Alcohol

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Project co-financed by the European Commission Directorate General for Mobility & Transport

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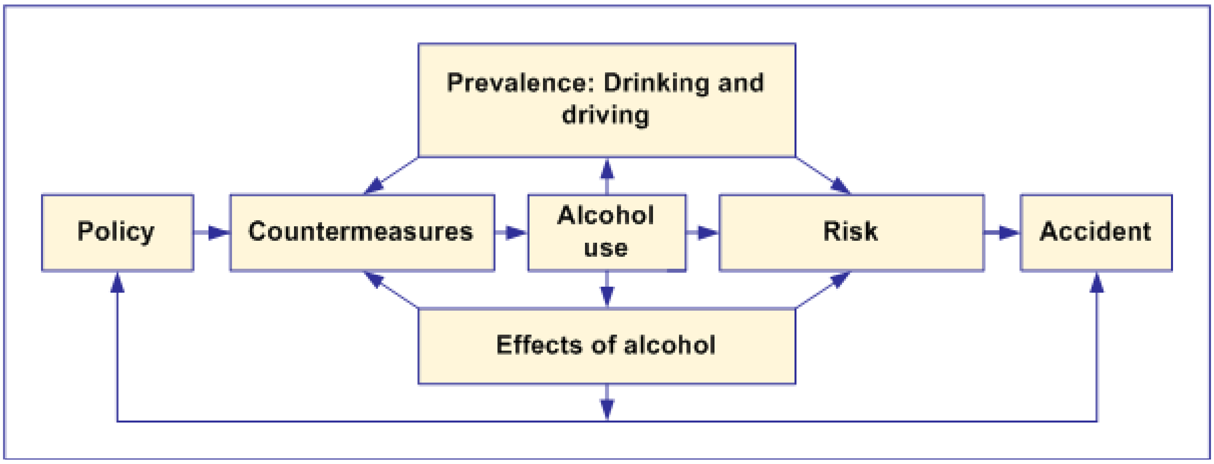
1 Overview



The scope of the problem
About 25% of all road fatalities in Europe are alcohol-related whereas about only 1.6% of all kilometres driven in Europe are driven by drivers with 0.5 g/l alcohol or more in their blood. As Blood Alcohol Concentration (BAC) in the driver increases, the relative crash risk also increases. The increase in relative crash risk accompanying increasing BAC is progressive. Compared to a sober driver, the relative crash risk of a driver with a BAC of 0.8 g/l (still the legal limit in 3 of 25 EU Member States) is 2.7 times that of sober drivers. A driver with a BAC of 1.5 g/l has a relative crash risk 22 times that of a sober driver. Not only does the relative crash risk grow rapidly with increasing BAC, but the crash also becomes more severe. With a BAC of 1.5 g/l the relative risk of a fatal crash is about 200 times that for sober drivers.

Why is drinking and driving so dangerous?
Alcohol diminishes driving skills at all levels. The driving task can be divided into three different levels. At the lowest level are tasks dealing with keeping a proper speed and maintaining the correct course (steering, accelerating, braking, etc.). Most of the skills related to this level, such as tracking performance, reaction times, and visual detection, already begin to deteriorate at a BAC below 0.5 g/l. At the intermediate level are decisions dealing with manoeuvring a vehicle in traffic. Skills related to this level are dividing attention, scanning capabilities, and information processing in general. These skills also begin to deteriorate at very low BAC levels. As stated above, the main tasks of a driver when driving are to maintain the proper course of the vehicle and to scan the driving environment for information, such as vehicles, traffic signs, and other events. Alcohol-impaired drivers have more difficulty maintaining a proper course for the vehicle and therefore focus more on the driving task than on the environment. Studies show that alcohol impaired drivers are more likely to use their central rather than their peripheral vision. Consequently, they may overlook information on coming events such as sharp bends and oncoming traffic.

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At the highest level, comes the decision as to whether one should drive or not. It is well-known that after having consumed alcohol, self-control becomes less stringent and that when only slightly inebriated, people are more inclined to think that they are still able to drive safely.

What measures are effective?

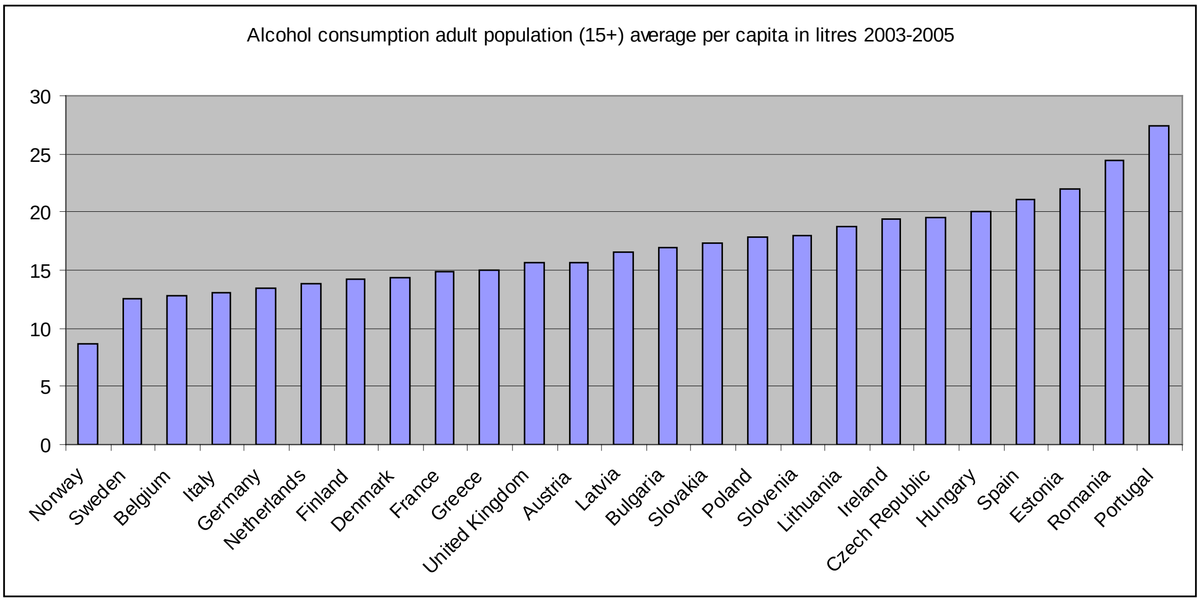
The problem of drink driving is not new and many measures have already been introduced. A very successful measure was the introduction of breath testing devices by the police in the 1970s. However, the fact that drink drivers know that they can be caught and that sanctions are tough, and despite public opinion regarding drink driving having changed considerably (most people in Europe nowadays wholeheartedly disapprove of drinking and driving), alcohol-impaired road users are still involved in about a quarter of all fatal crashes in Europe. New and more effective measures are needed.

2 Prevalence and risks associated with alcohol consumption

2.1 Alcohol consumption

Alcoholic beverages are popular throughout Europe. Compared to other global regions, Europe is by far the heaviest drinking region of the world (WHO, 2010). The drinking patterns and the type of drink (wine, beer, and spirits) preferred vary from country to country, but in all EU Member States alcohol consumption is substantial. Figure 1 shows litres of pure alcohol consumed by drinkers aged 15+ per capita (total population) of 23 EU Members States over the years 1997-2003. Cyprus, Luxembourg and Malta are not included.

Figure 1: Consumed litres of pure alcohol by adult population (15+) per capita in litres (2003-2005)

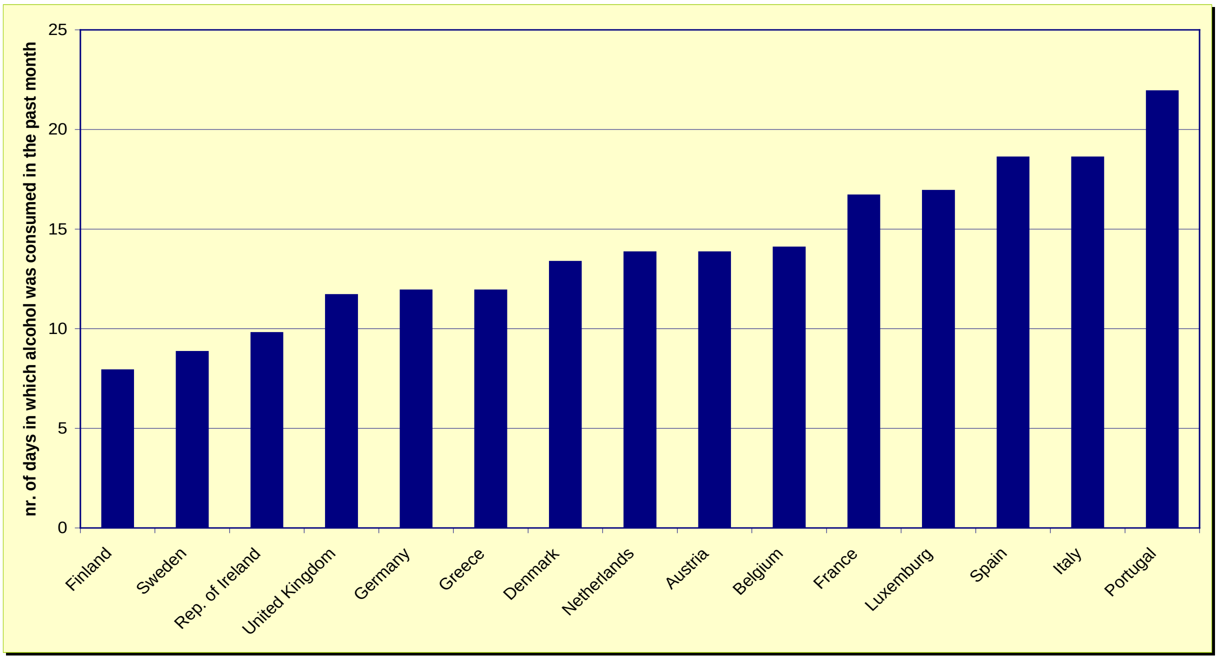


Source: WHO (2010)

Although drinking is popular in all EU Member States, there are some considerable differences between countries. For example, in Norway the alcohol consumption of the adult population per capita is only one third of that of Portugal and Romania. However, data based on sales should take into account that in countries where alcohol is expensive people may tend to buy alcohol in a neighbouring country where it costs less.
In general, countries from Northern and Western Europe consume less alcohol than countries in Eastern and Southern Europe, although Italy's consumption is below average. In some countries people tend to drink a regular amount of alcohol every day whereas in other

