 designated drivers leaving university bars was 0.6g/L.

A systematic review was conducted to assess the evidence of effectiveness of designated driver programs for reducing alcohol-impaired driving and alcohol-related crashes by evaluating population-based campaigns that encourage designated driver use, and programs conducted in drinking establishments that provide incentives for people to act as designated drivers (Ditter *et al.* 2005). Only one study of a population based designated driver promotion campaign was identified. Survey results indicated a 13% increase in respondents "always" selecting a designated driver, but no significant change in self-reported alcohol-impaired driving or riding with an alcohol impaired driver (Boots and Midford 1999). Seven studies (five of which were reported in the same journal article, and six of which were by the same two principal authors) evaluated the number of patrons who identified themselves as designated drivers before and after programs were implemented, with a mean increase of 0.9 designated drivers per night (Brigham *et al.* 1995; Meier *et al.* 1998; Simons-Morton and Cummings 1997). An eighth study reported a 6% decrease in self-reported driving or riding in a car with an intoxicated driver among respondents exposed to an incentive program (Boots 1994).

Interpretation of these results was complicated by the fact that only two of the studies (Brigham *et al.* 1995; Simons-Morton and Cummings 1997) reported the number of patrons or groups of patrons in the bar during each observation period. Thus, although the incentive programs generally found small increases in the number of patrons identifying themselves as designated drivers, the extent to which these changes related to actual designated driver use was unclear. Finally, it was impossible to estimate the public health effects of observed changes in the number of self-identified designated drivers without information on what their behaviour would have been in the absence of a designated driver program. Thus, due to the small effect sizes observed, and the limitations of the outcome measures, the present evidence is insufficient to draw any conclusions about the effectiveness of either type of designated driver promotion program evaluated.

Further, no study has evaluated whether the use of designated drivers actually decreases alcohol-related motor vehicle-related injuries. However, some studies of designated drivers have assessed their BALs, which are strongly associated with crash risk. Studies indicate that the BALs of designated drivers are generally lower than those of their passengers and also lower than those of other drivers who are not acting as designated drivers (Lange *et al.* 2000), but still often higher than the legal limit for drinking and driving (Timmerman *et al.* 2003).

The potential impact of designated driver programs on alcohol consumption is another important consideration. Several studies indicate an increase in passenger alcohol consumption when a designated driver is available. One study estimated that the mean increase in the BALs of passengers of designated drivers was 0.17 g/L, (Harding *et al.* 2001), with young and high-risk drinkers particularly likely to increase consumption (Knight *et al.* 1993; DeJong and Wintsen 1999; Boots and Midford 1999).

Several communities have organizations that provide free rides largely to individuals who drive while being alcohol impaired. A survey of 335 ride services in response to calls from passengers or the drinking places serving them found the biggest obstacle to be the inability of more than 15% of the programs to transport the driver's vehicle (Harding, Apsler and Goldfein 1998). Drivers were reluctant to leave their vehicles behind or return to the drinking location to collect their vehicles. Ross (1992) suggested that one approach to individuals could be to provide them with free taxi rides to drinking places. This would ensure their inability to drive away and, consequently, a heavy drinker would be forced to find alternative transportation to return home, as the vehicle would not be at the drinking location. One study found that if the safe ride program had not been in place 44% of drinkers would have driven themselves home (Sarkar *et al.* 2005). One third of the drinkers did not feel they had control over their choice to avoid drinking and driving.

4.7. EDUCATIONAL PROGRAMMES

A systematic review of the literature to assess the effectiveness of school-based programs for reducing drinking and driving and riding with drinking drivers identified thirteen peer reviewed papers or technical reports which met specified quality criteria and included evaluation outcomes of interest (Elder *et al.* 2005). The papers evaluated three classes of interventions: school based instructional programs, peer organizations, and social norming campaigns. For instructional programs, whereas the median effects of five studies found no effect on self-reported drinking and driving (Harre and Field 1998; Klepp *et al.* 1995; Shope *et al.* 1991; D'Amico and Fromme 2002; Sheehan *et al.* 1996), the median effects of four studies found a reduction in self-reported riding with drinking drivers (Harre and Field 1998; Newman *et al.* 1992; Wilkins 2000; Sheehan *et al.* 1996). Only one study looked at crashes and found no effect (Shope *et al.* 2001).Two studies of the effectiveness of peer organization programmes were unable to provide evidence for effect (Leaf and Preusser 1995; Klitzner *et al.* 1994). Two studies of social norming programmes appeared to reduce drink driving, and led to more frequent use of designated drivers (Cimini *et al.* 2002; Foss *et al.* 2001).

4.8. BRIEF ADVICE PROGRAMMES IN ACCIDENT AND EMERGENCY DEPARTMENTS

Brief advice delivered in emergency departments and trauma centres has been shown to be effective in reducing alcohol consumption (D'Onofrio and Degutis 2002;

D'Onofrio *et al.* 1998; Longabaugh *et al.* 2001; Gentilello *et al.* 1999; Spirito *et al.* 2004; Mello *et al.* 2005) and alcohol-related harm (Monti *et al.* 1999; Gentilello *et al.* 1999; Longabaugh *et al.* 2001; Mello *et al.* 2005). A systematic review of 23 studies found evidence for reduced motor-vehicle crashes and related injuries, falls, suicide attempts, domestic violence, assaults and child abuse, alcohol-related injuries and injury emergency visits, hospitalizations and deaths, with reductions ranging from 27% to 65% (Dinh-Zarr *et al.* 2004).

4.9. MASS MEDIA CAMPAIGNS

A systematic review of the effectiveness of mass media campaigns for reducing alcohol impaired driving and alcohol-related crashes identified seven qualifying studies that found that mass media campaigns were associated with a median decrease of 13% in total alcohol-related crashes (interquartile range, 6% to 14% decrease); six qualifying studies that found that mass media campaigns were associated with a median decrease of 10% in injury-producing alcohol-related crashes (interquartile range, 6% to 14% decrease); and two qualifying studies that found that mass media campaigns were associated with decreases in the proportion of drivers who had consumed alcohol (net decreases of 30% and 158%) (Elder et al 2005).

The median decrease in crashes across all studies and all levels of crash severity was 13%, Figure 13. The median decrease in injury-producing crashes, the most common crash outcome, was 10%. The two studies that used roadside BAL test results as outcome measures showed net decreases of 158% and 30% in the proportion of drivers with BAL levels that suggest alcohol impairment (0.5g?l and 0.8g/L respectively).

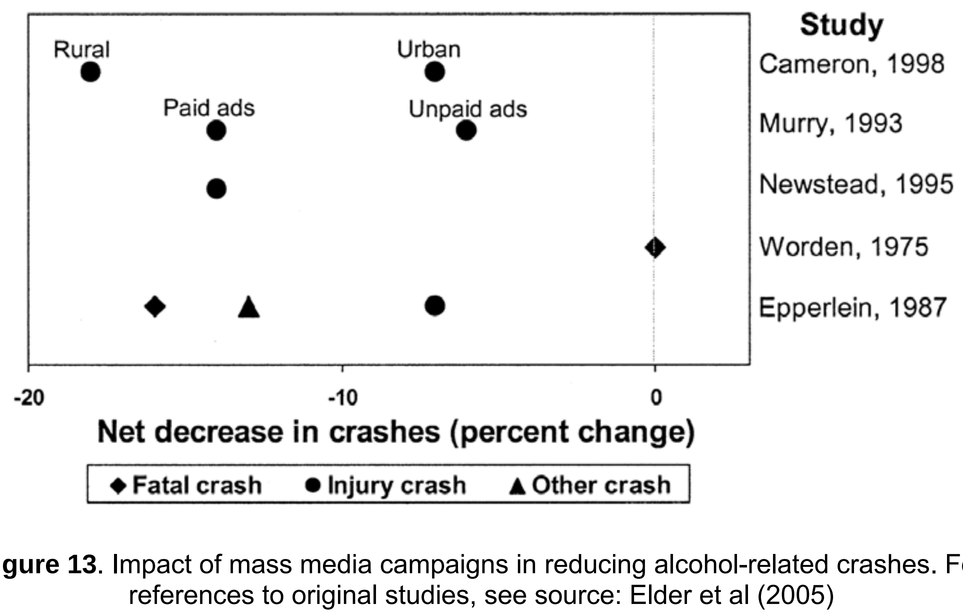

Figure 13. Impact of mass media campaigns in reducing alcohol-related crashes. For references to original studies, see source: Elder et al (2005)

The evaluated mass media campaigns had several components in common: pretested messages; high levels of audience exposure to the message, generally achieved through paid advertising; and complementary prevention efforts at the local level such as high-visibility enforcement of impaired driving laws. Campaign messages ranged from those focused on law enforcement activities and the legal consequences of drinking and driving to the social and health consequences of alcohol-impaired driving. There was no clear difference in the effectiveness of campaigns that used legal deterrence messages and those that used social and health consequences messages.

