SWOV Fact sheet

Driving under the influence of alcohol

Summary
Driving under the influence of alcohol is a threat to road safety. In the Netherlands, the legal limit for novice drivers is a blood alcohol concentration (BAC) of 0.2 g/l and for all other drivers a BAC of 0.5 g/l. Young males and heavy drinkers form the most significant risk groups for drink driving. In the Netherlands, the percentage of motorists driving while under the influence of alcohol is dropping only among the group of relatively light drinkers and not among heavy drinkers who are precisely the drivers causing the vast majority of crashes. Taking certain measures, particularly increasing enforcement among heavy drinkers and introducing the use of alcolocks, can benefit road safety. This also applies to random testing by police provided that the subjective probability of detection among these drivers is high enough.

Background
Article 8 of the Dutch Road Traffic Act makes it "an offence for a person to drive or to be in charge of a motor vehicle, when he is under such influence of a substance of which he knows or reasonably should know that its use – either in combination with or not in combination with the use of another substance – could diminish driving skills, that he must be considered unfit to drive". These substances include alcohol, drugs and psychoactive medicines (see also SWOV Fact sheet *Driving under the influence of drugs and medicines*). In the Netherlands, the legal alcohol limit for novice drivers is a blood alcohol concentration (BAC) of 0.2 g/l and for other drivers 0.5 g/l. Between 2000 and 2007, the percentage of alcohol offenders decreased by about one-third, but this decrease occurred primarily among the light offenders who have a relatively low crash rate. During weekend nights in 2007, 3% of drivers had a BAC of 0.5 g/l or more (DVS, 2008).

How has alcohol consumption among drivers developed over time?
The development of alcohol consumption among drivers on Dutch roads has been followed by *Driving and Drinking Behaviour*, a research project conducted since the beginning of 1970. Until 1999, SWOV was commissioned by the Ministry of Transport, Public Works and Water Management to conduct this research project and did so in close cooperation with the police. In 1999, the former Netherlands Transport Research Centre (AVV), now the Centre for Transport and Navigation (DVS), a department in the Directorate-General for Public Works and Water Management, took over the research project. The research project consists of pulling over random motorists during weekend nights in the autumn and testing them for alcohol consumption. The random testing of motorists has been increasing steadily. This research project provides the best picture of how alcohol consumption among drivers has developed over time.

Figure 1 shows the development of the percentage of drivers under the influence of alcohol during weekend nights since 1973. Between 1973 and 2007, alcohol consumption among drivers on Dutch roads during weekend nights decreased by about 80%. The leading factors in this decrease over the last 35 years have been the introduction of a legal alcohol limit of 0.5 g/l in 1974, the introduction of electronic breath testing devices in 1984, and the introduction of breath analysis for evidence purposes in 1987, all of which increased the level of enforcement. In addition, regional traffic enforcement teams were introduced in 1999, and the ‘Bob’ public information campaign was launched in 2001. Lastly, the legal alcohol limit for novice drivers was lowered to 0.2 g/l on 1 January 2006. During recent years, the percentage of offenders during weekend nights has stabilized at around 3% (DVS, 2008). The decrease in 1974 is particularly striking. During the first period following the introduction of the alcohol limit, drivers estimated the probability of their being detected as being extremely high. After a while, when it became clear that the probability of detection was not nearly as high as they had estimated, the number of offenders quickly rose. Even so, the percentage remained significantly lower than during the period before the alcohol limit was introduced.