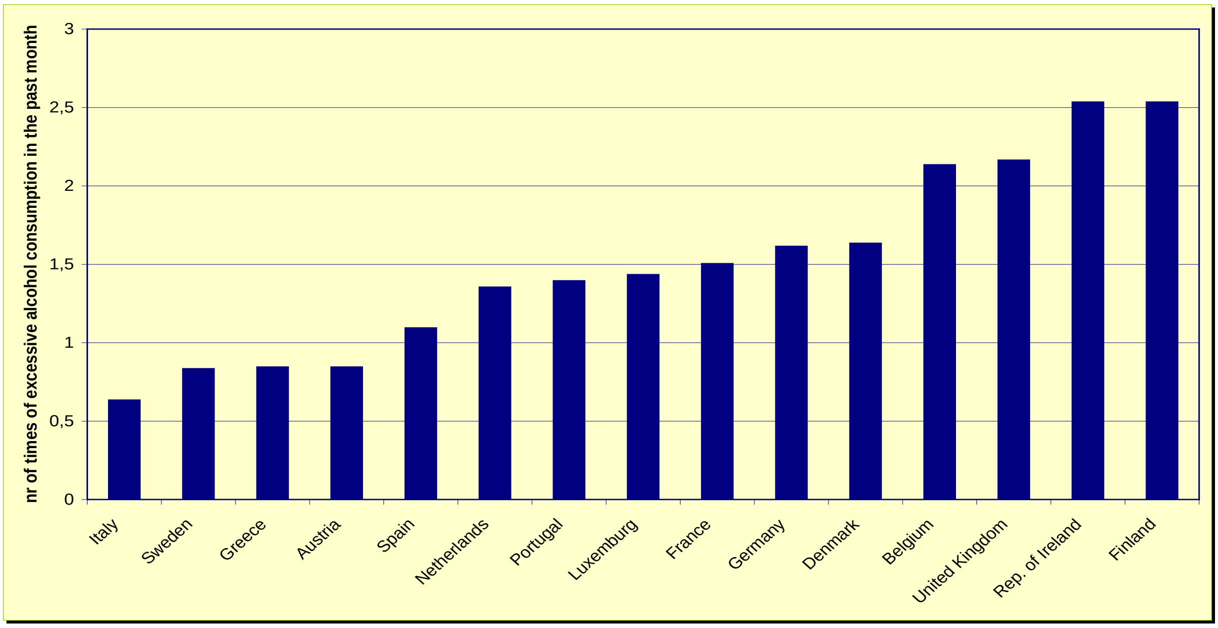
countries people drink less frequently but in higher quantity.. Figure 2 presents the self-reported number of days in the past month in which alcohol was consumed in the 15 old EU Member States.

Figure 2: Self reported number of days in the past month in which alcohol was consumed.



Source: Health, Food and Alcohol and Safety, European Opinion Research Group EEIG, special Euro barometer, European Commission (December, 2003)

Figure 3: Self reported number of times the equivalent of one bottle of wine or five pints/bottles of beer of five measures of spirits on one drinking occasion was consumed in the past month



Source: Health, Food and Alcohol and Safety, European Opinion Research Group EEIG, special Euro barometer, European Commission (December, 2003)

2.2 Drinking and driving

A definitive comparison of the prevalence of drink driving in EU Member States has not been possible until recently since definitions of drink driving and research methods applied have differed from country to country. In 2011 results from the European research project DRUID (Driving Under the Influence of Drugs, Alcohol and Medicines) were published. The main objective of this project was to provide a scientific base for European policy on driving under the influence of psychoactive substances. The project includes 13 national prevalence studies.

Alcohol use in EU countries

Figure 4 and 5 present an overview of the alcohol use in EU Member States both for single alcohol use (0.2 grammes/litre (g/l) or higher) and for the use of alcohol (0.2g/l or higher) in combination with other psychoactive substances (Houwing et al., 2011). The use of other psychoactive substances in combination with alcohol is important for traffic safety since the relative risk for combined use of alcohol and other psychoactive substances is higher than the relative risk for alcohol alone.

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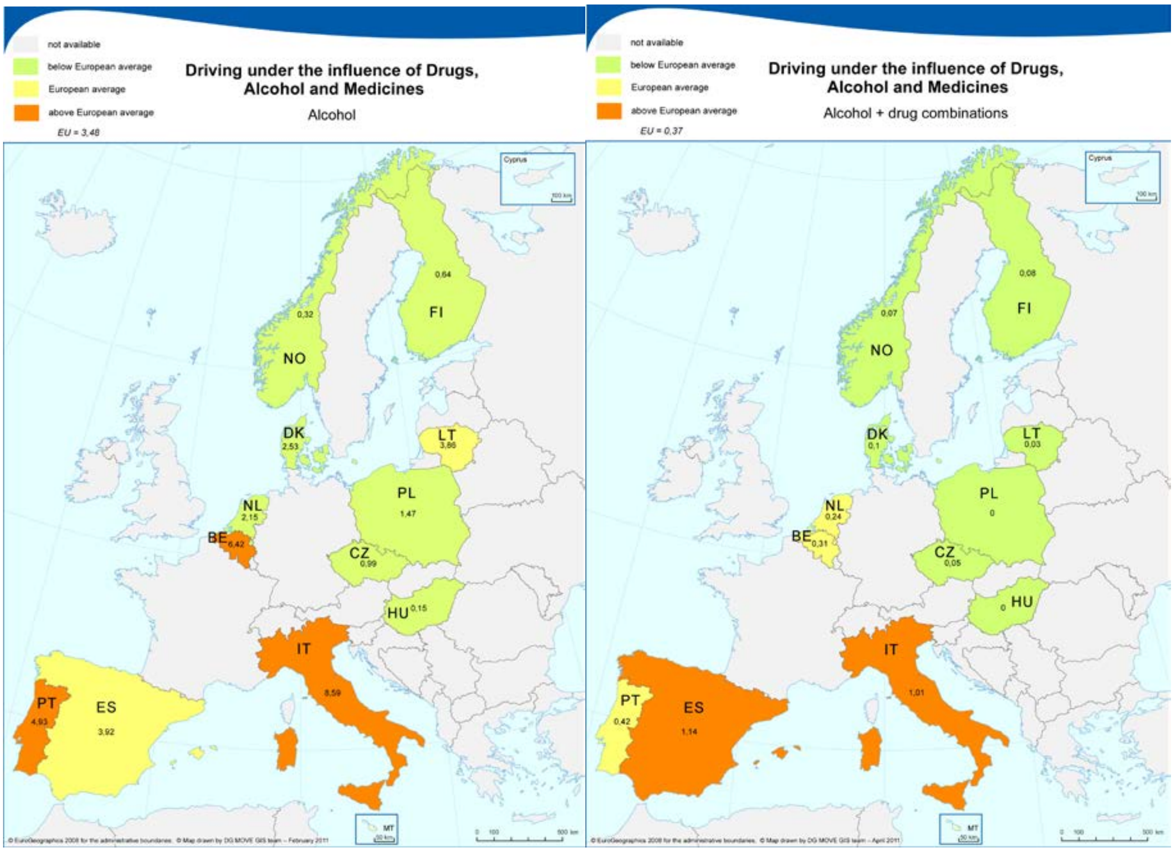
Figure 4 and 5: Prevalence of alcohol alone and alcohol in combination with other psychoactive substances in Europe in concentrations of 0.2 g/L or higher.



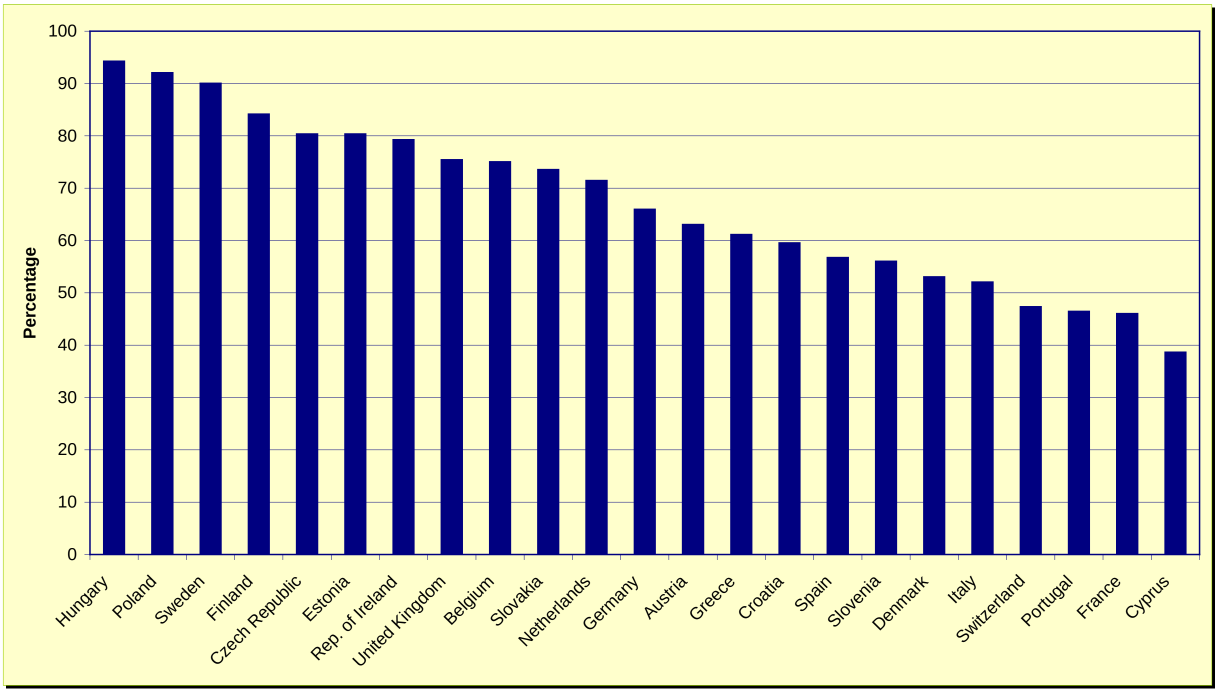
Source: DRUID Deliverable 2.2.3: prevalence of alcohol and other psychoactive substances in drivers in general traffic.

Based on the results of the prevalence studies, a weighted mean of the prevalence of alcohol use in European traffic was calculated. It was estimated that 3.85% of European drivers drove with a BAC of 0.2 g/l of which 3.5% with alcohol alone and 0.37 with alcohol in combination with other psychoactive substances. For 0.5 g/l and higher, the average prevalence of alcohol alone is 1.5% and 0.16% for alcohol in combination with drugs and medicines.

Survey data on drink driving behaviour is also available. In 2002, the SARTRE3 survey of driver opinion and reported behaviour was conducted in each of the 23 participating European countries. Around a 1000 drivers completed questionnaires in each country in a face to face interview. Some of the questions were about drink driving behaviour but those questions referring to driving over the legal limit are not mentioned here as few drivers will admit to illegal behaviour even though anonymity is guaranteed.

The SARTRE3-questionnaire asked: "How many days per week do you drive after drinking even a small amount of alcohol?" Figure 6 shows, in descending order, the percentage of drivers in each country saying that they never combine drinking and driving.

Figure 6: Percentage of respondents that answered "Never/Non drinker" to the question "How many days per week do you drive after drinking even a small amount of alcohol?".