Cost–benefit analyses were conducted for two of the campaigns evaluated and their results have been adjusted to 1997 $US. An analysis of the first 23 months of the Victorian campaign indicated that it cost $403,174 per month for advertisement development, supporting media, media placement, and concept research (Cameron et al 1993). Estimated savings from medical costs, productivity losses, pain and suffering, and property damage were $8,324,532 per month, with $3,214,096 of these savings accruing from averted medical costs. The 6-month campaigns in Wichita (using paid media) and Kansas City (using public service announcements) had total costs of $454,060 and $322,660, respectively (Murry et al 1996). Costs for planning and evaluation research, message production, and media scheduling were included. Total savings from averted costs of insurance administration, premature funerals, legal and court expenses, medical payments, property damage, rehabilitation, and employers' losses were estimated at $3,431,305 for the Wichita campaign and $3,676,399 in Kansas City. In all three sites evaluated, the estimated societal benefits substantially exceeded the costs of developing and airing the campaign messages.

4.10. COMMUNITY PROGRAMMES FOR SAFE DRIVING

Broad based community prevention programmes that include public information seem to be effective (Hingson *et al.* 1996; see below). The Saving Lives Project conducted in six communities in Massachusetts, USA was designed to reduce alcohol-impaired driving and related problems such as speeding (Hingson *et al.*, 1996). In each community a full time coordinator from the local government organized a task force representing various city departments. Programs were designed locally and involved a host of activities including media campaigns, business information programs, speeding and drunk driving awareness days, speed watch telephone hotlines, police training, high school peer-led education, Students Against Drunk Driving groups, college prevention programs, and other activities. During the five years that the program was in operation, sites that received the Saving Lives intervention produced a 25% greater decline in fatal crashes than the rest of Massachusetts, a 47% reduction in the number of fatally injured drivers who were positive for alcohol as well as a 5% decline in visible crash injuries and an 8% decline in crash injuries affecting 16-25 year olds. In addition, there was a decline in self-reported driving after drinking (specifically among youth) as well as observed speeding. The greatest fatal and injury crash reductions occurred in 16-25 year old age group.

4.11. CONCLUSIONS

There is an enormous wealth of evidence that the drinking-driving policies that are going to have an impact in reducing drinking and driving and drink driving fatalities are those that lower blood alcohol concentration (BAL) levels, with adequate enforced through unrestricted (random) breath testing, and adequate penalties including administrative license suspension, Table 6. The evidence shows that designated driver and safe drive programmes and school-based education are not effective and cannot be an alternative to lower BAL levels and random breath testing.

Drink driving laws need to be publicized through mass media campaigns, and their effectiveness can be enhanced through community based programmes.

Table 6 Effectiveness ratings for drink-driving countermeasures

	Effectiveness[1]	Breadth of Research Support[1]	Cost Efficiency[1]
Lowered BAL levels	+++	+++	+++
Random breath testing (RBT)	+++	++	+
License suspension	+++	++	++
Alcohol locks	+	+	+
Low BAL for youth	+++	++	+++
Graduated licensing	++	++	+++
Server training and civil liability	+	++	+
Designated drivers and ride services	O	+	++
School based education courses	?/O	+	+
Mass media campaigns	++	+	+
Community programmes	++	++	+

Effectiveness	**Breadth of Research Support**	**Cost Efficiency**
This criterion refers to the scientific evidence demonstrating whether a particular strategy is effective in reducing alcohol consumption, alcohol-related problems or their costs to society. The following rating scale was used: **0** Evidence indicates a lack of effectiveness **+** Evidence for limited effectiveness. **++** Evidence for moderate effectiveness. **+++** Evidence of a high degree of effectiveness **?** No studies have been undertaken or there is insufficient evidence upon which to make a judgment.	The highest rating was influenced by the availability of integrative reviews and meta analyses. Breadth of research support was evaluated independent of the rating of effectiveness (i.e., it is possible for a strategy to be rated low in effectiveness but to also have a high rating on the breadth of research supporting this evaluation). The following scale was used: 0 No studies of effectiveness have been undertaken + Only one well designed study of effectiveness completed. ++ From 2 to 4 studies of effectiveness have been completed. +++ 5 or more studies of effectiveness have been completed. ? There is insufficient evidence on which to make a judgment.	This criterion seeks to estimate the relative monetary cost to the state to implement, operate and sustain this strategy, regardless of effectiveness. For instance, increasing alcohol excise duties does not cost much to the state but may be costly to alcohol consumers. In this criterion, the lowest possible cost is the highest standard. Therefore, the higher the rating, the lower the relative cost to implement and sustain this strategy. The following scale was used: o Very high cost to implement and sustain + Relatively high cost to implement and sustain. ++ Moderate cost to implement and sustain. +++ Low cost to implement and sustain. ? There is no information about cost or cost is impossible to estimate.

Source: Babor *et al.* (2003).

5. DRINK DRIVING AND POLICIES IN EUROPE

The 2001 European Commission Recommendation on the maximum permitted blood alcohol content (BAL) for drivers of motorized vehicles called for all Member States to adopt a BAL of 0.5g/L lowered to 0.2g/L for inexperienced, two-wheel, large vehicle or dangerous goods drivers, and random breath testing so that everyone is checked every 3 years on average. Currently, four EU Member States have a BAL of greater than 0.5g/L (Ireland, Luxembourg, Malta, and United Kingdom). The proportion of road traffic fatalities appears to be higher in countries with higher limits. 43% of European drivers admit to driving one day or more per week after having drunk alcohol, and some 5% of European drivers state that they thought they had driven over the legal limit of BAL one day or more in the past week. Drink drivers were much more likely to be men than women, with surprisingly little difference by age, and were more likely to have a lower level of education, to have been previously punished for drinking and driving and to be more frequent drinkers than non-drink drivers. Drink driving accidents are much more common amongst men than women and are particularly common amongst teenagers and young adults, whereas drink driving fatalities are more common amongst a slightly older age group. Enforcement activity seems to be fairly low across Europe, with only 26% of drivers in 23 European countries studied stating that they had been tested for alcohol over the last three years. 86% of drivers in countries where RBT is not allowed declare they have not been checked in the last three years compared with 65% in countries where RBT is allowed. Further, in countries where RBT is not allowed 46% of drivers think they will never be checked, compared to 22% of drivers in countries where RBT is allowed.

5.1. BLOOD ALCOHOL LEVELS

EU road safety policies have often dealt with alcohol-related driving accidents, in particular the ‘Commission Recommendation on the maximum permitted blood alcohol content (BAL) for drivers of motorized vehicles’ in Jan 2001 (2001/115/EC). This called for all Member States to adopt a BAL of 0.5g/L lowered to 0.2g/L for inexperienced, two-wheel, large vehicle or dangerous goods drivers, and random breath testing so that everyone is checked every 3 years on average. Take-up of the recommendation has since been encouraged by the European Road Safety Action Programme (COM (2003) 311), while the Commission has said that it will propose a Directive if insufficient progress is made towards a 50% reduction in road deaths by 2010 (2004/345/EC). Several other recent moves include efforts to tackle drink-driving, including harmonized penalties and the exchange of best practice (COM (2001) 370; 2004/345/EC).

In line with the Commission Recommendation, most of the EU countries have a maximum Blood Alcohol Concentration (BAL) of no more than 0.5g/L, although the UK, Ireland and Luxembourg continue to have a higher limit, Table 7. Four countries (Czech Republic, Hungary, Romania and Slovak Republic) prohibit any alcohol in drivers Some countries also have different BALs for different groups, such as the 0.3g/L limit for novice and professional drivers in Spain. Interestingly, the proportion of deaths over the legal BAL is similar in countries with differing BALs, (Table 8) suggesting that in countries with higher limits, the proportion of deaths linked to drink driving is higher than in countries with lower limits.

Table 7 BAL Levels in European countries

BAL	Countries
Zero	Czech Republic, Hungary, Romania, Slovak Republic
0.2g/L	Estonia, Norway, Poland, Sweden
0.4g/L	Lithuania
0.5g/L	Austria, Belgium, Bulgaria, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Italy, Latvia, Netherlands, Portugal, Slovenia, Spain, Switzerland, Turkey
0.8g/L	Ireland, Luxembourg, Malta, United Kingdom

Table 8 BAL Levels in European countries

Country	Legal BAC limit	Enforcement intensity	Proportion of deaths from accidents caused by drivers over the legal limit[5]
Sweden	0.2 mg/ml	high (17% of inhabitants)	about 10% (SUNflower 2002)
Finland	0.5 mg/ml	high (34.5% of inhabitants)	16% (2003)
Netherlands	0.5 mg/ml	high (12.3% of inhabitants)	18% (2003)
Luxembourg	0.8 mg/ml	low (4.7% of inhabitants)	14% (2004)
UK	0.8 mg/ml	low (1% of inhabitants)	17.5% (2004)
Ireland	0.8 mg/ml	n/a	n/a
Cyprus	0.9 mg/ml	low (5.3% of inhabitants)	40% (2005)

Source: Townsend et al 2006

5.2. THE DRINK DRIVERS IN EUROPE

Driving after drinking

Driving after drinking even a small amount of alcohol is relatively widespread in southern European countries, with 43% of drivers driving one day or more per week after having drunk alcohol (Sartre 2004a). In western countries it is every fifth driver (19%), while in northern (8%) and eastern countries (11%) driving after drinking alcohol is less common. In general, the higher the BAL limit, the more frequent driving after drinking even a small amount of alcohol. More male drivers (20%) than female drivers (7%) responded that they have driven after drinking, with no consistent differences by age, Table 9. On average, 5% of European drivers studied stated that they thought they had driven over the legal limit of BAL one day or more in the past week. This was highest in southern European countries (13%), 4% in eastern and western countries, and 0.2% in northern European countries, Figure 14.