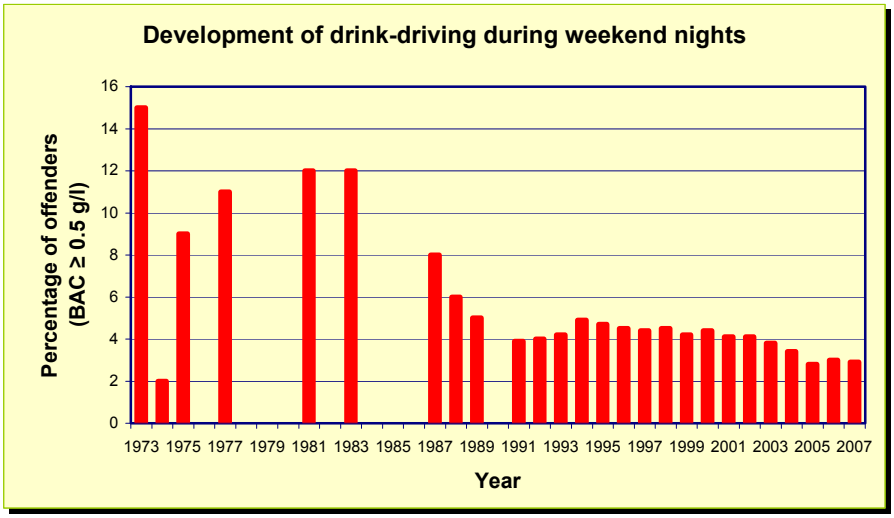

Figure 1. *Sources: SWOV (through 1998); DVS (starting in 1999).*

Combination of alcohol and drugs
In the autumns of 1997 and 1998, the SWOV conducted research into the use of drugs, medicine and alcohol among motorists during weekend nights (Mathijssen, 1999a). According to this study, 1.3% of these drivers tested positive to having used a combination of alcohol and drugs. Between 2000 and 2004, the SWOV also conducted a large-scaled study in Tilburg and vicinity into the use and risks of driving under the influence of psychoactive substances. According to this study, the combined use of alcohol and drugs was 0.3% 24/7. For weekend nights (including Sunday nights), this was 2.0% (Mathijssen & Houwing, 2005).

What are the risks associated with driving under the influence of alcohol?
After consumption, alcohol enters the stomach and is then absorbed into the bloodstream through the walls of the stomach and small intestines. Once in the blood, the alcohol reaches the brain in about ten minutes. Alcohol has a numbing effect on the brain resulting in a lowering of inhibitions, a reduction in the ability to concentrate and remember, and an increase of the user's overestimation of his abilities.
The consumption of alcohol also affects driving behaviour. Because the driver cannot steer the car as effectively, it begins to swerve. The driver's reaction time increases as well. Because drivers under the influence of alcohol become indifferent, they will also be less inclined to start compensating for their reduced driving skills. In addition, these drivers overestimate their own abilities and underestimate the risks (Steyvers & Brookhuis, 1996).

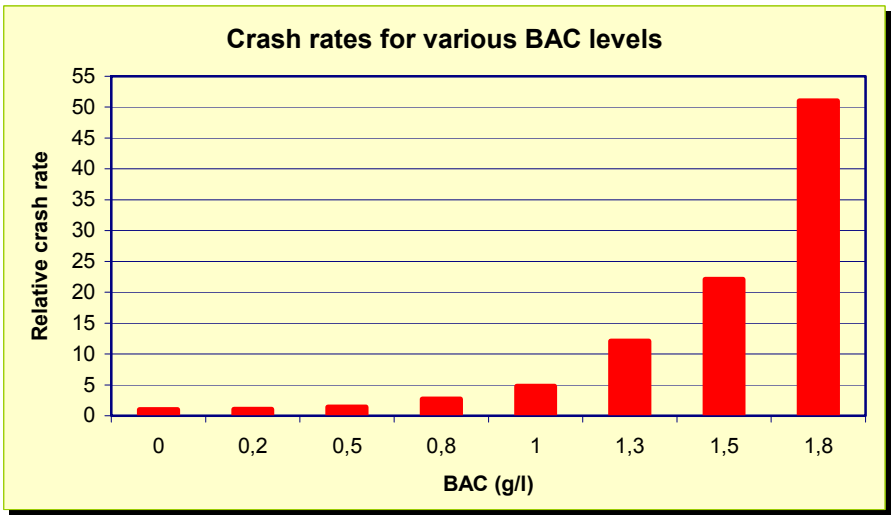

Figure 2. *Crash rates for various BAC levels (Blomberg et al., 2005)*

Figure 2 shows that driving under the influence of alcohol leads to an increased crash rate (Blomberg et al., 2005). This rate increases exponentially as the BAC level increases. Blomberg et al. (2005) estimate the crash rate for drivers with a BAC of 0.5 g/l to be approximately 40% higher. At 1.0 g/l, the crash rate is almost 4 times higher and even 20 times higher at a BAC of 1.5 g/l.