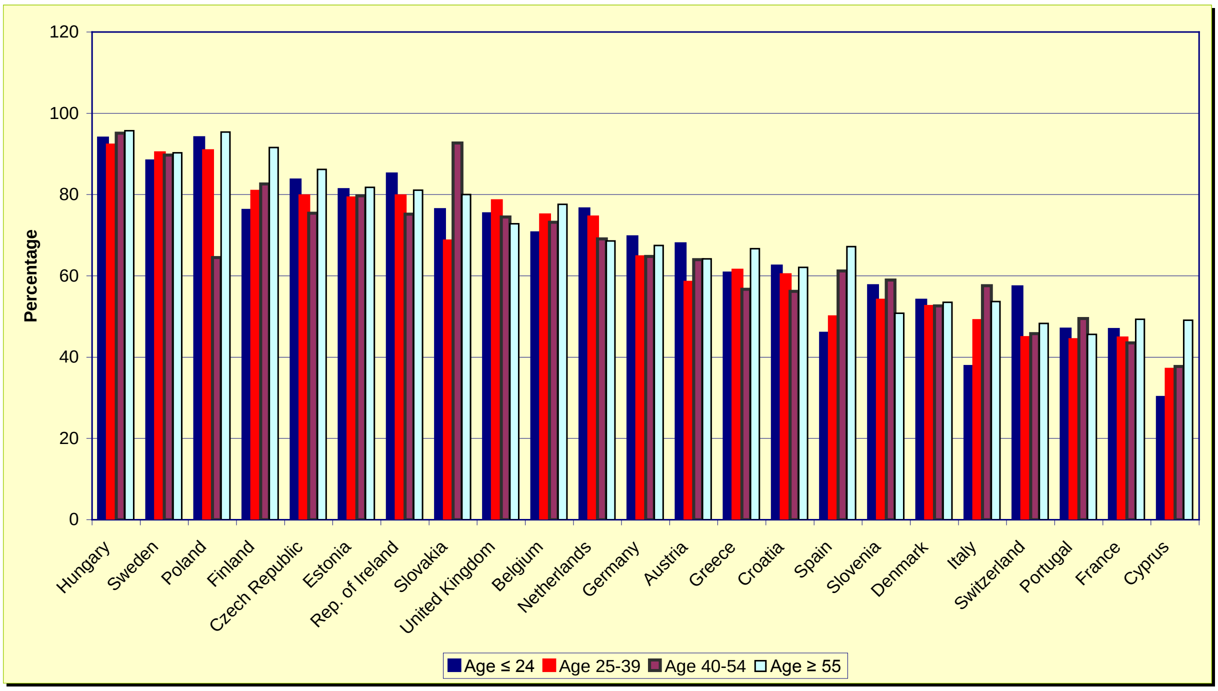
Source: SARTRE3

In Cyprus a minority of the drivers said that they had always been completely sober when driving, whereas in Hungary more than 90% said that they had not consumed even the smallest amount of alcohol before driving.

Is drinking and driving more prevalent in certain age groups?

Figure 7 shows the percentage of drivers per age group that replied "never" or "non drinker" to the question "How many days per week do you drive after drinking even a small amount of alcohol?".

Figure 7: Percentage of respondents that answered "Never/Non drinker" to the question "How many days per week do you drive after drinking even a small amount of alcohol?" by age band.

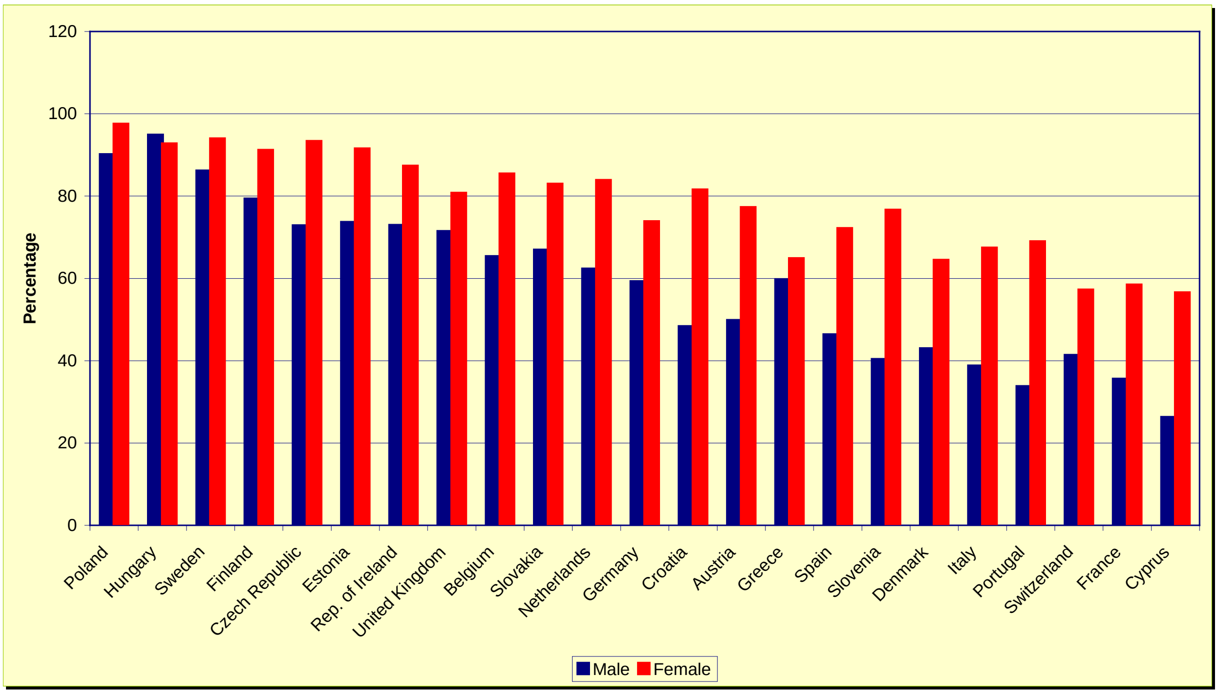


Source: SARTRE3

In most countries the difference between age-groups is quite moderate. People tend to think that young drivers combine drinking and driving most often, but Figure 5 shows that for most countries the opposite is the case. There are however exceptions. In Italy, Cyprus, Finland, and Belgium young drivers say that they drink and drive more often than in any other age group.

Do men combine drinking and driving more often than women?
Figure 8 shows the percentages of men and women that say that they never drink and drive, be it that they are total abstainers or because they never combine drinking and driving.

Figure 8: Drivers that say that they never drink and drive or never drink at all by gender.



Source: SARTRE3

In all countries except in Hungary more women than men say that they do not drink and drive. In Cyprus and Portugal even more than twice as many women than men say that they don't drink and drive.

2.3 The legal limit

The legal limit is not the same in all EU Member States. In the Table 1 the legal limits of the 25 EU Member States are presented. Some EU Member States have different penalties for different limits and have different limits for novice drivers and professional drivers. These limits are not mentioned in Table 1.

Table 1 Legal BAC limits (g/l) for the general driving population EU (25)

Country	Standard BAC limit (g/l)
Austria	0.5
Belgium	0.5
Cyprus	0.5 (was still 0.9 during SARTRE3)
Czech Republic	0
Denmark	0.5
Estonia	0
Finland	0.5
France	0.5
Germany	0.5
Greece	0.5
Hungary	0
Rep. of Ireland	0.8
Italy	0.5
Latvia	0.5
Lithuania	0.4
Luxemburg	0.8
Malta	0.8
Netherland	0.5
Poland	0.2
Portugal	0.5
Slovakia	0
Slovenia	0.5
Spain	0.5
Sweden	0.2
United Kingdom	0.8

It is only possible to estimate the prevalence of drivers that are over the legal limit in a particular country accurately, when random roadside breath tests are carried out in a systematic way. The roadside breath tests carried out by the police are not suitable for the assessment of the prevalence as most of these tests are not random, but are purposely carried out at particular times (weekend nights) and in particular spots (in the vicinity of bars and discos). Except for 12 of the 13 countries that participated in the prevalence studies in the DRUID project, no recent real random samples from breath tests were available. In the DRUID prevalence study (Houwing et al., 2011) on the basis of real random roadside breath tests (all hours of the day, all days of the week) carried out between 2007 and 2009, it is estimated that of all the car kilometres driven annually, a little less than 1.65 percent is driven by drivers with 0.5 g/l (the legal limit in most EU countries) or more alcohol in their blood. In order to get accurate estimates about the prevalence of drink driving in EU countries, and in order to monitor the prevalence of drinking driving, it is necessary for all EU Member States to carry out the same standardized random breath tests for research purposes.

2.4 Crashes and injuries

Drinking drivers are clearly over-represented in road traffic crashes. Alcohol-related crashes are also severe. In Germany for example, the severity of drink-drive crashes (expressed as fatalities per 1,000 injury crashes) is nearly twice as high as that of crashes in general (Sweedler et al., 2004) Unfortunately, systematic testing all road users involved in crashes for alcohol is rare in EU countries. Therefore, alcohol-related crashes are underreported in official statistics. In Germany, in 2003, around 7% of all crashes with personal injury were alcohol-related, according to the police records. On the basis of a sample in which the police were instructed to try to obtain breath samples from the driver responsible for causing the crash it is estimated that about 12% of all crashes in Germany are attributable to alcohol (Krüger & Vollrath, 2004). In Finland it is compulsory to test all road users involved in a fatal crash for alcohol. Recent results from the DRUID study (Isalberti et al., 2011) on the prevalence of alcohol and other psychoactive substances in injured and killed drivers show that in Finland, Norway, Portugal and Sweden the prevalence of killed drivers positive for alcohol of 0.5 g/l and above ranged between around 16% and 35%. Among injured drivers in Belgium, Denmark, Finland, Italy, Lithuania and the Netherlands the prevalence of alcohol of 0.5 g/l and above varied between 16% and 38%. Furthermore, in France from a sample of 7458 fatal crashes that happened between a two year period (2001-2003), 28.6% (95% confidence interval; 26.8% - 30.5%) appeared to be attributable to drivers that had alcohol in their blood (OFTD, 2005). Table 2 provides an overview of the results of the DRUID prevalence study among killed and injured drivers for alcohol.