Table 9. Drivers of different age groups responding that they drive after drinking, 1 or more days/last week (%).

Country	≤24	25--39	40—54	≥55
Austria	10	14	19	22
Belgium	16	12	14	15
Cyprus	33	42	30	22
Czech Rep.	3	2	4	2
Denmark	14	14	12	19
Estonia	8	1	3	3
Finland	2	2	4	4
France	10	19	24	24
Germany	13	12	10	12
Greece	22	22	23	17
Hungary	3	2	1	1
Ireland	3	11	13	12
Italy	42	33	28	33
Netherlands	11	8	7	11
Poland	1	2	1	1
Portugal	21	29	34	33
Slovakia	3	5	4	4
Slovenia	17	21	21	30
Spain	35	31	30	19
Sweden	1	1	2	3
United Kingdom	4	7	10	13
Croatia	16	17	27	22
Switzerland	18	20	23	23
Average	*15*	*15*	*15*	*15*

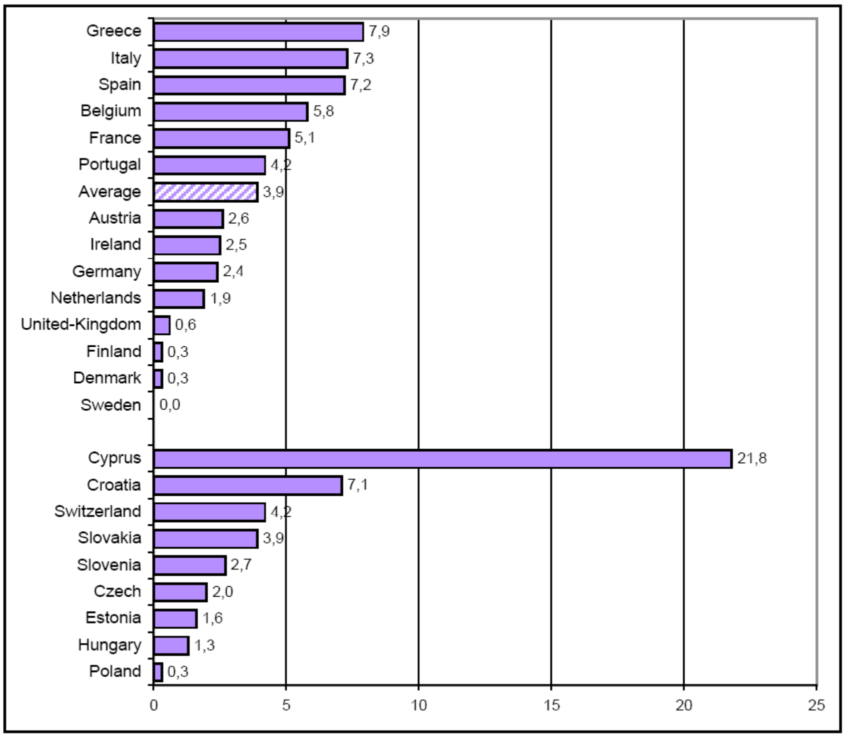

Figure 14. Over the last week, how many days did you drive, when you may have been over the legal limit for drinking and driving: one day or more (%)?
Source: Sartre (2004a).

More male drivers assumed having drunk above the legal limit and driven over the last week (5%) than female drivers (2%), with no substantial differences by age, Table 10. The younger men and women with the highest risk are those who are single, having a secondary level of education and less driving experience, with the younger men tending to live in cities driving older cars, and the younger women tending to live in rural areas. For all drivers, independent predictors of drink driving over the limit included a lower level of education, having received punishment for drinking and driving in the last three years, and more frequent drinking (Sartre 2004b). Data from England and Wales found that those who drank alcohol more often were more likely to have driven after drinking alcohol, with the frequency of drinking being more important than the level of drinking (Brasnett 2004). More drivers who had driven whilst 'over the limit' three or more times a year drank alcohol daily (58%) than drivers who had driven whilst 'over the limit' once or twice a year (38%) than drivers who had not driven whilst 'over the limit' (17%).

Table 10 Drivers of different age groups assuming that they drove over the legal limit, one or more days/last week (%).

Country	≤24	25—39	40--54	≥55
Austria	2	3	3	2
Belgium	5	6	6	6
Cyprus	16	26	19	9
Czech Rep.	3	2	3	1
Denmark	1	0	1	0
Estonia	3	1	3	1
Finland	2	0	0	0
France	4	5	6	5
Germany	2	3	2	3
Greece	7	9	10	5
Hungary	2	2	1	1
Ireland	0	3	3	2
Italy	17	9	4	5
Netherlands	3	2	2	1
Poland	0	0	1	1
Portugal	6	6	3	3
Slovakia	2	5	4	3
Slovenia	2	3	3	2
Spain	12	9	6	4
Sweden	0	0	0	0
United Kingdom	0	1	0	1
Croatia	5	6	9	8
Switzerland	4	5	5	2
Average	*5*	*5*	*4*	*3*

Who are involved in drink driving accidents?

The definition of a drink driving accident varies across Europe, and there are no routinely available data of Europeans involved in drink driving accidents. Data from the United Kingdom shows that the failure rate for a breath test in a driving accident is three times higher for men than for women, and higher for younger drivers than older drivers, Table11. (Department of Transport 2006)

Table 11 Car drivers in injury road accidents: breath tests and failures, Great Britain.

Number/ *percentage*

	Men					Women				
	a: Involved in accident	b: Tested	c: Failed	b as % of a	c as % of a	a: Involved in accident	b: Tested	c: Failed	b as % of a	c as % of a
0 - 16	318	154	36	*48.4*	*11.3*	52	31	4	*59.6*	*7.7*
17 - 19	14,469	10,029	662	*69.3*	*4.6*	6,480	4,040	101	*62.3*	*1.6*
20 - 24	21,834	14,093	1,221	*64.5*	*5.6*	12,657	7,270	216	*57.4*	*1.7*
25 - 29	17,967	11,033	838	*61.4*	*4.7*	11,026	6,060	148	*55.0*	*1.3*
30 - 34	18,235	10,752	580	*59.0*	*3.2*	11,183	5,870	155	*52.5*	*1.4*
35 - 39	17,623	10,532	532	*59.8*	*3.0*	11,565	6,313	152	*54.6*	*1.3*
40 - 49	28,721	17,674	720	*61.5*	*2.5*	18,048	9,877	213	*54.7*	*1.2*
50 - 59	19,316	12,067	358	*62.5*	*1.9*	10,594	5,926	75	*55.9*	*0.7*
60 - 69	10,940	6,838	128	*62.5*	*1.2*	4,522	2,500	25	*55.3*	*0.6*
70 - 99	8,274	4,995	63	*60.4*	*0.8*	3,110	1,670	12	*53.7*	*0.4*
All ages[1]	171,552	99,433	5,240	*58.0*	*3.1*	93,448	49,950	1,116	*53.5*	*1.2*

1 Includes age not known

Source: Department of Transport (2006).

Table 12 shows that, when looking at rates per licence holder, it is the 17-24 year old age group who are most at risk of drink driving accidents, and when looking at rates per miles driven, it is the youngest drivers (17-19 year olds) who have the highest risk.

Table 12 Car drivers in road injury accidents: Accidents per licence holder and per mile driven, Great Britain.

Number

	Car driver drink-drive accidents	Drink-drive accidents per 100 thousand licence holders[2]	Drink-drive accidents per 100 million miles driven[2,3]
Under 17	70	..	..
17 - 19	1,050	79	41
20 - 24	2,280	87	18
25 - 29	1,520	49	8
30 - 34	1,320	35	5
35 - 39	1,050	25	3
40 - 49	1,500	21	3
50 - 59	680	11	1
60 or over	320	4	1
All ages[1]	10,010	28	4

1 Includes age not known.
2 National Travel Survey data 2004.
3 Uses traffic data from 2004.

Source: Department of Transport (2006).

However, when looking at fatalities in Great Britain, on average over the ten year period 1996-2005, a higher proportion of fatalities in drivers of cars and other motor vehicles had illegal blood alcohol levels amongst those aged 20-29 (31%) and those aged 30-39 (30%), than those aged 16-19 (21%) and those aged 40 and over (12%) (Department of Transport 2006).

5.3. ENFORCEMENT

An essential component of an effective drink-driving policy is enforcement, particularly using random breath testing. According to the most recent SARTRE 3 study, enforcement activity is fairly low across Europe (Sartre 2004a). In 23 European countries studied, only 26% of drivers said that they had been tested for alcohol over the last three years, 16% only once, suggesting that being checked for alcohol is more an exception than a systematic rule across Europe. The highest levels of drink driving checks are found in Finland, Estonia, Sweden, France, Slovenia, the Netherlands, Greece and Hungary (Figure 15). In all these countries, police have been empowered to stop and breath test drivers at random, i.e. without the driver revealing any suspicious behaviour. 86% of drivers in countries where RBT is not allowed declare they have not been checked in the last three years as opposed to 65% in countries where RBT is allowed. Further, in countries where RBT is not allowed 46% of drivers think they will never be checked, compared to 22% of drivers in countries where RBT is allowed. RBT thus plays a key role on determining the experience and the perception of the enforcement strategy of the interviewed drivers.