Combination of alcohol and drugs
Drivers who combine the use of alcohol and drugs and/or medicines are about twice as likely to be injured in a road crash as a driver who has consumed only alcohol. Mathijssen & Houwing (2005) found that drivers who combine the use of drugs and/or medicines with alcohol and who have a BAC exceeding 0.8 g/l are about a hundred times more likely to be injured in traffic than sober drivers.

Besides the crash rate, the BAC level also affects the injury severity. The outcomes of crashes involving alcohol use are generally serious. Drivers with more than 1.5 g/l of alcohol in their blood, for example, are about two hundred times more likely to die in a road crash than sober drivers. This must be attributed to both the increased crash rate and the more severe injury in the event of a crash (Simpson & Mayhew, 1991).
The more severe injuries resulting from road crashes are due particularly to two factors: motorists under the influence of alcohol often speed and they make less frequent use of their safety belt. The reduced physical condition of heavier drinkers may be yet another factor (Desapriya et al., 2006).

How many casualties result from alcohol-related crashes?
The degree to which drink driving affects road safety is best illustrated by the number of fatalities and injuries resulting from alcohol-related crashes. We define an alcohol-related crash as a crash in which at least one of the drivers involved has consumed alcohol. And, if we only look at the reported crashes, this definition definitely results in an underestimation of the problem. In the first place, just as in other crashes, nowhere near all alcohol-related crashes appear in police reports. Secondly, nowhere near all the drivers involved in a crash are tested by the police for alcohol consumption. Drivers who die in a crash, for example, are practically never tested for alcohol since this is considered useless from the standpoint of criminal proceedings.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Fatalities	83	92	88	72	97	72	68	62	40	44
In-patients	1154	1173	1130	1036	1.98	1012	890	1003	902	920
Total	1237	1265	1218	1108	1195	1084	958	1065	942	964

Table 1. *Registered numbers of casualties resulting from alcohol-related crashes according to the severity of the injury (Source: VenW-BRON).*

Table 1 shows that the *number* of registered alcohol-related casualties is decreasing in the Netherlands. The *percentage* of registered alcohol-related casualties (fatalities and inpatients), however, has been around 9.5% for twenty years. This difference indicates that measures taken to reduce drink driving have less effect on the heavy drinkers that cause the most alcohol-related crashes. Another explanation could be the increase in combining the use of alcohol and drugs.
The actual percentage of alcohol-related casualties is considerably higher. According to the SWOV's estimates, about 25% of the road fatalities in the Netherlands are the result of alcohol, whether or not in combination with drugs. Of these road fatalities, around two-thirds involve alcohol alone and the remaining one-third a combination of alcohol and drug use (Mathijssen & Houwing, 2005).

Which groups are more likely to drive under the influence of alcohol?
Research (among others: Blomberg et al., 2005; Mathijssen & Houwing, 2005) shows that that young males and heavy drinkers are more likely to be involved in alcohol-related crashes.

Young males
Although young males ages 18 through 24 formed only 4% of the total Dutch population in 2002, they accounted for 23% of the in-patients and fatalities due to alcohol-related crashes. Despite the fact that young drivers consume less alcohol when they drive than older drivers, they are over-represented in the group of casualties and drivers involved in alcohol-related crashes (Mathijssen & Houwing, 2005). Due to their lack of experience, not only do young drivers have a higher crash rate, even when they

are sober, but the crash rate of young novice drinkers after consuming alcohol increases faster than that of older, more experienced drinkers (Blomberg et al., 2005; Mathijssen, 1999b; Peck et al., 2008). In the Tilburg study (Mathijssen & Houwing, 2005), the young males ages 18 through 24 also accounted for the most users of alcohol-drug and drug-drug combinations. Five times as many (3%) were found positive for these dangerous combinations as compared to 0.6% for all other drivers.