Table 2: Prevalence of alcohol among seriously injured and killed drivers (source DRUID)

	Seriously injured drivers						Fatally injured drivers			
	BE	DK	FI	IT	LT	NL	FI	NO	PT	SE
Alcohol (≥0.5 g/l)	38.2%	17.8%	30.2%	20.6%	16.1%	28%	29.3%	23.8%	35.1%	16.3%

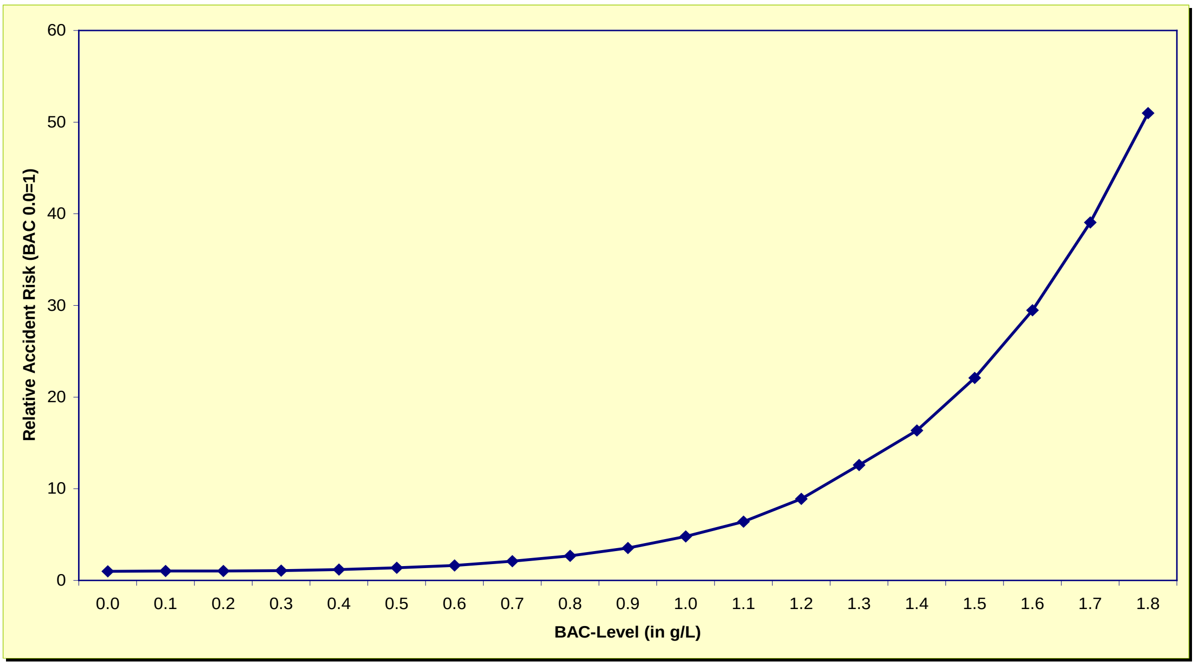
It is also possible to estimate the number of drinking drivers that have died in road traffic crashes on the basis of the number of drivers admitted to hospital after a crash and are tested for alcohol. In a random sample in the Netherlands, 25% of severely injured drivers that had ended up in hospital, had alcohol in their blood (Mathijssen & Houwing, 2005).

Drinking drivers not only kill themselves, but they also kill other road users. Based on the above mentioned research in the Netherlands, it is estimated that around 25% of all the annual traffic fatalities are attributable to alcohol. Not only drinking driving but also drinking and walking, drink and riding and drink and cycling cause fatalities. For instance Keigan and Tunbridge (2003) estimate that in the United Kingdom 39% of the fatally injured adult pedestrians have a BAC level that exceeds the legal limit for drivers (0.8 g/l) in the UK. In view of the above, the estimate made by the European Commission that one quarter of all annual road fatalities in the European Union are due to alcohol, is an under-estimate. If one assumes that the prevalence of drivers with a BAC of 0.5 g/l or more is around 1 % of the total driver population in Europe (as is estimated for the Netherlands), than 1% of the drivers is responsible for around 25 % of the road fatalities in Europe.

Relative crash risk

Relative crash risk is calculated on the basis of epidemiological studies. To estimate the relative risk for drinking drivers of crash involvement, the distribution of BAC levels in the entire driver population (measured in random roadside breath tests) is compared with the distribution of BAC levels among drivers involved in crashes. These so-called case-control studies have been repeated many times and the results are very similar. A much-cited one is the Grand Rapids study by Borkenstein (1974). Borkenstein and colleagues were the first to carry out an in-depth case-control study. With the aid of modern techniques it is possible to control for even more confounding factors than in the Grand Rapids study. A methodologically sound modern case-control study is the study by Compton (2002). The results of this study are shown in Figure 9.

Figure 9: Relative rate for drink drivers to be involved in a crash as their BAC-level increases. The rate of a sober driver is set at 1.



Source: Compton et al, 2002

The relationship between relative crash rate and BAC-level is exponential. From Figure 7 it can be concluded that, for example, the crash rate per kilometre driven for a driver with an 0.8 g/l BAC limit (still the legal limit in the United Kingdom, Luxemburg, and Malta) is approximately 2.7 times higher than the rate for a sober driver. A difference between Figure 9 and the often cited but old 'Borkenstein curve' is, that the 'Borkenstein curve' had a small dip in relative crash rate for low BAC-levels between 0.0 g/l and 0.5 g/l. but the 'Compton curve' has not. Another difference is that the 'Compton curve' is steeper than the old 'Borkenstein curve'.

The curve for involvement in only fatal crashes is different from the curve for crash involvement in general. Up to BAC 1.0 g/l the rise in rate of crash involvement in general and the rise in rate of involvement in a fatal crash is more or less the same. Above this level the rise in rate for fatal crashes is much steeper than the rise in rate for all crashes. The relative crash rate for a driver with a BAC of 1.5 g/l is about 22, but the relative crash rate for fatal crashes with that amount of alcohol in the blood is about 200 (Simpson & Mayhew, 1991). Thus with increasing BACs not only the crash risk increases, but also the severity.

The increase in crash rate with increasing BACs is not the same for all age groups. In the United States, based on the crash database (FARS) between 1987-1999, Preusser (2002) outlined the relative crash rate by BAC and age group as shown in Table 3:

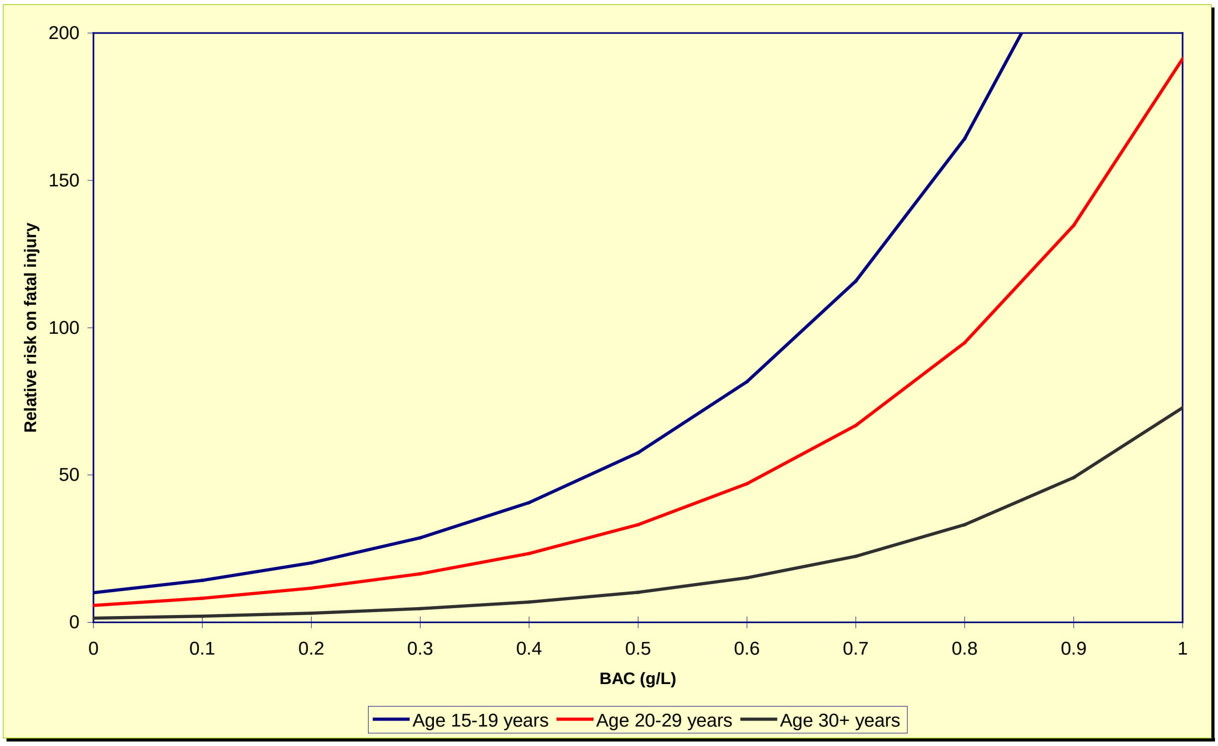
Table 3: Relative crash rate by BAC and age group

	Relative Crash Rate								
Age	BAC 0.0	BAC 0.1	BAC 0.2-0.3	BAC 0.4-0.5	BAC 0.6-0.7	BAC 0.8-0.9	BAC 1.0-1.4	BAC 1.5-1.9	BAC ≥0.2
16-20	3.31	4.37	4.12	5.44	8.17	10.10	15.77	25.30	28.19
21-24	1.79	2.18	2.59	4.42	6.11	8.13	10.73	16.43	26.00
25-34	1.25	1.38	1.89	2.32	2.94	4.37	7.27	11.61	16.08
35-49	1.00	1.09	1.49	1.78	2.62	3.56	5.64	10.44	16.99
50-64	1.02	0.93	1.17	1.24	2.03	2.23	4.71	8.48	13.24
65+	2.04	1.97	2.49	2.50	2.50	3.55	4.83	7.48	9.48

Source: Preusser (2002)

As shown in Table 3, low doses of alcohol (lower than 0.5 g/l) have a far more devastating effect on young drivers (24 years of age and younger) than on older drivers (older than 24 years of age). Further results are shown in a New Zealand study in Figure 10 (Keall et al., 2004).

Figure 10: Relative rate of fatal injury and BAC-level per age group.



Source: Keall et al. (2004)

Alcohol is not the only substance that impairs driving skills.. In particular, when illicit drugs are combined with alcohol, the effects are devastating. A case-control study in the Netherlands (Mathijssen & Houwing, 2005) revealed that the relative injury risk of BAC 0.5-0.8 g/l was 8.28 (95% confidence interval; 2.73-25.2) when only alcohol was consumed. For BAC 0.2- 0.8 g/l + illicit drugs it was 12.9 (95% confidence interval; 3.78-44.2). For BAC ≥ 0.8 g/l in combination with illicit drugs it even was 179 (95% confidence interval; 49.9-638). In another case-control study in France (Laumon, 2005) it was found for at fault drivers in fatal crashes, that the relative risk of drivers that were intoxicated by both alcohol and cannabis (a relative risk of 14) was about the same as the product of relative rate of cannabis alone (a relative risk of 1.78) and alcohol alone (8.51).