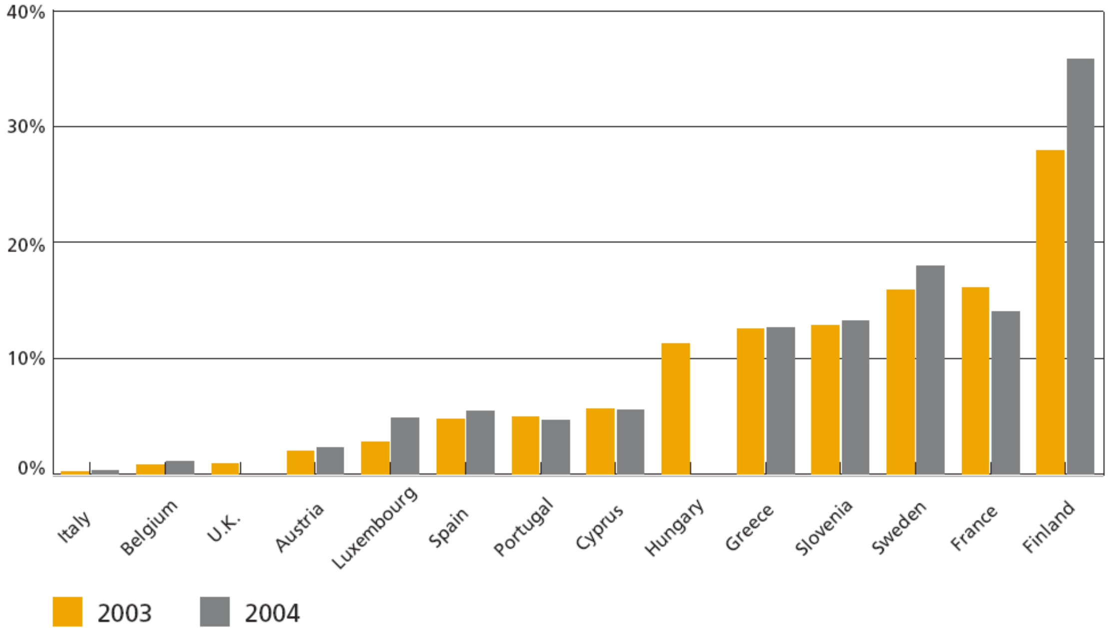

Figure 15 Drink driving checks per population. Source: Sartre (2004a).

When random breath testing is applied, drivers not only feel that they run a high risk of being tested, they also understand that all blood alcohol levels over the legal limit will be detected in these tests. Generally, few drivers will test positive in random tests. If testing is based on suspicion, on the other hand, the chances of being tested will be minimal. Moreover, only drivers that have BAL levels far over the limit will typically be apprehended whereas drivers that have BAL levels that are just over the limit may go undetected. Among those countries that have high levels of checks, Sweden, the Netherlands, Finland and France report fairly low levels of offences, Figure 16. In Slovenia and Estonia, on the other hand, the numbers of offences are still comparatively high. This is because the Northern and Western European countries introduced random breath testing earlier and offences declined as a result. The Eastern European countries introduced this more recently and the levels of offences started to drop later.

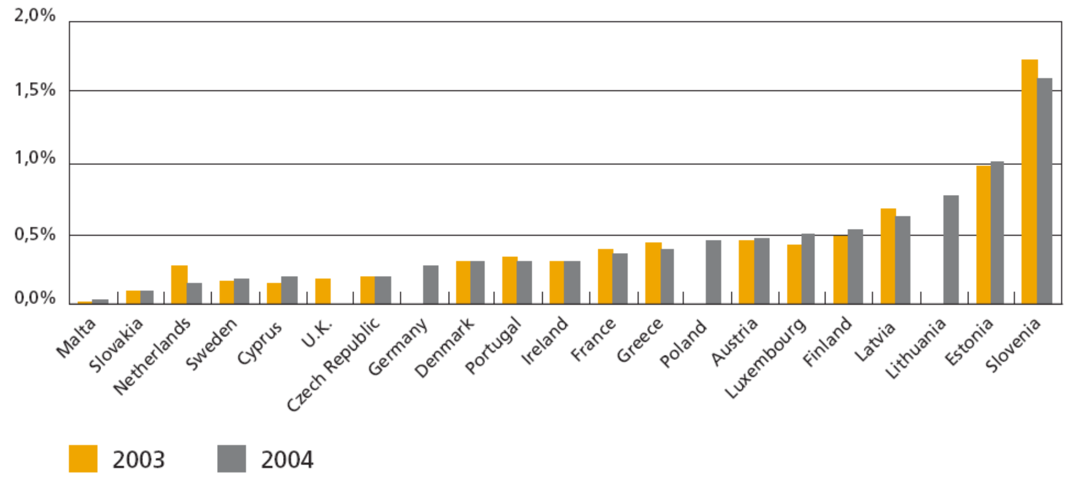

Figure 16 Drink driving offences per population. Source: Sartre (2004a).

The UK, Austria, Luxembourg, Spain, Portugal and Cyprus, on the other hand, are among those countries where few drivers are checked annually (Figure 5). This is also true for Italy and Belgium where complete figures are unavailable. Moreover, in Italy, Austria, the UK and Luxembourg a large proportion of alcohol tests result in a drink driving offence being sanctioned, Figure 17. In these countries, police apparently test drivers based on suspicion, no matter whether random testing is permitted or not.

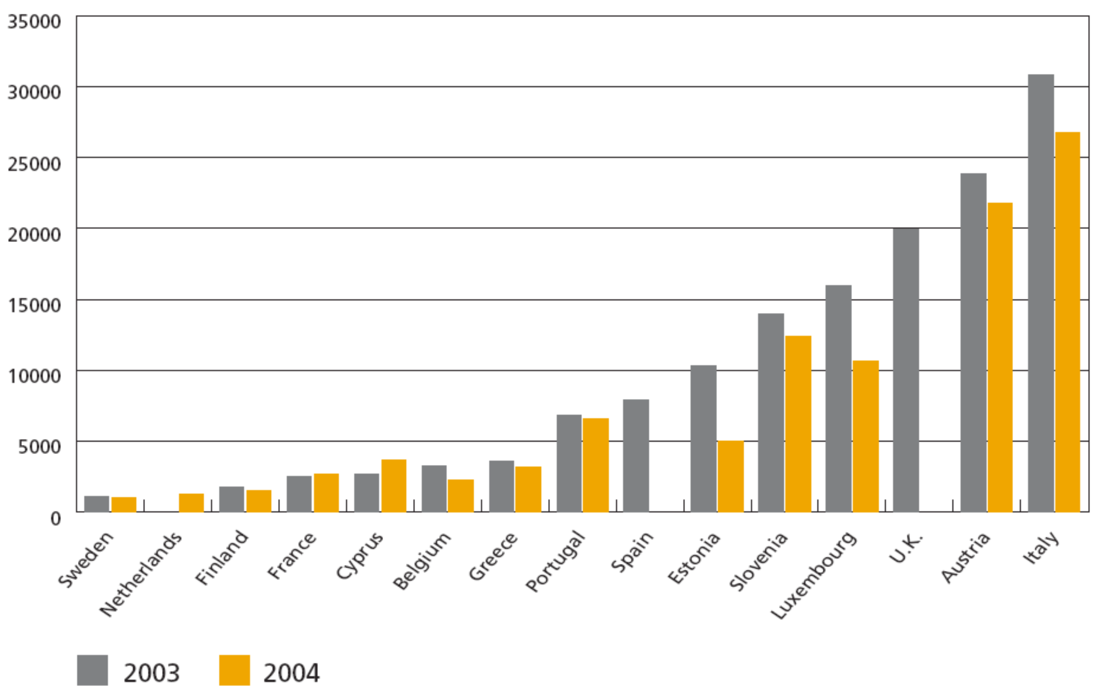

Figure 17 Offences sanctioned per 100,000 screening tests. Source: Sartre (2004a).

5.4. CONCLUSIONS

The Commission's Communication on alcohol calls for an enforced maximum limit of 0.5 g/L or less, and notes that lower or zero BAL limits should be introduced for young and novice drivers and, for safety reasons, also for public transport drivers and drivers of commercial vehicles. Although a number of countries are introducing a level of 0.2g/L for novice drivers, currently, four European Member States have legal BAL levels of 0.8g/L. In general it seems the higher the BAL limit, the more frequent driving after drinking even a small amount of alcohol. One in twenty drivers admit that they thought they had driven over the legal BAL at least one day during the previous week, this proportion increasing for drivers who have already received punishment for drinking and driving in the last three years, and for drivers who drink more frequently. It is primarily teenagers and young adults that are involved in drink driving accidents, men more so than women, with fatalities being more common in a slightly older age group. Checking drivers for blood alcohol levels seems to be more the exception rather than the rule across Europe, and is certainly lower in countries where random breath testing is not permitted. Further, in countries where random breath testing is not allowed nearly one half of drivers think that they will never be checked. Thus, random breath testing plays a key role in determining the experience and the perception of the enforcement strategy of drink driving policies.