Heavy drinkers
The same Tilburg study (Mathijssen & Houwing, 2005) shows that about three-quarters of the drivers in severe alcohol-related crashes had a BAC exceeding 1.3 g/l.
Heavy drinkers who had also used drugs were responsible for about half of these crashes. Although the group of heavy drinkers in Tilburg accounted for not more than 0.2% of all drivers on the road, they made up 20% of all the motorists driving under the influence of alcohol.

What measures can be taken?

Lowering limits
As of 1 January 2006 the legal alcohol limit for novice drivers was reduced to 0.2 g/l. In 1999, SWOV had estimated the effects of reducing the legal limit for novice drivers in the Netherlands. At an equal level of police enforcement, this could result in a 5% reduction in the total number of alcohol-related crashes (Mathijssen, 1999). An additional advantage of introducing such a measure is that it can contribute to reducing combined alcohol and drug use that is more frequent among young males in particular and which leads to a very high crash rate. According to SWOV, a general reduction of the legal limit would have an adverse effect on the total number of alcohol-related crashes if it were not accompanied by increased police enforcement. After all, the same level of enforcement would have to be used for a larger number of offenders, thus reducing the real, objective probability of detection for heavy drinkers. A study of the effects of reducing the legal limit in Finland reached the same conclusion (Penttilä et al., 2004).

Enforcement
Enforcing legal measures is a major factor in the duration of the effects as well as in their degree of success (Fell & Voas, 2004; Geary & Preusser, 2004). Various studies (e.g. Mathijssen (2001); Erke et al., 2008) showed that enforcement is more effective when supported by publicity. Publicity about intensified enforcement results in a higher subjective probability of being caught and to a more rapid decrease in the number of offenders. The establishment of regional traffic enforcement teams in 1999 resulted in an increase in the enforcement of drink driving. This was accompanied by a slight decrease in drink driving (AVV, 2003). The recent increase in random testing at the national level has been particularly effective in the case of light offenders. The reduction in drink driving between 2000 and 2007 occurred only among relatively light offenders and not among the serious offenders who cause the vast majority of crashes (DVS, 2008). Over the next few years, enforcement should therefore focus on increasing the objective (and thus simultaneously the subjective) probability of detection among the heavy drinkers.

Public information and education
Campaigns are nearly always carried out in combination with other measures. This is why their direct effect on behaviour associated with drink driving cannot be proven. However, campaigns can contribute to maintaining desired behaviour which has more or less been forced on people (Schults et al., 2004). Indications of this in the Netherlands were found particularly during the early 1990s. Despite a significant decrease in the enforcement of drink driving that resulted from a reorganisation of the police, driving under the influence increased only very slightly at that time (Mathijssen, 1999a).

Increasing penalties
In comparison with many other European countries, the penalties for alcohol-impaired driving in the Netherlands are relatively light. Research into the opinions, preferences and behaviour of Dutch motorists indicates that they are against drink driving and would like to see it punished more severely (SARTRE, 2004). However, whether increased penalties would lead to a substantial reduction in drink driving is doubtful. In any case, a considerable increase in the penalties issued in 1992 did not result in a decrease in drink driving in following years. It even increased slightly, probably partly because of a sharp drop in the enforcement level (Mathijssen, 1994). This indicates that the severity of penalties has less impact than the probability of detection (also see the SWOV Fact sheet *Penalties in traffic*).