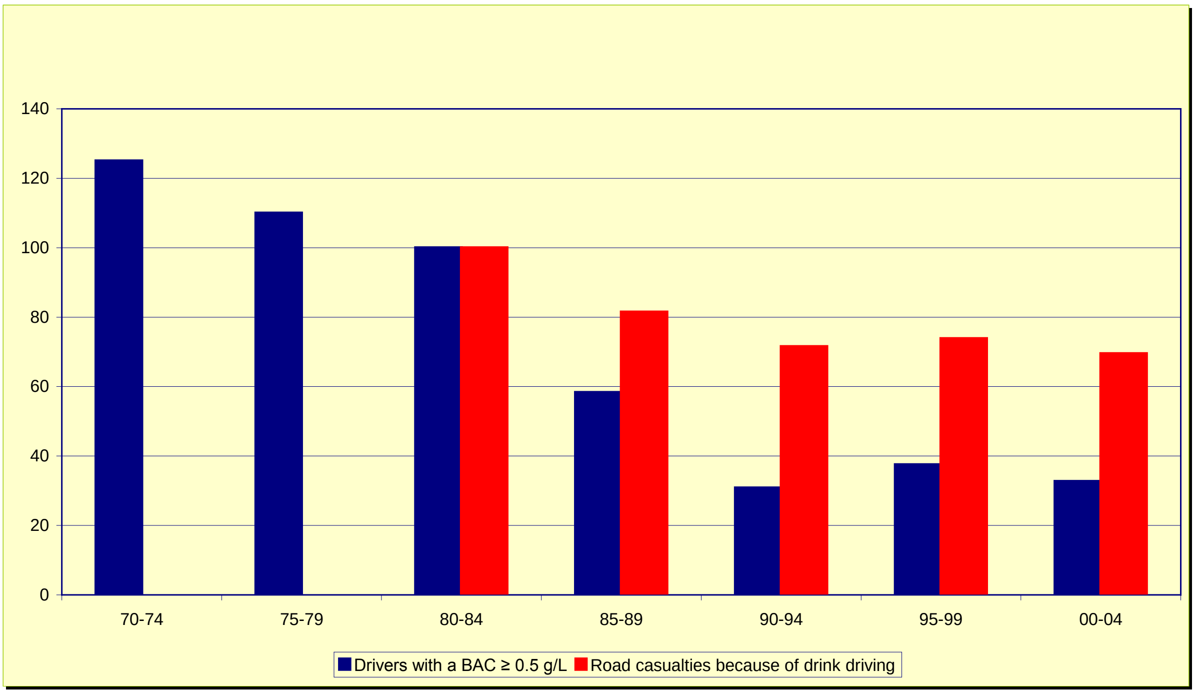
Developments over time

Is the drinking and driving problem in Europe increasing or decreasing? To answer this question the annual proportion of all fatalities and injuries in all EU Member States that are attributable to alcohol over a long period of time is needed. Some EU Member States have quite reliable statistics about prevalence and the number of fatalities attributable to alcohol, but most EU Member States have not.

Sweedler et al. (2004) analysed a large number of studies on the drinking and driving problem in various countries over the past decades. They conclude that improved laws, stricter enforcement, and public awareness brought about by citizens' concern during the 1980s, led to dramatic decreases in drinking and driving in the industrialized world. The decreases amounted to about 50% in Great Britain, 28% in the Netherlands, 28% in Canada, 32% in Australia, 39% in France, 37% in Germany, and 26% in the United States. Some of these decreases may be due in part to changes in lifestyle, demographic shifts, and economic conditions. In most countries the decreases reversed in the early 1990s and drinking and driving began to increase. By the middle of that decade the increases stabilized and the rate of drinking and driving began to decrease once more. These decreases were much less dramatic than those in the 1980s. At the end of the 1990s and early in the new century, the numbers vary. In some countries like France and Germany (Germany until 2002) drinking and driving continued to decrease while in other countries (Canada, the Netherlands, Great Britain, and the United States), there was stagnation and in some cases there was a small or even a large increase, as was the case in Sweden. A major part of the increase in Sweden is believed to be related to a changing culture concerning alcohol consumption, in which everyday consumption in accordance with “continental” European habits is more common. The changing distribution between different types of beverages, in which the consumption of wine and beer is increasing and that of hard liquor is decreasing, supports this explanation. Further support is found in the fact that drinking is changing from being a weekend activity to becoming an everyday activity (OECD, 2006). As an example a quantitative development for the Netherlands is presented in Figure 11.

Figure 11 indicates that in the Netherlands both the proportion of all drivers that drive with a BAC over the legal limit (BAC $\geq$ 0.5 g/l) in the Netherlands, and the proportion of casualties due to drink driving, are declining. However drinking driving seems to decrease faster than the number of crashes that involve drinking drivers. A possible explanation for is that drinking driving has decreased, but that the number of drivers that drive while being intoxicated by both alcohol and illegal drugs has increased. As already mentioned, in combination with drugs, even small quantities of alcohol (quantities below the legal limit) can lead to a large deterioration in driving skills. Another explanation is that, at least, in the period 2000-2004 the number of drivers exceeding the legal BAC limit decreased, but the number of hard-core drinking drivers (drivers with high BACs) has not. This relatively small group of hard-core drink drivers is probably responsible for many casualties.

Figure 11: Indexed development in the Netherlands of the proportion of drivers with a BAC ≥ 0.5 of the entire driver population and the proportion of road casualties (fatal and seriously injured) due to drunk driving of all casualties (80-84=100).



Source: Wegman, F. & Aarts, L. (Ed.) (2005)

Notes: Some of the estimates used to produce Figure 11 were rather speculative. Both the number of drivers with a BAC of 0.5 or more and the number of casualties (fatalities and severely injured road users) because of drinking and driving (the drink drivers themselves, their passengers and/or the occupants of the vehicles, and pedestrians they crash into) were indexed at 100 for the period 1980-1984. It was not possible to estimate the proportion of casualties due to drinking driving for the periods 1970-1974 and 1975-1979.

2.5 Characteristics of alcohol-impaired drivers

The characteristics of drivers impaired by alcohol differ from those of the average driving population in several ways. A Canadian study (Macdonald & Mann, 1996) showed that drivers under the influence of alcohol were more often alcohol dependent, drank excessively, were more often aggressive, impulsive and depressed, had more often negative attitudes to laws, and experienced more often stress. The authors concluded that these problems had more to do with their alcohol use than their driving under the influence. Alcohol impaired drivers are also less tending to wear seatbelts (Eluru & Bhat, 2007; Everett et al., 1999) and are more likely to commit traffic violations (Ferguson et al., 1999; Glitsch, 2003). Ferguson et al. (1991) state that the following groups drive more often under the influence of alcohol:

young males with a lower social-economic status, persons who have problems with alcohol use or who drink more often, persons with insufficient knowledge and deviating attitudes towards drink driving, and persons with an extensive background of criminal behaviour or who commit a lot of traffic offences.

Another interesting finding is that the characteristics of first time offenders show more resemblance with repeated offenders than with drivers who did not commit offences. This is contrary to the impression that most drivers who are caught for the first time are social drinkers (Rauch et al., 2010).

3 Effects of alcohol consumption

The effects of alcohol on mental and physiological functions are numerous. Alcohol leads to both acute impairments and chronic impairments. Acute impairments are immediate but transient, whereas chronic impairments mostly develop gradually and are persistent.

- Acute impairments
- Chronic impairments
- Effects on driver capabilities

3.1 Acute impairments due to alcohol consumption

Alcohol is easily absorbed in the bloodstream. The direct effects on the central nervous system (brain, spinal cord and the nerves originating from it) are the most noticeable. In the first place alcohol functions as a depressant of the central nervous system. This is to say that after having consumed low quantities of alcohol, social inhibition starts to get less stringent and one begins to act and feel more emotionally. Cognitive, visual, and motor functions also begin to deteriorate after small quantities of alcohol have been consumed. Even with BAC as low as 0.3 g/l, most people can divide their attention less adequately and are less vigilant than without alcohol. With a BAC just above 0.5 g/l, most people start to get perception problems and to perform less well on cognitive tasks and tracking tasks. Reaction times get longer. Motor impairment can be observed in most people with a BAC of 1.5 g/l and higher. Alcohol has a strong motivational and emotional impact especially on young people, who become more euphoric, more impulsive and start to show-off with more risk-taking behaviour. After consuming large quantities of alcohol people can become aggressive. High doses of alcohol lead to alcohol poisoning which can cause brain damage and death. There are not only acute effects because of brain dysfunctions due to alcohol, but also other parts of the body are affected. An important acute effect in relation to road safety is that the muscles weaken. This means that in case of a crash, the injuries will be more severe if a road user has consumed alcohol.

The strength of the acute impacts of alcohol is dependent upon weight and sex. If a heavy in weight man consumes the same quantity of alcohol as a light in weight woman (and both are not regular drinkers), the man will be slightly less adversely affected than the woman. The reason for this is that alcohol dilutes itself in the water volume of the body and muscle tissue contains more water than fat tissue. On average men have more muscle and less fat than women.

Absorption of alcohol from a healthy adult body occurs at an average rate of about 8 grams per hour. This means that it takes about one hour and thirty minutes for one consumed glass (xy ml) of wine (12%) or one consumed glass (275 ml) of beer (5%) to be absorbed.

The maximum BAC-level a person has after having consumed alcohol can roughly be estimated with the help of 'Widmark formula'. This formula can be given as follows:

BAC-level (in g/l)= (Alcohol dose in grams) / (Body weight in kilograms x R)

R = the whole body alcohol distribution ratio:
R= 0.55 for females
R= 0.68 for males

Example: A man that weighs 80 kilogrammes has consumed three cans of beer in a short period of time. Each beer can contains 33 cl beer and the volume percentage of alcohol in that beer is 5%. What would his maximum BAC-level be?

Calculation: The man has consumed (3x33cl) 1 litre beer. As the alcohol concentration of that beer is 5 %, he has consumed 50 ml pure alcohol. 1ml alcohol = 0.789 grams alcohol. Thus the man has consumed (50 x 0.789) 39.45 grams alcohol. His maximum BAC-level now is: 39.45/(80 x 0.68) = 0.73 g/l

The formula can be refined by also taking the rate of absorption of alcohol from the body in time into account. It must be stressed that the 'Widmark formula' is a rough indicator only.

Acute effects can still occur even if the alcohol has completely disappeared from the body. If alcohol has been consumed excessively, this will lead to a hangover. A hangover is the result of dehydration, low-blood sugar, and poisoning. The symptoms of a hangover are: headache, thirst, vertigo, nausea, insomnia, and fine tremors of the hand. The psychological symptoms include: acute anxiety, guilt, depression, irritability, and extreme sensitivity.

3.2 Chronic impairments due to prolonged alcohol consumption over time

Daily consumption of no more than about 30 ml of pure alcohol for men, and about 20ml pure alcohol for women, will cause no health problems. Above these quantities there is an increasing health risk. Almost all organs of the body can be affected. Alcohol can have an impact on the following organs: liver, digestive system, heart and circulatory system, the bones, and the brain and nervous system. The diseases stemming from chronic alcohol abuse include: liver cirrhosis, Korsakoff's psychosis, cancer, strokes, pancreatitis, gastritis, high-blood pressure, fertility problems, and impotence. Heavy drinking is also closely linked with social problems (at home and at work) and even psychiatric illness (violence, suicide).

3.3 Effects on driver capabilities

An overview of studies carried out in laboratories, driving simulators and instrumented vehicles concluded that most skills related to the driving task already start to deteriorate at a BAC-level as low as 0.2 g/l (Moskowitz & Robinson, 1987).