6. COST EFFECTIVENESS OF DRINK DRIVING POLICY MEASURES

Nearly one half of European drivers think that drivers should not be allowed to drink any alcohol before driving. Three quarters of Europeans would agree to a lower blood alcohol level for young and novice drivers of 0.2 g/l, and eight in ten Europeans believe that random police alcohol checks on EU roads would reduce peoples' alcohol consumption before driving. It has been estimated that unrestricted breath testing in Europe, compared with no breath testing, could avoid 111,000 years of disability and premature death at an estimated cost of €233 million each year. A number of criticisms against reducing BAL levels are unfounded, in that there is good evidence that critical driving related skills are adversely affected at BALs below 0.5g/L; there is good evidence that lower BAL levels would save lives; lower BALs would not interfere with social drinking; lowering the BAL limit is likely to increase, rather than decrease, public support for the law; lower BAL levels can reduce 'hard core' drinking drivers; it is unlikely that lower BAL levels would overburden the courts; and the benefits of a lower BAL level would far outweigh any extra enforcement costs.

6.1. PUBLIC OPINION AND DRINK DRIVING POLICIES

The Eurobarometer survey found that although 51% of the EU population appear to know that the maximum legal blood alcohol level for drivers is between 0.01 and 0.59 g/l, which is indeed the case in 19 Member States, 36% of the EU population do not know the current BAL level in their country, Figure 18 (Eurobarometer 2007). In two countries with a zero limit, the population is more aware of the limit, Czech Republic (75%) and Slovakia (57%), although in the third country, Hungary less aware (39%). In Malta, the UK, and Ireland, where the BAL is above 0.5g/L, 96% of respondents in Malta, 70% in the UK and 66% in Ireland did not know their current BAL level. The do not know rate was also high in Cyprus (77%), Romania (76%), Italy (74%), Bulgaria (68%), the Turkish Cypriot Community (68%), Spain (59%) and Greece (49%). A higher proportion of do not know rate was found amongst women (43%), respondents aged 55 and over (44%), respondents finishing their full time education by age 15 (51%), house persons (53%), retired persons 42%), inhabitants of large towns (41%) and those who do not drink alcohol (52%).

	00.00 g/l	0.01 – 0.59 g/l	0.60 - 1 g/l	More than 1 g/l	DK	BAC allowed in the country g/l
EU25	6%	51%	4%	3%	36%	
BE	-	73%	3%	4%	20%	0.5
CZ	75%	11%	-	-	14%	0
DK	-	77%	10%	2%	11%	0.5
DE	4%	86%	2%	2%	6%	0.5
EE	53%	19%	2%	10%	16%	0.2
EL	-	44%	7%	-	49%	0.5
ES	-	36%	3%	2%	59%	0.5
FR	2%	77%	10%	3%	8%	0.5
IE	1%	33%	-	-	66%	0.8
IT	2%	18%	2%	4%	74%	0.5
CY	-	23%	-	-	77%	0.22
LV	-	60%	2%	3%	35%	0.5
LT	3%	60%	1%	3%	33%	0.4
LU	2%	18%	60%	1%	19%	0.5
HU	39%	28%	1%	-	32%	0
MT	-	2%	-	2%	96%	0.9
NL	1%	58%	2%	11%	28%	0.5
AT	3%	88%	1%	1%	7%	0.5
PL	9%	61%	1%	2%	27%	0.2
PT	-	54%	4%	5%	37%	0.5
SI	5%	82%	1%	-	12%	0.5
SK	57%	18%	-	-	25%	0
FI	2%	74%	3%	7%	14%	0.5
SE	10%	72%	2%	1%	15%	0.2
UK	-	19%	9%	2%	70%	0.8
CY (tcc)	-	21%	10%	1%	68%	
BG	1%	28%	1%	2%	68%	
RO	3%	14%	7%	-	76%	
HR	89%	5%	-	-	6%	
Highest percentage within a country						

Figure 18 What is the legal blood alcohol level (BAL) allowed for car drivers in your country. Source: Eurobarometer (2007).

In the Sartre study, more than 88% of interviewed drivers think that the penalties for drink-driving offences should be much more severe, with homogeneity across countries. 45% of participants think that drivers should not be allowed to drink any alcohol before driving, being higher in eastern European countries (60%), similar in northern (47%) and western (43%) European countries, and lower in southern European countries (26%), Figure 19.

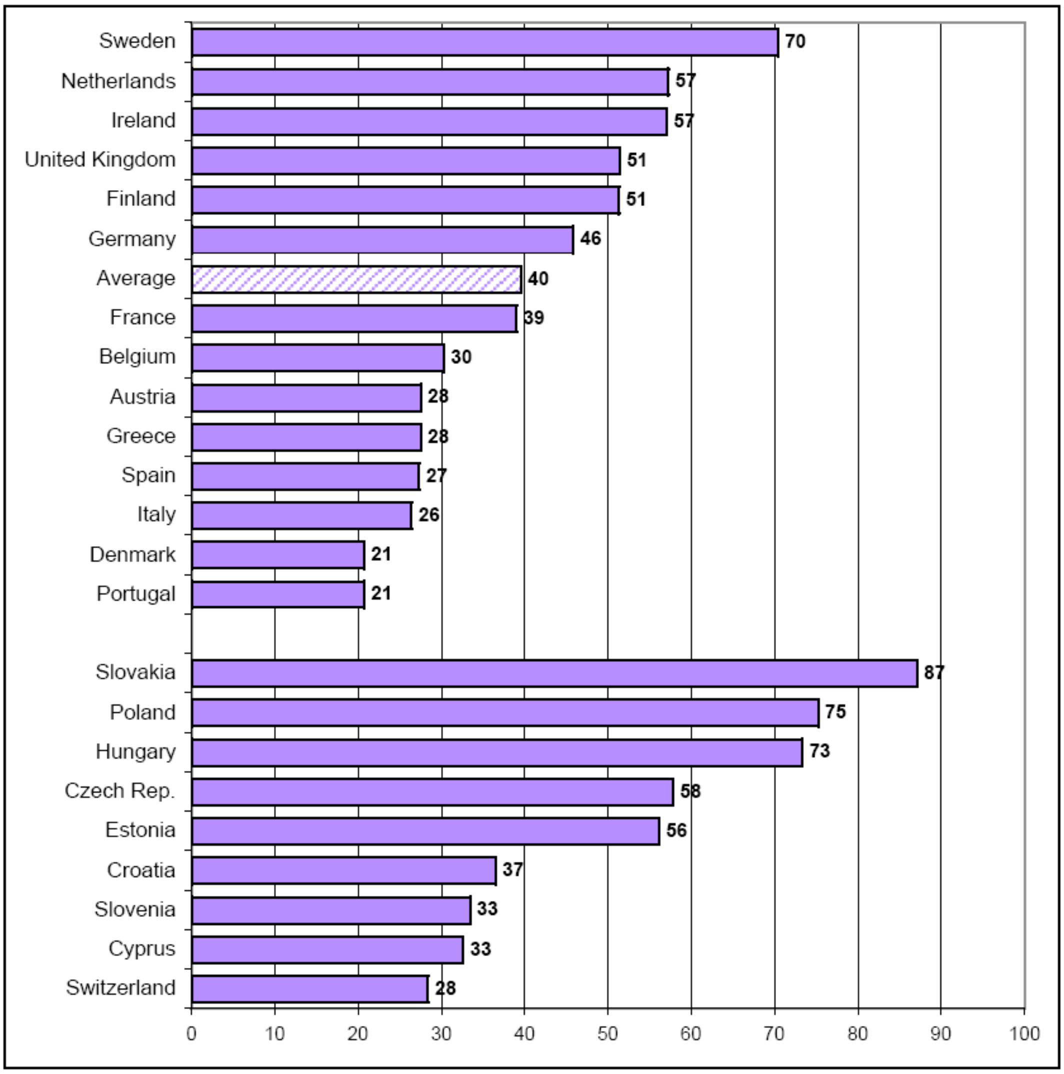

Figure 19 Do you think that drivers should be allowed to drink no alcohol at all (%)? Source: Sartre (2004a).

In the Sartre study, more than two thirds of all drivers were in favour of having a maximum alcohol limit of 0.5 g/l. 80% of drivers from countries where this limit is already in place, and 75% of drivers from countries with a limit of 0.8g/L are in favour of the 0.5g/L limit. In general, the more the current legal limit differs from 0.5 g/l, independent of whether it is higher or lower, the less do the drivers favour a maximum limit of 0.5 g/l. This result indicates, that the acceptance of legal regulation is strongly influenced by habituation and own experiences. Eighty-two per cent of interviewed drivers were very or fairly in favour of having a BAC limit for novice drivers of 0.0 g/l. In the Eurobarometer survey, almost three quarters of Europeans surveyed (73%) would agree to a lower blood alcohol level for young and novice drivers of 0.2 g/l, with 51% totally agreeing to this proposal, Figure 20. People from Germany, Netherlands, and Sweden were most likely to agree to a lower level, Figure 21. People from Slovakia, Czech Republic and Hungary were least likely to agree, but this is probably explained by the fact that the limit in Slovakia, the Czech Republic and Hungary is already zero for all drivers.