Educational Measure Alcohol and Traffic
The Educational Measure Alcohol and Traffic (EMA) consists of a three-day course imposed on drivers with relatively high BACs as well as on recidivists. Originally, the EMA was imposed on drivers with a BAC between 1.3 and 2.1 g/l, but the upper limit was lowered to 1.8 g/l in 2000. Since 2002 the lower limit has been reduced to 0.8 g/l for novice drivers who have had their driving licence for less than five years. A study into the effectiveness of the EMA showed an increased knowledge among the participants of drink driving, but no effect on recidivism (Nägele & Vissers, 2000).

Alcolock
An alcolock is an in-vehicle alcohol tester which is connected to the starting mechanism and acts as an ignition interlock. Only after an alcohol test has been successfully passed can the engine be started. Various provisions and regular enforcement make fraud very difficult (Beirness, 2001). Various assessments have shown that an alcolock is more effective in preventing recidivism than licence suspension. In North America and Sweden, there was 65 to 90% less recidivism among the serious offenders who participated in an alcolock programme than among offenders who had their licences suspended (Bax et al., 2001). However, after the alcolock programme had been completed, the participants became recidivists as often as the drivers whose licences had been suspended. Experiences in the United States indicate that an alcolock should be part of a broader programme aimed at preventing recidivism. A possible extension of the alcolock programme and providing assistance to treat these drivers' alcohol problem could reduce recidivism among drivers (Silverans et al., 2006). An alcolock programme in the Netherlands is expected to be introduced by the end of 2009 or early 2010. More information about this topic is available in the SWOV Fact sheet *Alcolock*.

Licence suspension
Licence suspension has a limited impact on driving under the influence of alcohol. A study conducted in the United States shows that the success of licence suspension depends on the severity of the punishment and the probability of detection. The number of kilometres driven by offenders, however, decreases (Ross & Gonzales, 1988). US and Canadian research, however, shows that after a comparable offence, people who have had their licence suspended become recidivists two to three times as often as drivers who are allowed to drive with an alcolock (Bax et al., 2001). Based on these results, requiring heavy drinkers to use an alcolock is more effective in terms of road safety than suspending their licences.

Conclusions and recommendations
The percentage of drivers who drive under the influence of alcohol is still decreasing. This drop, however, is occurring only among the relatively light offenders. Measures such as random testing, alcohol campaigns and the EMA appear to have little if any effect on the heavier drinkers, whereas these are exactly the ones who are responsible for the vast majority of alcohol-related crashes.
In addition to taking these measures, the percentage of alcohol-related casualties can be further reduced by subjecting the group of heavy drinkers to specific forms of enforcement. If they were then included in an alcolock programme, this would have a positive effect on road safety.

Publications and sources

AVV (2003). *Rijden onder invloed in Nederland, onderzoek 2002; Ontwikkeling van het alcoholgebruik van automobilisten in weekendnachten.* Adviesdienst Verkeer en Vervoer AVV, Heerlen.

Bax, C. (ed.), et al. (2001). *Alcohol interlock Implementation in the European Union; Feasibility study. Final report of the European research project.* D-2001-20. SWOV, Leidschendam.

Beirness, D.J. (2001). *Best practices for alcohol interlock programs.* Traffic Injury Research Foundation of Canada TIRF, Ottawa.

Blomberg, R.D., et al. (2005). *Crash risk of alcohol involved driving: A case-control study.* Dunlap and Associates, Inc., Stamford.

Desapriya, E., Pike, I. & Raina, P. (2006). *Severity of alcohol-related motor vehicle crashes in British Columbia: case-control study.* In: International Journal of Injury Control and Safety Promotion, vol. 13, nr. 2, p. 89-94.

DVS (2008). *Rijden onder invloed in Nederland in 1999-2007; Ontwikkeling van het alcoholgebruik van automobilisten in weekendnachten.* Dienst Verkeer en Scheepvaart DVS, Delft.

Erke, A., Goldenbeld, C. & Vaa, T. (2008). *Good practice in the selected key areas : speeding, drink driving and seat belt wearing; Results from meta-analysis.* Deliverable 9 of the European Research Programme PEPPER. European Commission, Brussels.