The driving task can be divided in three subtasks using the model of Michon.

Figure 12. Michon's model (1985)

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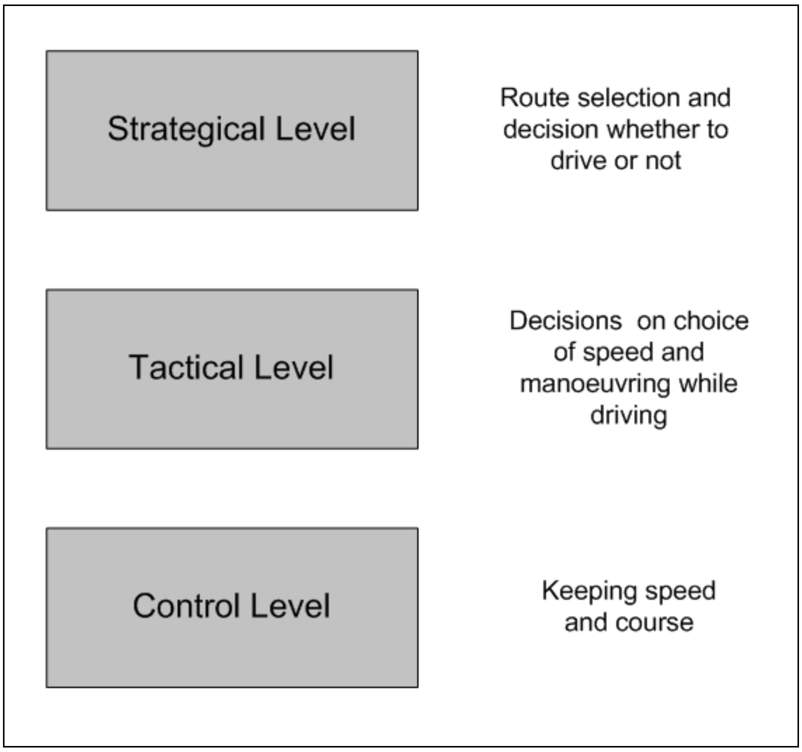


The first group of sub-tasks includes the tasks on the operational level . These are the actions that have to be carried out to keep speed and course. They include steering, changing gear, accelerating, braking but also other manual and mostly fully automated actions for manoeuvring and keeping the vehicle in an optimum operational state (i.e. switching on the windscreen wipers) while driving.

The second group of subtasks includes the tasks at the tactical level. These are the decisions taken when participating in traffic e.g. the application of the rules of the road (i.e. I have to yield for that other car) and decisions concerning manoeuvres that include other road users (i.e. now I can safely overtake that other car).

The third group includes the tasks at the strategic level e.g. vehicle choice and route choice. Here, the decision concerns whether the driver will drive or not after having consumed alcohol.

Alcohol affects task performance at all three levels. However the overwhelming majority of the research that has been carried out is on the effects alcohol has on the tasks at the operational level and the tactical level. For a recent overview, see Caird et al. (2005). For the operational level of the driving task, the review's conclusions are:

- Tracking performance (keeping course) starts to deteriorate at a BAC as low as 0.18 g/l. Reductions in performance with respect to keeping a constant distance behind a leading vehicle (keeping headway) starts at a BAC of 0.54 g/l when the leading vehicle keeps a constant speed. When the leading vehicle changes speed, reductions in performance start at a BAC as low as 0.3 g/l
- Reaction times when driving get longer. There is a difference between a driver's capability to carry out simple reaction time tasks and choice reaction time tasks. In a simple reaction time task a driver has to press a key as quickly as possible after a stimulus (auditory or visual) has been presented. In a choice reaction time task a driver has to respond differently to two stimuli by pressing one key for event A and a separate key for event B. Choice reaction time begins to deteriorate at a BAC of 0.6 g/l, but for simple reaction time tasks the BAC is considerably higher before significant prolonged reaction times appear
- Reactions on a visual detection task (perception*)* when driving starts to decrease significantly at a BAC of 0.8 g/l.

At the tactical level:

- Decreases in the ability to divide attention between the driving task and another task start at BACs between 0.3 and 1 g/l (depending on the complexity of the second task). When drivers have to divide their attention between driving and another task (i.e. having a conversation with a passenger) and this ability starts to deteriorate because of alcohol, subjects tend to focus on one of the two tasks at the expense of the other
- When BAC increases, drivers tend to fix their eyes more on the central visual field and fewer eye movements are made to the peripheral view. When under the influence of alcohol, drivers use fewer sources in the visual field to obtain information about the environment, take longer to recognize and respond to aspects that present vital information about their environment (i.e. street signs) and focus their attention on aspects occurring in the central field of vision often at the cost of peripheral information
- The increase in the number of mistakes and prolonged reaction times when drivers are confronted with a complex secondary task, even when small quantities of alcohol are consumed, indicates that alcohol causes information processing to be hampered.

The impact of alcohol on the performance of a driver at the strategic level cannot be studied in driving simulators or instrumented vehicles. However, according to the Theory of Planned Behavior (TPB) (Ajzen, 1991) alcohol must have a significant impact on the strategic level. The TPB states that intentions are influenced by three mechanisms: attitudes, subjective norms and perceived behavioural control (PBC). Attitudes towards certain behaviour reflect the degree of positive or negative evaluation the individual has towards performing it (i.e. drinking and driving is dangerous). Subjective norms refer to the perceived social pressure to engage or not engage in certain behaviour. This reflects a driver's 'significant others' would think about the intended behaviour (i.e. my friend would disapprove when I drive while I am drunk). PBC reflects the perceived ease or difficulty of undertaking a given behaviour (i.e. if I wanted to, I could easily drive safely when I am drunk). Alcohol consumption leads to loss of self-control and thus it has an effect on PBC. After having consumed alcohol a driver is much more inclined to think that he or she can easily drive safely.

4 Measures

A measure is effective when it leads to either a substantial reduction of the crash or crash injury rate associated with alcohol consumption or to a substantial reduction of the number of kilometres driven while the driver is drunk (the prevalence). The measures to reduce drink driving can be categorized in four separate groups. These groups are:

Reducing the availability of alcohol
- Limiting points of sale
- Increasing prices
- Raising the minimum drinking age

Separating drinking from driving
- Alcohol ignition interlocks
- Designated driver programmes
- Public transport

Police enforcement
- Legal limits
- Amount of (random) roadside breath tests
- Sanctions

Education and information (which support proven interventions)
- Education programmes on alcohol in schools and in driver training
- Driver improvement courses (rehabilitation courses)
- Public campaigns
- Promotion of safety culture

4.1 Reducing the availability of alcohol

Increasingly, steps are being taken by countries aimed at reducing the negative aspects of alcohol consumption. Research and experience show that it is possible to discourage alcohol consumption by increasing the price of alcohol (higher taxes), restricting the sale of alcohol in time (restricting the opening hours of the places where alcohol can be bought and where it can be consumed) and place (especially banning the sale of alcohol in petrol stations and transport cafes). Another measure in this category is raising the minimum drinking age (i.e. in the US alcohol is not for sale for people younger than 21).

Effectiveness of measures to reduce the availability of alcohol
Of all the measures mentioned in this category, only evaluation studies on changes in the general drinking age could be found. These studies have all been carried out in the United States. From these studies Elvik et al. (2009) conclude that raising the drinking age (from 18 to 21) leads to a decrease of 24% of all fatal crashes involving drivers of 18 to 21 years of age and a 31% decrease of injury crashes in this age group.

4.2 Separating drinking from driving

Alcolocks (See also ERSO Vehicle Safety and eSafety texts)

Alcolocks or alcohol ignition interlock systems are automatic control systems which are designed to prevent driving with excess alcohol by requiring the driver to blow into an in-car breathalyser before starting the ignition. The alcohol ignition interlock can be set at different levels and limits.

The fitment of alcolocks is a well-established feature of mandatory rehabilitation schemes for excess alcohol offenders. Several Member States as well as road transport operators are now promoting and including the voluntary fitment of alcolocks in passenger cars and in commercial and passenger transport operations.

In EU countries only Sweden uses them on a large scale in rehabilitation programs as well as for general preventive use in commercial vehicles. Countries are increasingly mandatory alcolocks in rehabilitation of offender programmes and for school buses.

Effectiveness of alcolocks

Rehabilitation programmes
Alcolocks have an important role to play within rehabilitation programmes. Large scale quantitative research on alcohol ignition interlocks in use has shown that alcolocks are 40 to 95% more effective in preventing drink driving recidivism than traditional measures such as license withdrawal or fines (ICADTS, 2001; SUPREME, 2007). A literature review (UK Department for Transport, 2004) showed a recidivism reduction of about 28-65% in the period where the alcolock is installed compared with the control groups who were not using the alcolock. According to a methodologically sound evaluation study on the installation of an alcohol ignition interlock in cars of offenders, the recidivism in this group dropped by about 65% in the first year after installation (Beck, 1999). Research indicates that alcolocks need to be fitted permanently to have an effect, for after removal of the lock recidivism increases again (Bax et al., 2001).

Benefits to cost of alcolocks in different countries

The results of cost benefit analyses for implementing alcolocks for drivers caught twice with a BAC between 0.5g/l and 1.3g/l and for drivers caught with a BAC above 1.3g/l in several countries are

- For the *Netherlands,* the reduction of 35 traffic fatalities annually is valued at 4.8 million per death, leading to a benefit of 168 million Euros.Benefit/cost ratio =4.1
- For the *Czech Republic*, the 8 fatalities prevented are counted at 1.1 million Euro/death, leading to estimated benefits of 9 million Euro/year. Benefit/cost ratio = 1.6
- For Norway, the benefits are calculated as 5.5 deaths less per year a rate of 5.9 million Euro per death, or at 32.5 million Euro /year. Benefit/cost ratio = 4.5
- For Spain, the reduction with 86.5 deaths/year at 800.000 Euro per death would imply benefits of 69 million Euro/year. Benefit/cost ratio = 0.7

Source: IMMORTAL (2005)

Research has shown that participation rates will be lower if an imposed alcohol interlock programme is preceded by a long-term of license suspension(Beirness, 2001). Another factor that influences the participation rate is the costs of the program for the participant. An evaluation of the Californian alcohol interlock programme (DeYoung, 2002) found that one of the main reasons for the courts not order installment of the alcohol ignition interlock was that many offenders seemed unable to pay for an alcohol interlock. Other reasons for not ordering alcohol interlocks were that they did not believe that it would be an effective measure, as many offenders owned no vehicle, and that the monitoring of offenders was time consuming. The participation rates of voluntary alcohol interlock programmes were low as well. The main reason for the low participation was explained by the low risk of detection for driving while suspended that outweighed the inconvenience and costs associated with the participation in an alcohol interlock programme.