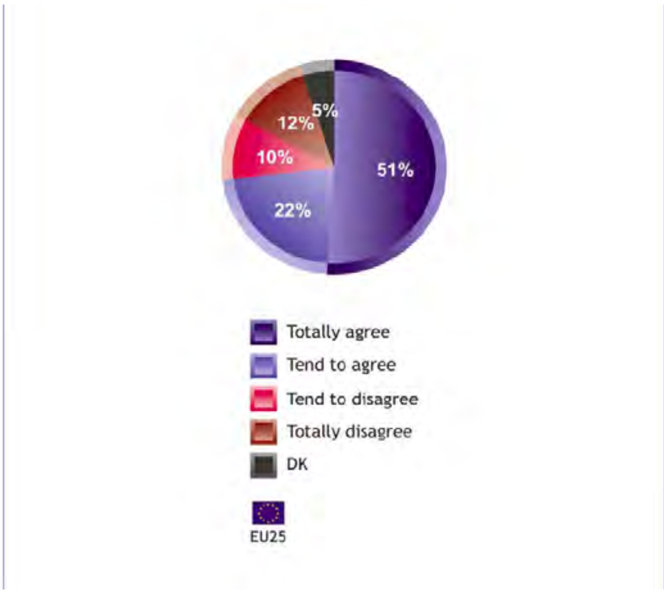

Figure 20 The extent to which European citizens agree with lower blood alcohol levels (BAL) for young and novice drivers to 0.2g\l in all 25 European Union Member States. Source: Eurobarometer (2007).

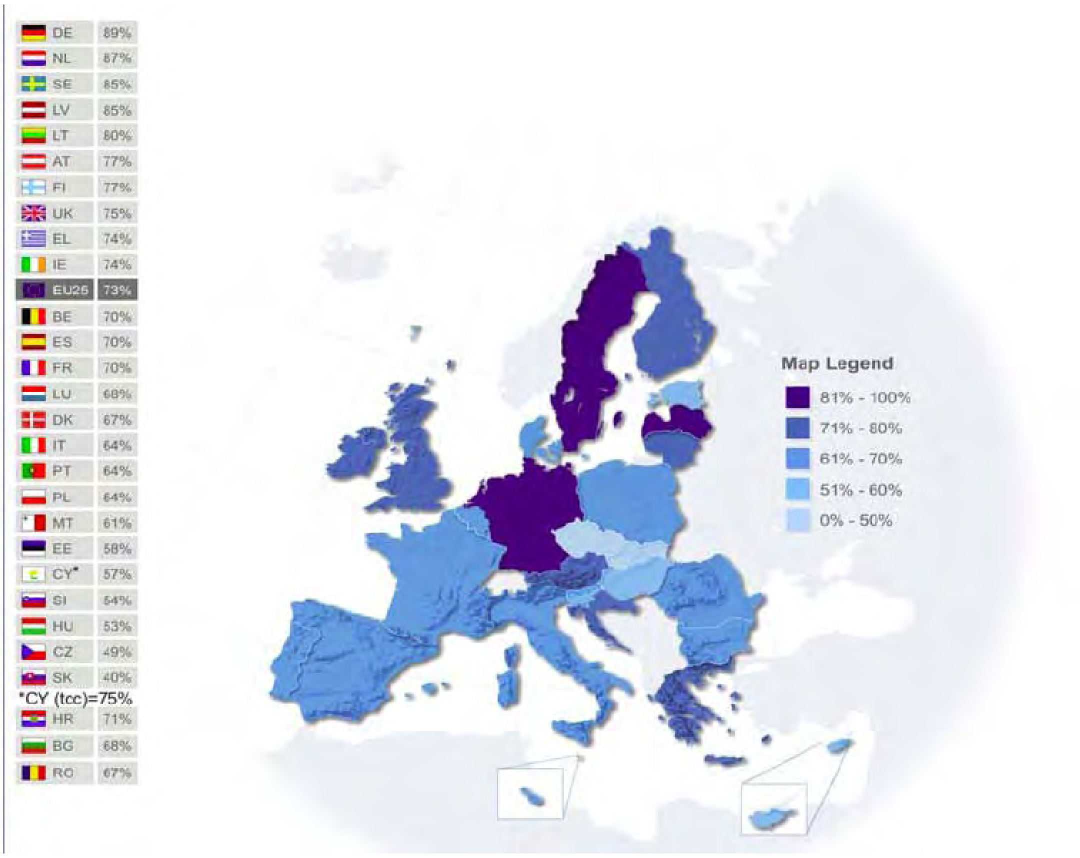

Figure 21 The extent to which European citizens agree with lower blood alcohol levels (BAL) for young and novice drivers to 0.2g\l in all 25 European Union Member States. Source: Eurobarometer (2007).

Eight in ten (80%) EU citizens believe that random police alcohol checks on EU roads would reduce peoples' alcohol consumption before driving, with 47% totally agreeing with this statement, Figure 22. There was support for this statement in all countries surveyed, Figure 23.

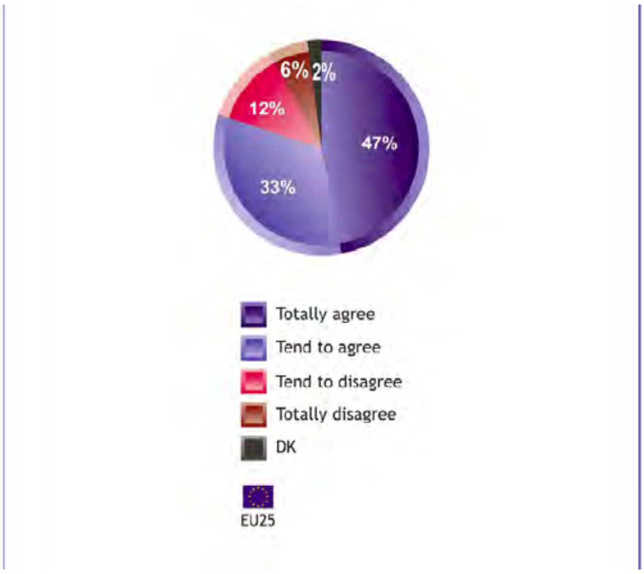

Figure 22 The extent to which European citizens agree that random police checks would reduce alcohol consumption before driving. Source: Eurobarometer (2007).

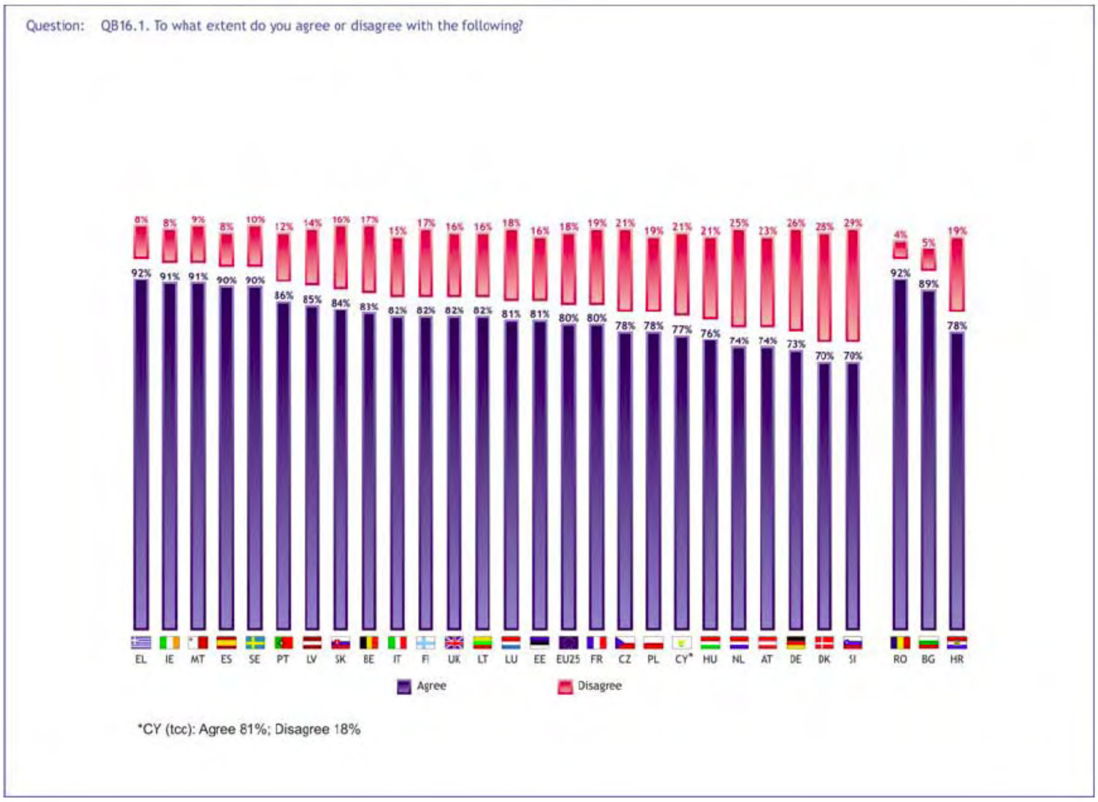

Figure 23 The extent to which European citizens agree that random police checks would reduce alcohol consumption before driving. Source: Eurobarometer (2007).

In the Sartre study, one third (32%) of the drivers were very much in favour and another 25% fairly in favour of having an alcohol-meter in the car that prevents them from driving if over the BAL limit. More than 70 % of people were in favour in Sweden, France, Portugal and Greece, while in Germany, Austria and Greece less than 30% of the drivers were in favour. Interestingly, drivers who were in favour of an alcohol-meter were nearly 50% more likely to have reported drinking driving over the limit than those who were not in favour of an alcohol meter.