Fell, J.C. & Voas, R.B. (2004). *The effectiveness of reducing illegal BAC limits for driving; Evidence for lowering the limit to .05 BAC in Canada.* In: Alcohol, drugs and traffic safety, proceedings of the 17th ICADTS International Conference on Alcohol, Drugs and Traffic Safety, 8-13 August 2004. Glasgow, United Kingdom.

Geary, L.L. & Preusser, D.F. (2004). *Suspended drivers.* In: Alcohol, drugs and traffic safety, proceedings of the 17th ICADTS International Conference on Alcohol, Drugs and Traffic Safety, 8-13 August 2004. Glasgow, United Kingdom.

Mathijssen, M.P.M. (1994). *Rijden onder invloed in Nederland, 1992-1993 Ontwikkeling van het alcoholgebruik van automobilisten in weekendnachten.* R-94-21. SWOV, Leidschendam.

Mathijssen, M.P.M. (1999a). *Drug-, medicijn- en alcoholgebruik van automobilisten in Nederland, 1997/1998.* R-99-5. SWOV, Leidschendam.

Mathijssen, M.P.M. (1999b). *Schatting van de effecten van verlaging van de wettelijke limiet voor alcoholgebruik in het verkeer.* R-99-11. SWOV, Leidschendam.

Mathijssen, M.P.M. (2001). *Rijden onder invloed en het politietoezicht daarop.* R-2001-8. SWOV, Leidschendam.

Mathijssen, R. & Houwing, S. (2005). *The prevalence and relative risk of drink and drug driving in the Netherlands: a case-control study in the Tilburg police district.* R-2005-9. SWOV, Leidschendam.

Nägele, R. & Vissers, J. (2000). *Gedragseffecten van de EMA; Een evaluatieonderzoek naar de leer- en gedragseffecten op middellange termijn van de Educatieve Maatregel Alcohol en verkeer.* TT 00-119. Traffic Test, Veenendaal

Peck, R.C., et al. (2008). *The relationship between blood alcohol concentration (BAC), age, and crash risk.* In: Journal of Safety Research, vol. 39, p. 311-319.

Pentillä, A., Portman, M., Kuoppasalmi, K., Lunetta, P. & Nevala, P. (2004). *Roadside surveys in Uusimaa in Finland. Increase of the rate of motor vehicle drivers in traffic with a low blood alcohol content.* In: Alcohol, drugs and traffic safety, proceedings of the 17th ICADTS International Conference on Alcohol, Drugs and Traffic Safety, 8-13 August 2004. Glasgow, United Kingdom.

Ross, H.L. & Gonzales, P. (1988). *Effects of license revocation on drunk–driving offenders.* In: Accident Analysis and Prevention, vol. 20, nr. 5, p. 379-391.

SARTRE (2004). *European drivers in road risk; Project on Social Attitudes to Road Traffic Risk in Europe SARTRE 3, part 1; Report on principal results.* Institut National de Recherche sur les Transports et leur Sécurité INRETS, Arcueil.

Shults, R.A., Elder, R.W., Sleet, D.A., Nichols, J.L. & Thompson, R.S. (2004). *Effectiveness of mass media campaigns for reducing drinking and driving and alcohol-related crashes.* In: Alcohol, drugs and traffic safety, proceedings of the 17th ICADTS International Conference on Alcohol, Drugs and Traffic Safety, 8-13 August 2004.

Silverans, P., et al. (2006). *Alcolock implementation in the European Union; Deliverable D-2: Description, results and discussion of the alcolock field trial.* European Commission, Brussels.

Simpson, H.M. & Mayhew, D.R. (1991). *The hard core drinking driver.* Traffic Injury Research Foundation of Canada TIRF, Ottawa.

Steyvers, F.J.J.M. & Brookhuis, K.A. (1996). *Effecten van lichaamsvreemde stoffen op het rijgedrag: een literatuuroverzicht*. Rijksuniversiteit Groningen RUG, Verkeerskundig Studiecentrum VSC, Haren.