Expert recommendations for a set of criteria to maximise the effect of alcohol interlock programmes specify: participation of the programme should be obligatory, the programmes should fall under administrative law, the driving license should clearly identify that a person is only allowed to drive a vehicle with an alcohol interlock, the compliance to the programme should be properly enforced and the contents and duration of the programme need to be tailored to the characteristics of the target groups (Beirness & Robertson, 2002).

Use in commercial and passenger transport operations

There has been no evaluation of the impact that alcohol interlocks used in commercial transport have on road safety but Swedish companies report that fitting alcolocks have prevented excess alcohol amongst fleet drivers. Some 23% of municipalities and 18% of county councils have stipulated the need for alcolocks when purchasing new public and private transport vehicles. Some 70,000 alcolocks are in use in Sweden in trucks, buses and taxis on a voluntary basis.

4.3 Designated driver programmes

Another means of separating drinking from driving is not offering alcohol to drivers in restaurants, discos, pubs, bars etc. One way of doing this is the so-called 'designated driver programme'. Here, a designated driver who has to abstain from alcohol is appointed before a group of people decides to drive in one car to a certain place where they are about to the others drink the designated driver has to abstain from alcohol. To compensate for this inconvenience the designated driver is very often offered free soft drinks.

Effectiveness of designated driver programmes

It is very difficult to evaluate the effectiveness of designated driver programmes. Ditter et al. (2005) carried out a systematic review of the sparse available studies and found only one evaluation of a designated driver programme. This was the "Pick-a-Skipper" campaign in Western Australia. Telephone surveys indicated a 13 percentage point increase in people always selecting a designated driver and these people were also more likely to report awareness of the 'Skipper' concept. However, there was no significant change in self-reported drinking and driving or riding with an alcohol-impaired driver. Ditter et al. found more evaluations of small-scale designated driver programmes (i.e. a particular disco that has a designated driver programme). Some positive effects were found but overall the effects were quite modest.

Public transport

One measure in this category is good and cheap public transport including taxis to and from places where alcohol is consumed.

4.4 Police enforcement

The enforcement of the legal limit for excess alcohol is the most commonly used method to reduce drinking driving. The effective element of police enforcement is deterrence and the effectiveness of deterrence depends on the driver’s perception of the risk of detection and the severity of the ensuing penalty.

A distinction can be made between general deterrence and specific deterrence. The aim of general deterrence is to motivate all drivers not to break the rules by creating fear of sanctions and by conveying the impression that the chance of being caught is high. The aim of specific deterrence is to improve the attitudes and behaviour of drivers once they are caught in order to prevent recidivism. For this purpose, severe sanctions like suspension of the driving license are used (."I will never drink and drive again because the temporary loss of my driving license has been a horrible experience.") as well as remedial treatment programmes are used. Well-known remedial treatment programmes are for instance compulsory driver rehabilitation courses for offenders.

Effectiveness of police enforcement
As mentioned previously the effect of police enforcement is based on three elements: the level of the legal limit, the risk of being caught when exceeding the limit and the severity of the sanctions. The effects of these elements will be dealt with separately.

The effect of low legal limits
The prevailing public health and road safety message is that it is better not to drink any alcohol and drive. However, most countries introduce specific thresholds for excess alcohol which allow enforceable limits and 0.5 g/l is most commonly used in Europe. The World Health Organisation states that a legal limit for the general driving population of 0.5 g/l is the highest legal BAC limit that can be supported a combination of crash injury and behavioural research (Peden et al., 2004).

A meta-analysis of studies carried out by Elvik et al. (2009) on reducing the existing BAC limit for all drivers in a country from 0.8 g/l to 0.5 g/l found a reduction of 2% in fatal crashes and a reduction of 13% in injury crashes. Allsop (2005) estimates that in the United Kingdom 65 lives would be saved annually if the legal limit for the general driver population is reduced from 0.8 g/l to 0.5 g/l.

Some countries have introduced lower limits for 0.2 g/l for the general driving population and/ or for young drivers and professional drivers. The main rationale for a 0.2 g/l limit rather than zero is 1) to take account of the possibility of inaccuracy in breath testing devices at these low levels and the fact that alcohol can be present in the mouth without having consumed alcohol.

For young drivers, the crash rate starts to rise significantly at very low levels and the introduction of lower limit has resulted in road safety improvements. For example, after implementing a BAC limit of 0.1 g/l in Austria for novice drivers, there was a 16.8% fall in fatal crashes involving drivers with a BAC-level of 0.8 g/l or more (Bartl & Sturmvoll, 2000). The implementation of BAC limits of at maximum of 0.2 g/l was recommended by the European Commission for those drivers and riders who have a much higher crash risk, either because of their lack of experience and/or the type of vehicles they drive, and also for drivers of large goods and passenger carrying vehicles, and also for drivers of vehicles carrying dangerous goods. (Commission Recommendation 2001/115/EC of January 2001).

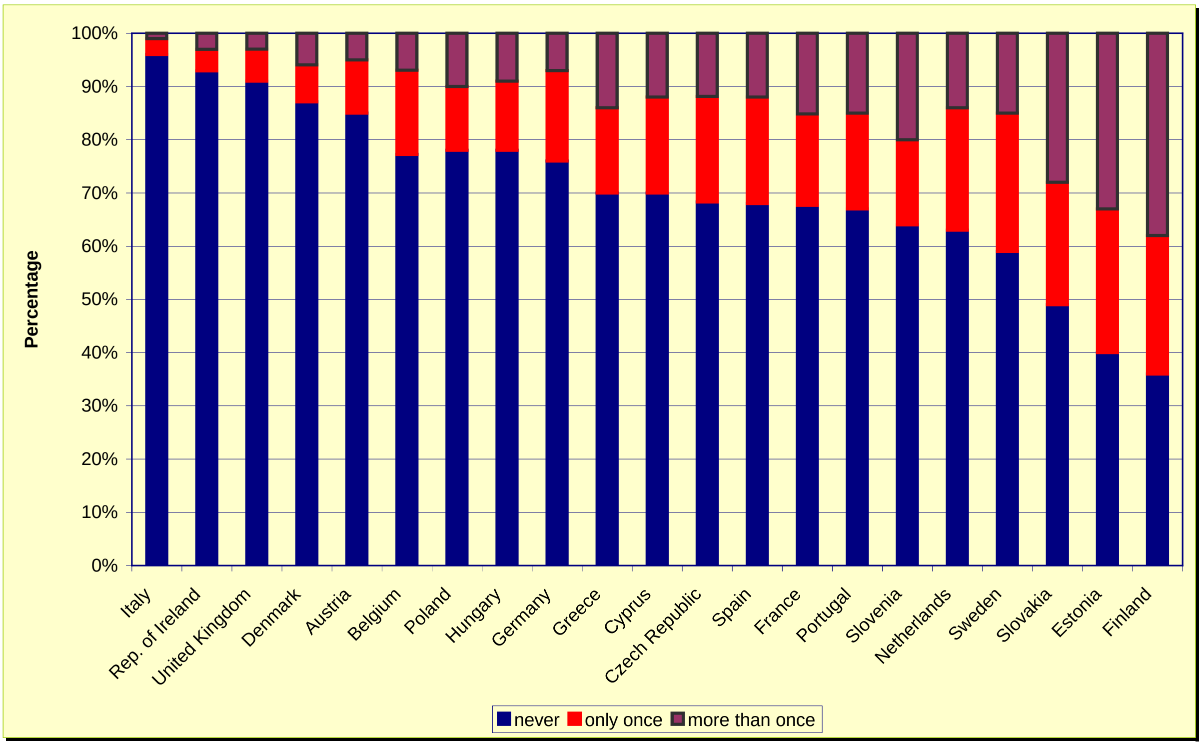
The effect of police enforcement
Some countries provide for random roadside breath testing. Others require ‘reasonable cause for suspicion’ (i.e. the smell of alcohol or erratic driving) before a police officer can test a driver. Both systems are effective, but random breath testing (RBT) is twice as effective as testing only after suspicion (Henstrig, 1997). After each doubling of the number of RBTs in the Netherlands, the number of drink driving offenders decreased by approximately 25% (Mathijssen, 2005). The effectiveness of RBT can be enhanced when it is targeted in the vicinity of places where alcohol is consumed and at times when the prevalence of drink driving is high, i.e. in weekend nights, and when publicity accompanies enforcement

campaigns. Research and experience suggest that highly-visible RBT (to deter) combined with targeted RBT that is not clearly visible (to detect) is the most effective (ETSC, 1999).

The ESCAPE Project (Mäkinen et al., 2003) reports that the Finnish police have pursued a systematic DUI (Drinking Under the Influence) surveillance, including random breath testing and extensive use of publicity, for over a quarter of a century. In Finland, the risk of being caught for drink driving has increased considerably since 1977 when the police were first empowered to carry out random breath testing and were equipped with pocket-size Alcometer breath analysers. In 2003, some 40% of drivers were tested annually in Finland and the number of those caught for excess alcohol had fallen within a decade from 0.33% to 0.14%. Penalties for drinking and driving were gradually reduced.

The risk of being controlled for alcohol differs substantially between EU Member States. One of the questions in the SARTRE3-questionnaire (2002) was: "In the past 3 years, how many times have you been checked for alcohol?" The results are shown in Figure 13.

Figure 13: Self-reported frequency of alcohol controls over the past 3 years.



Source: SARTRE3

In 2002, almost none of the drivers in Italy had been checked on alcohol in the past three years as opposed to just one 1 in 3 (36%) in Finland.

The effect of sanctions

Fines have some effect, but studies show that these effects are not sustained. A Canadian case-crossover study of general police enforcement (Redelmeier, 2003) found that the fatal crash rate in the month after conviction was about 35% lower than in a comparable month with no conviction However, 3-4 months after the conviction drivers drove in as unsafe a manner as they did before the conviction. When the severity of the conviction increased (more demerit points), the effect on the relative rate reduction increased, but this was not sustained. However, if the conviction was very severe (two of these types of convictions would be enough to lose one's driving license), the effect on the reduction of the relative crash rate was small again.

According to a meta-analysis by Elvik & Vaa (2004) driving licence suspension leads to a reduction of all crashes by 18%. This makes driving licence suspension very effective. However, if enforcement is weak, drivers who have lost their driving licence may start to drive illegally.

Withdrawal of the driving licence can be sanctioned either with or without conditions such as alcohol interlocks, exclusion of specific types of vehicles or medical examinations. After the period of withdrawal, a license is only re-granted after a new driving licence application is made. This is different from suspension where a driver gets his driving license back at the end of the suspended period. A recent study including a questionnaire and a literature study (Bukasa et al., 2011) concludes that there were significant reductions in recidivism rates from driving licence measures with a duration of 3 months to 12 months. For driving licence measures with a duration longer than 12 months an increase of recidivism rates was often found. Furthermore, the best effects were visible when driving licence sanctions were combined with additional treatment or rehabilitation measures.

Penalty point systems for alcohol are included in the legal practice of a number of European countries. However, there are many differences between these systems regarding the number of points collected or deducted and sanctions applied. The effectiveness of penalty point systems in general is estimated as modest. But it can be increased by increasing the general and specific deterrence effect (SWOV fact sheet penalties in traffic).