6.2. COMPARISON WITH OTHER ALCOHOL POLICY MEASURES

The World Health Organization's CHOICE project modelled five policy options to reduce alcohol-related harm: drink-driving laws, adjusted for the current level of implementation and enforcement via random breath testing; the impact of a tax on alcohol set at the current level increased by 25%, compared with no tax at all, and adjusted for the observed or expected level of unrecorded use; reduced access to and availability of alcohol through estimating what would happen if alcohol could not be purchased for a 24-hour period at the week-end; brief interventions such as physician advice provided in primary health care to 25% of the at risk population; and the impact of advertising controls based on a 2%-4% reduction in the incidence of hazardous alcohol use, derived from international time-series analyses of the impact of an advertising ban (Grube and Agostinelli 2000; Saffer 2000; Saffer and Dave 2002).

A summary of the estimated impact of the five different interventions, (DALYs[7] prevented per million people per year) compared to a Europe with none of these policies is shown in Figure 24, and the estimated costs (Euro per 100 people per year) in Figure 25, for the three regions of the European Union, based on the WHO classification, Table 13.

Table 13 WHO classification of European Union countries based on mortality rates.

Europe A Very low child and very low adult mortality		**Europe B** Low child and low adult mortality	**Europe C** Low child and high adult mortality
Austria	Italy	Cyprus	Estonia
Belgium	Luxembourg	Poland	Hungary
Czech Republic	Malta	Slovakia	Latvia
Denmark	Netherlands		Lithuania
Finland	Portugal		
France	Slovenia		
Germany	Spain		
Greece	Sweden		
Ireland	United Kingdom		

[7] A DALY (Disability-Adjusted Life Year) is a measure of the number of healthy years of life lost due to a specific risk factor (in this case alcohol). While a year of perfect health will count as 1 and a year of death will be 0, a year of damaged health that significantly affects Quality of Life will be somewhere in between. DALYs measure a gap in health between the current position and what could be achieved. Each DALY can be considered as one year of ill-health or premature death.

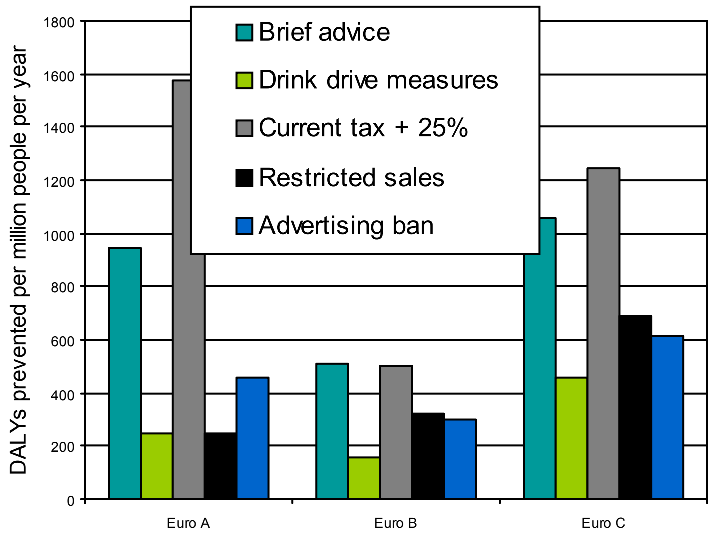

Figure 24 The impact of different policy options (DALYs prevented per million people per year) in the three sub-regions of EU25.

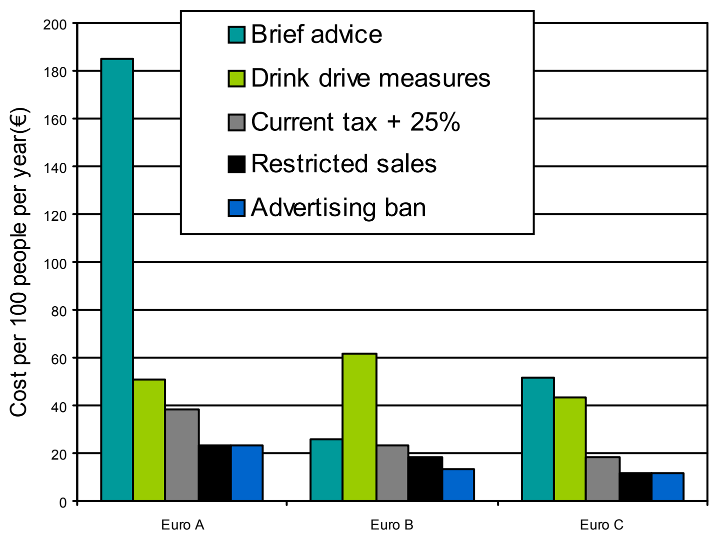

Figure 25 The cost of different policy options (per 100 people per year (€)) in the three sub-regions of EU25.

Two independent effects on alcohol-related traffic injuries were modelled: drink-driving laws, estimated to reduce traffic fatalities by 7% if widely implemented within a region (Shults *et al.* 2001), adjusted for the current level of implementation; and enforcement via random breath testing (RBT), estimated to reduce fatalities by a further 6-10% (Peek-Asa 1999; Shults *et al.* 2001). The model found that the full implementation of random breath testing (compared to no random breath testing) throughout the European Union (EU) prevents between 161 (EuroB countries) and 460 (EuroC countries) DALYs per million people per year, at an estimated cost of between €43 (EuroC countries) and €62 (EuroB countries) per 100 people per year. The model estimated that unrestricted breath testing in Europe, compared with no breath testing, can avoid 111,000 years of disability and premature death at an estimated cost of €233 million each year (adapted from Chisholm *et al.* 2004).

In all three regions of the European Union, taxation (current tax levels with a 25% increase in tax, compared to no tax) had the greatest impact in reducing the harm done by alcohol, followed by brief interventions delivered by primary providers to 25% of the at risk population. The three regulatory measures, (taxation, restricted sales and advertising controls) were the cheapest in terms of cost to implement, with drink driving measures and brief interventions being the most expensive. Thus, in all three sub-regions of the European Union, taxation, restricted access, and advertising bans were the most cost-effective policy options.

6.3. COMMON CRITICISMS AGAINST REDUCING BAL LEVELS

There is a lack of consensus among experts on the issue of lower BAL limits
As described in Chapter 2, there is good evidence that critical driving related skills are adversely affected at BALs below 0.5g/L, and that the skills that are most important to driving are also among the most sensitive to alcohol. There is a parallel body of unchallenged research on the increased relative risk of fatal crash at BALs of 0.5g/L or less. There has been a clear trend in Europe to lower BAL limits, a trend supported by numerous leading medical, accident prevention, and traffic safety organizations.

There is no evidence that a lower BAL offence would save lives
The extensive evidence described in Chapter 4 shows that important traffic safety benefits can be attributed to lower BALs, independent of confounding factors. For example, in Queensland, Australia, the 0.5g/L BAL limit prevented 599 serious collisions and 91 fatal collisions in each year of its implementation (Henstridge et al 1997). As previously described, this study controlled for seasonal effects, weather, economic trends, road use, alcohol consumption, and day of the week. It also statistically removed the impact of other countermeasures, such as random breath testing (which was not introduced in Queensland until eight years after the 0.5g/L BAL limit came into force), to determine the percentage of the decline that was directly attributable to the lower BAL limit.

A lower BAL offence would interfere with social drinking
It has been argued that lower BAL limits would interfere with what might be described as lighter social drinking, thereby causing huge losses to the alcohol and hospitality industries. It might be considered that traffic safety policy should be set independent of concern about the profitability of the alcohol industries. Moreover, a lower level should not interfere with lighter social drinking, but rather might impinge on more excessive consumption by those intending to drive.

A lower BAL offence would decrease public support for the law
Interestingly, an American study found that support for lower legal BAL limits increased when respondents were told how many beers it takes to reach the current BAL limit. When asked how many beers a person should be allowed to drink within two hours before driving, approximately 70% gave an answer equivalent to a BAL of 0.5g/L or lower (Snyder 1992). In addition, when asked to state the number of beers that they would personally be able to drink and still drive safely, only one third of respondents gave an estimate that exceeded 0.4g/L BAL. Furthermore, as indicated by the public attitude studies in some countries, a lower BAL limit may help change public attitudes about drinking and driving (Bernhoft 2000; Loxley et al 1992). Drivers are more likely to appreciate the risks posed by drinking and driving and consider it a

serious offence. Drivers may become more conscious of the number of drinks they consume before driving. In addition, as the benefits of the lower BAL limit are communicated to the public in terms of reduced crashes, injuries and deaths, public perceptions will likely be more favourable. Consequently, lowering the BAL limit is likely to increase, rather than decrease, public support for the law.

A lower BAL offence would not deter 'hard core' drinking drivers
Opponents of lower BAL limits claim that they not only criminalize so-called "social drinkers", but also detract attention from the small minority of so-called "hard core" drinking drivers (Simpson et al 1999; Morrison 1999). It is suggested that "social drinkers" have already changed their behaviour due to the public education campaigns of the 1980s and 1990s, and that a very small number of "hard core" drinking drivers are largely responsible for the remaining impaired driving problems. In addition to blaming most of the problem on "hard core" drinking drivers, the proponents of this view state that this recalcitrant group is undeterrable (Morriison 1999). They argue that these "hard core" drinking drivers are unlikely to be prompted to obey a new, lower limit.