In the United States alcohol anklets are being imposed by courts as a measure to reduce recidivism among convicted drivers. The anklet is part of a non-invasive alcohol monitoring system that samples an offender's perspiration every 30 minutes to ensure compliance to sobriety. This system is being evaluated at the moment by comparing recidivism rates for offenders sentenced to the monitoring program to offenders who do not participate in this program.

Imprisonment seems to be less effective according to Elvik et al (2009). A change in Norway and Sweden from imprisonment to a graduated tariff of fines and licence suspension had lead to reduction of all crashes by 4%.

4.5 Education and information

Information and awareness about the dangers of drinking and driving, walking and cycling need to be available at an early age in order to encourage healthy attitudes and is a recommended curriculum topic in both primary and secondary schools.
In secondary schools, programmes that aim to shock and confront students with the effects of alcohol are being introduced increasingly.

One example in the Traffic Informers programme. Traffic Informers are people who have been seriously disabled in a road crash where they at fault (i.e. they were drunk) and who inform students and the circumstance of their crash and how the consequences of the crash have affected their lives. Another example are so called 'road shows' .These are plays in which the destructive consequences of road crashes are presented in an emotionally charged and moving way. In the US another approach is adopted for programmes based on social norms. Here, nothing is communicated about the dangers. Instead students are told in a positive manner and based on research that the overwhelming majority of the students do not drink and drive based. Often these messages are combined with positive strategies to avoid drinking and driving. The assumption is that most students want to conform to what is considered normal in their social environment.

The dangers of drinking and driving also need to be addressed in formal novice driver training.

Public campaigns using mass media also aim at raising awareness of the dangers of drinking driving and are intended to change attitudes and behaviour. Some public campaigns only inform about the dangers of drinking and driving. These dangers can be presented in a quite neutral way but they can also be presented in a shocking manner and Dwell the dire consequences. There are also public campaigns with the explicit intention to raise the perception of the risk of getting caught. Another category is use of a positive message that the more and more people do not drink and drive and promote strategies to avoid drinking and driving e.g. the so-called Bob-campaigns in Belgium and the Netherlands (http://en.wikipedia.org/wiki/Bob_campaign).

The effects of education programmes in schools and in basic driver training
The effect of having the subject of drinking and participating in traffic in the curriculum of primary and secondary schools is very difficult to evaluate in terms of a road safety effect. Similarly, the effects of including reference to the drinking and driving problem in basic driver training are unknown. Nevertheless, these subject can be usefully included in the school curriculum and in the curriculum of basic driver training to help encourage sympathetic attitudes, not least, to anti-drinking and driving measures.

Parents have a strong effect on the development of attitudes of adolescents towards drinking and driving. A study on the effect of socialization on drinking behaviour among adolescents showed strong associations between alcohol-specific socialization (particularly of enforcing (Vorst, van der, et al., 2005) rules) and adolescent alcohol use. Although parents strongly differentiated their socialization practices between children, no differences in associations between alcohol-specific socialization and drinking were found between older and younger adolescents.

Driver improvement courses on alcohol (rehabilitation courses)

More is known about the effects of driver rehabilitation courses on alcohol for convicted drivers. These mandatory courses are not intended for drivers that are have a disease-status alcohol problem. For these drivers therapy would be more suitable. According to (Bartl, 2002) various evaluations of driver rehabilitation courses for excess alcohol offenders (not being problem drinkers) indicate that the recidivism rate can be reduced by 50% compared to control-groups without course participation. The variation of recidivism rates is quite large, though. In general it is found that drivers with a high risk of recidivism were of the male gender; young age and had a lower educational level. Furthermore, a positive relation was found between prior offences and recidivism risk (Boets et al., 2008).

In the recently conducted DRUID project a standard was prepared for good practice rehabilitation courses. This standard includes the existence of a national quality management body, a definition of the operative tasks of this quality management body, a multidisciplinary approach in case of prior driver assessment, objective, valid and reliable tools in driver assessment and evaluation of driver rehabilitation programmes. Out of the 90 Driver Rehabilitation programmes that were validated only 5 met these criteria (Bukasa et al., 2009).

Public campaigns

Overall public campaigns seem to be effective, but not generally in isolation (Delhomme, 1999). The effects can differ quite substantially. Public campaigns are more effective when first a study is carried out of how the target group can best be addressed, and when the public campaign is linked with other measures (enforcement and education). There are indications that fear-arousing public campaigns regarding drink driving (i.e. a TV-spot in which a driver who has been drinking crashes into another vehicle and dies) are not so effective. Harré et al. (2005) discovered that a group that had watched fear-arousing clips of drinking and driving showed more crash-rate optimism subsequently than a group that had watched non-fear arousing clips. Crash-rate optimists believe that crashes might happen to others, but not to them. In many industrialized countries, attitudes towards drink driving have substantially changed over the past decades (from something that is not seen as so dangerous to something that is considered to be a crime and unacceptable). This is probably caused by a combination of public campaigns and police enforcement.

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Safety culture
When a driver has to drive for work, his or her employer can also take measures to prevent driving under the influence of alcohol. Measures of this type are mostly headed under the name 'safety culture' with *Safe System* representing its new paradigm. See ERSO Work Related Road Safety web text.

A company can be said to have a safety culture when in all sections of the company, safety is considered to be of the utmost importance, and that the safety aspect is given weight to in all management decisions in all procedures and in all actions. http://erso.swov.nl/knowledge/content/60_work/strategies_measures_and_their_implementation.htm.

In particular, a company with a safety culture:
- Adopts the long term *Safe System* goal towards the elimination of death and serious injury and sets interim targets towards these
- Has a clear safety policy and the management not only promotes this policy but also leads by example
- Analyses crashes, risk factors and near misses made in the past, and is willing to learn from these crashes and near misses
- Takes and monitors measures that tackle the root causes of serious and fatal injury risk in road traffic crashes.

A new ISO 39001 standard on road traffic safety (RTS) management systems encourages organisations of all types and sizes towards these ends. See ERSO Work Related Road Safety web text.

An example is the use of alcohol interlock devices as part of commercial company fleet policies in Sweden. The precise effects of the establishment of a safety culture in a company on drinking and driving are not known.

4.6 Summary of effective measures

The problem of drink driving is not new and many measures have been taken. A very successful measure was the introduction of breath testing devices by the police back in the 1970s. Despite the fact that drinking drivers now know that they can be caught and that sanctions are tough, and despite public opinion regarding drinking and driving having hardened considerably, alcohol-impaired road users are still involved in about a quarter of all fatal crashes in Europe. New and better measures are needed.

Depending upon the circumstances, the effectiveness of new measures may vary from country to country. However, in general it can be stated that the following measures are effective:
- Random breath tests for all drivers and not only for 'suspected' drivers to raise the perception of the risk of being caught by carrying out more random roadside breath tests (especially at times and locations where drinking and driving is expected). However it

must be noted that an increase in random roadside breath tests is less effective in countries where those test are already carried out on a large scale than in countries where random roadside breath testing is carried out occasionally (Elvik, 2001).

- A legal limit for the experienced driver of 0.5 g/l or lower and a legal limit for novice drivers of 0.2g/l or below. However it must be noted that a very low legal limit (lower than 0.5 g/l) for the experienced driver can be counterproductive. This is the case when the energy spent on enforcement of low levels is at the expense of the energy on enforcement of higher levels.
- Alcohol ignition interlocks installed in the cars of severe first time offenders and all recidivists in combination with a driver rehabilitation course
- Better public campaigns combined with police enforcement and education programmes (for all age groups) based on scientific research which can help to encourage sympathetic attitudes to action on drinking and driving.
- Restrict the availability of alcoholic beverages, especially for young novice drivers. This can be done by raising the age limit for buying alcohol and by banning the sales of alcoholic beverages in petrol stations and transport cafes
- Improve the recording of the prevalence of drinking and driving and the involvement of drinking drivers in crashes in all EU Member States in order to monitor the effects of measures.
- In the long run it may be possible to equip all cars with fraudulent-proof, user -friendly alcohol ignition interlocks that cause no inconveniencies for non-drinking drivers.

When developing a policy to combat the drinking and driving problem in a country, it is important not to single out any one measure since a package of interrelated measures will offer the best results. The focal point of such a package is the legal limit(s) which ultimately gives drivers guidance about society's perception of safe drinking and driving levels.

4.7 Public support for measures

There is public support for stringent measures to combat drinking and driving. In the SARTRE3-questionnaire (2002) an overwhelming majority of the 24,000 interviewed drivers (88%) wanted more severe penalties for drinking drivers in their country. The differences between the EU Member States were small.

Of all drivers, 45% of SARTRE respondents believed that there should be a BAC-limit of 0 g/l. In Eastern Europe 60% of the respondents are of the opinion that there should be a BAC-limit of 0 g/l, but only 26% of the respondents in Southern Europe are in favour of this. The percentages for northern and western European countries are respectively 47% and 43%. In Eastern Europe more drivers prefer a zero BAC-limit than in other parts of Europe. This is not so surprising as a couple of countries in Eastern Europe already have a BAC-limit of 0 g/l.
The lower the national BAC-limit in, the more drivers think that they can drink less alcohol to stay under the legal limit. 70% of the drivers of countries with a legal limit of 0 g/l (Czech Republic, Hungary, and Slovakia) stated that they may not drink any alcohol at all to remain under the legal limit. In countries with a legal limit of 0.2 g/l (Estonia, Poland, Sweden) 33%

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of the driver population think that they cannot drink at all before driving. When the legal limit is 0 g/l, 28% of the drivers nevertheless think that they remain under the legal limit after having consumed the equivalent of one glass of wine (175 ml of wine with an alcohol percentage of 12) or beer (0.5 litre of beer with an alcohol percentage between 3-3.5). When the legal limit is 0.2 g/l 64% of drivers think they remain under the legal limit after one glass of wine or one glass of beer. When the legal limit is 0.5 g/l 78% of the drivers think that they remain under the legal limit after having consumed the equivalent of one glass of wine or one glass of beer. In countries with a BAC of 0.8 g/l, 42% of the drivers think that they can legally consume more than one glass of wine or one glass of beer before driving and in Cyprus (legal limit of 0.9 g/l) even 31% of the drivers estimate that they can drink more than one glass of wine or one glass of beer.

82% of all drivers of all countries in the SARTRE-project are 'very' or 'fairly' in favour of a BAC-limit of 0 g/l for novice drivers.

When asked if an alcohol ignition interlock should be installed in all cars, one third of the drivers is 'very much' in favour of this and 25% of the drivers is 'fairly much' in favour of this. In Sweden, France, Portugal, and Greece 70% is 'fairly much' to 'very much' in favour of this but only 30% of the drivers in Germany, Austria, and Greece approve of this technological support.

77% of the drivers are 'very much' to 'fairly much' in favour of courses like the driver rehabilitation courses for offenders. There is not much difference between the countries on this subject although support in eastern countries is a little bit less.

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