The purported dichotomy between "hard core" and "social" drinkers ignores those people who usually drink moderately, but occasionally drink to excess. These people, who would not generally be viewed as "hard core" drinkers, do have a much greater risk of an alcohol-related crash at any given BAL level. And, in fact, the evidence shows that lower BAL limits reduce impaired driving across BAL levels, including very high ones. As indicated, after Sweden lowered its BAL limit to 0.2g/L, the average BAL of convicted impaired drivers, as well as the percentage of impaired drivers with BALs above 1.5g/L, fell substantially (Norstrom & Laurel 1997). The American experience with 0.8g/L laws also lends some support to the view that lower BAL limits affect drivers across the range of BALs. The 2001 meta-analysis of 0.8g/L BAL laws in the United States reported that the lower limit reduced the number of fatalities involving drivers with BALs of 1g/L or higher (Shults et al 2001).

A lower BAL offence would overburden the courts
While it is true that a lower BAL limit would make more drivers potentially liable to prosecution, it does not necessarily follow that the police and the courts will be overburdened with cases. In fact, a study of the Australian Capital Territory indicated that the number of drivers with BALs between 0.5g/L and 0.8g/L decreased after the BAL limit was lowered from 363 per 10,000 tests in 1990 to an estimated 34 per 10, 000 tests in 1991 (Brooks & Zaal 1992).

A lower BAL offence would cost too much to enforce
Cost criticisms fails to consider the potential savings generated by reductions in alcohol related crashes, injuries, and deaths (Single et al 1996). While it is not clear that a criminal lower BAL offence would raise criminal justice costs substantially, even if it did, these costs would most likely be more than outweighed by the benefits. A study by Stanford University's Institute for Economic Policy Research examined the potential costs of decreasing the legal BAL limit from 1g/L to 0.8g/L in New York State (Eisenberg 2001). Based on a conservative estimate of the number of crashes avoided and lives saved, the author estimated that a 0.8g/L BAL law would save $9 to $11.4 billion (US) in its first 10 years. This included savings in property damage, insurance administrative costs, legal costs, emergency medical services, workplace costs, and travel delay. Conversely, the estimated costs of the additional arrests and prosecutions were only $80 million over the 10 years, or less than 1% of the most conservative estimate of the law's benefits.

6.4. Conclusions

There is overwhelming public support for introducing effective drink driving countermeasures, including lower BALs for all drivers, a lower BAL for novice drivers, and random breath testing. Drink diving measure are effective in saving lives, and, although not as cheap to implement as other alcohol policy measures, the benefits of increased measures far outweigh any additional enforcement costs. Although a number of criticisms have been made at the desirability of reducing BAL levels, none of the criticisms stand up to examination. Much stronger policy emphasis should be placed on lowering legal BAL levels, ensuring that such changes are enforced through high visibility random breath testing and supported by extensive mass media campaigns.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. CONCLUSIONS

Drinking and driving

The majority of the driving population is impaired in some important driving skills at blood alcohol levels as low as 0.2g/L BAL, and some fourth fifths of the driving population are impaired at blood alcohol levels of 0.5g/L. This is reflected in the relationship between blood alcohol level and the risk of a crash, which increases with increasing blood alcohol concentration, with no evidence for a threshold effect. The relationship is exponential, with huge increases in crash risk at high blood alcohol levels. The evidence leads to the conclusion that there should be no drinking alcohol and driving, and that legal blood alcohol concentrations for driving should be as low as possible, and certainly no greater than 0.2g/L.

Regulating the availability and marketing of alcohol and drink driving accidents

Jurisdictions that implement effective and comprehensive alcohol policies to reduce the harm done by alcohol, including policies that manage the price of alcohol, that regulate the availability of alcohol, and that regulate the marketing of alcohol, will also benefit from reduced drink driving accidents and fatalities. With regard to legal minimum ages to purchase alcohol, which are effective in reducing alcohol related road traffic crashes, these only work if they are adequately enforced.

Drink driving countermeasures

There is an enormous wealth of evidence that the drinking-driving policies that are going to have an impact in reducing drinking and driving and drink driving fatalities are those that lower blood alcohol concentration (BAL) levels, with adequate enforced through unrestricted (random) breath testing, and adequate penalties including administrative license suspension, Table 5. The evidence shows that designated driver and safe drive programmes and school-based education are not effective and cannot be an alternative to lower BAL levels and random breath testing. Drink driving laws need to be publicized through mass media campaigns, and their effectiveness can be enhanced through community based programmes.

Drink driving and policies in Europe

The Commission's Communication on alcohol calls for an enforced maximum limit of 0.5 g/L or less, and notes that lower or zero BAL limits should be introduced for young and novice drivers and, for safety reasons, also for public transport drivers and drivers of commercial vehicles. Although a number of countries are introducing a level of 0.2g/L for novice drivers, currently, four European Member States have legal BAL levels of 0.8g/L. In general it seems the higher the BAL limit, the more frequent driving after drinking even a small amount of alcohol. One in twenty drivers admit that they thought they had driven over the legal BAL at least one day during the previous week, this proportion increasing for drivers who have already received punishment for drinking and driving in the last three years, and for drivers who drink more frequently. It is primarily teenagers and young adults that are involved in drink driving accidents, men more so than women, with fatalities being more common in a slightly older age group. Checking drivers for blood alcohol levels seems to be more the exception rather than the rule across Europe, and is certainly lower in countries where random breath testing is not permitted. Further, in countries where random breath testing is not allowed nearly one half of drivers think that they will never be checked. Thus, random breath testing plays a key role in determining the experience and the perception of the enforcement strategy of drink driving policies.

Cost effectiveness of drink driving policy measures
There is overwhelming public support for introducing effective drink driving countermeasures, including lower BALs for all drivers, a lower BAL for novice drivers, and random breath testing. Drink diving measure are effective in saving lives, and, although not as cheap to implement as other alcohol policy measures, the benefits of increased measures far outweigh any additional enforcement costs. Although a number of criticisms have been made at the desirability of reducing BAL levels, none of the criticisms stand up to examination. Much stronger policy emphasis should be placed on lowering legal BAL levels, ensuring that such changes are enforced through high visibility random breath testing and supported by extensive mass media campaigns.

7.2. RECOMMENDATIONS

INFORMATION AND MONITORING SYSTEMS

1. Standardized definitions of drinking and driving, drinking and driving accidents, and drinking and driving fatalities should be agreed and used across Europe
2. Breathalysers and breath tests and their results should be uniformly standardized across Europe.
3. A monitoring system, with common and standardized measures across European countries, should be put in place to produce annual reports on drinking and driving in Europe, such as the reports prepared by the SARTRE project and the European Transport Safety Council.
4. Particular attention should be given to monitoring drinking and driving amongst professional drivers, for which data is currently lacking
5. Particular attention should be given to monitoring drinking and driving amongst repeat offenders, who at risk of continued drinking and driving.

REGULATING THE AVAILABILITY AND MARKETING OF ALCOHOL TO REDUCE DRINKING AND DRIVING

6. Minimum tax rates for all alcoholic beverages should be increased in line with inflation; should be at least proportional to the alcoholic content of all beverages that contain alcohol; and should at least cover the external costs of alcohol as determined by an agreed and standardized methodology.
7. Jurisdictions that manage outlets through number and density, location and hours and days of sale should consider not relaxing their regulations; jurisdictions without such regulations or with very limited regulations should analyze the impact of introducing or strengthening them.

8. Agreements and mechanisms should be explored to restrict or ban the marketing of alcoholic beverages at the European level, ensuring a level playing field across Europe.

DRINK DRIVING COUNTERMEASURES

9. A maximum blood alcohol concentration limit of 0.5 g/L should be introduced throughout Europe; countries with existing lower levels should not increase them. Eventually, a lower limit of 0.2g/L should be introduced for all drivers.

10. A lower limit of 0.0g/L should be introduced for young drivers and drivers of public service and heavy goods vehicles; countries with existing lower levels should not increase them.

11. Unrestricted powers to breath test, using breathalysers of equivalent and agreed standard, should be implemented throughout Europe. 50% of all European drivers should have been stopped and breath tested at some time by the year 2012

12. Common penalties with clarity and swiftness of punishment, with penalties graded depending at least on the BAL level, should be implemented throughout Europe.

13. Driver education, rehabilitation and treatment schemes, linked to penalties, based on agreed evidence-based guidelines and protocols should be implemented throughout Europe.

14. Action to reduce drinking and driving should be supported by a Europe wide campaign.

15. Existing designated driver campaigns should be evaluated for their impact in reducing drink driving accidents and fatalities before financing and implementing any new campaigns.

16. Effective and appropriate training for the hospitality industry and servers of alcohol should be implemented to reduce the risk of drinking and driving.

17. Comprehensive community-based educational and mobilization programmes, including urban planning and public transport initiatives, should be implemented to reduce drinking and driving, including alcohol awareness training in all in driver instructor training courses.

18. Resources should be made available to ensure the widespread availability and accessibility of identification and advice programmes to reduce drinking and driving in accident and emergency departments.

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