ORIGINAL ARTICLE

# Drinking, drugs and driving in Ireland: more evidence for action

**P Fitzpatrick, L Daly, C P Leavy, D A Cusack**

*Injury Prevention* 2006;**12**:404–408. doi: 10.1136/ip.2006.013177

See end of article for authors' affiliations

Correspondence to:
Dr P Fitzpatrick, Senior Lecturer, UCD School of Public Health & Population Science, University College Dublin, Earlsfort Terrace, Dublin 2, Ireland; patricia.fitzpatrick@ucd.ie

Accepted 18 August 2006

**Objective:** To examine the prevalence of drug positivity among drivers suspected of driving under the influence of an intoxicant, and consequently apprehended by the police in Ireland.
**Design:** 2000 specimens were selected for drug analysis, 1000 with results under the limit for alcohol and 1000 over the limit. The limit for alcohol is 80 mg/100 ml in blood and 107 mg/100 ml in urine. Seven drugs/drug classes were examined; amphetamines, methamphetamines, benzodiazapines, cannabinoids, cocaine, opiates and methadone.
**Results:** 331 (33.1%) of the drivers under the legal limit for alcohol tested positive for one or more of the relevant drugs, and the corresponding figures of drivers over the limit was 142 (14.2%; $p<0.001$). Using weighted analysis, this corresponds to 15.7% (95% confidence interval (CI) 13.5% to 18.1%) of all tested drivers (15.8% in men and 14.5% in women). Among drivers who had minimal blood alcohol levels, 67.9% (95% CI 61.2% to 74.1%) were taking at least one type of drug. The prevalence of taking drugs reduced steadily as alcohol concentrations increased, but still remained as high as 11.1% (95% CI 8.3% to 14.6%) for drivers with blood alcohol concentrations >200 mg/100 ml. Being under the limit for alcohol, stopped in a city area, stopped between 6 am and 4 pm, or 4 pm and 9 pm, and being of a younger age were each independently associated with drug positivity.
**Conclusions:** There are immediate implications for the evidential breath alcohol program and for checkpoints; in the event of a nil or low alcohol reading being obtained, a separate blood or urine specimen should be sought for analysis, which is currently non-routine.

Driving under the influence of drugs (DUID) has been a statutory offense in Ireland under the 1961 Road Traffic Act. The Medical Bureau of Road Safety (MBRS) is the independent forensic body responsible for chemical testing of intoxicants under the Road Traffic Acts. There are graded penalties for driving under the influence of alcohol, depending on concentration. The law does not set prohibited concentrations for other drugs nor does it distinguish between legal and illegal drugs.

Studies on drug levels in drivers have been carried out in some European countries, after deaths or injuries caused by road traffic.[1–3] Other studies have been carried out on impaired drivers.[4 5] However, prevalence data from different countries are not comparable owing to differences in study designs. The statistics gathered are insufficient to give a detailed picture of the DUID situation internationally.

The government's first strategy for Road Safety, to reduce the number of deaths and serious injuries on Irish roads, was introduced in 1998; this identified the need for research into the field of drugs and driving. The Road Safety Action of the European Union, adopted on 2 June 2003, stated that "If nothing is done urgently there could soon be more accidents due to drugs than to alcohol".[6] At the time of this study, testing of drivers in Ireland was non-random; the police (An Garda Siochana) must form an opinion that the driver is under the influence of an intoxicant before they can stop and test a driver. The Garda must have evidence of aberrant driving behavior. The aim of this study was to examine the prevalence of drug positivity among drivers suspected of driving under the influence of an intoxicant and consequently apprehended by the police, comparing those under and over the legal limits for alcohol.

## METHODS

Under the Road Traffic Acts, the MBRS receives blood and urine specimens from apprehended drivers throughout the whole country; 2000 specimens were selected for drug analysis, 1000 with results under the limit for alcohol and 1000 over the limit. As expected, it took >2 years to accumulate the 1000 consecutive specimens under the limit for alcohol. The 1000 specimens over the limit were gathered in two sequential batches during the period of collection of specimens under the limit. These separate batches were considered to be representative of all specimens over the limit during the period of the survey. The Road Traffic Act 1994 set the alcohol limits at 80 mg/100 ml (blood) and 107 mg/100 ml (urine); the apprehended driver has the choice of providing either specimen. There were 1143 blood specimens (57%) included in the survey, 614 over and 529 under the limit, and 857 urine specimens (43%), 386 over and 471 under the limit.

For this study, urine alcohol levels have been converted to equivalent blood alcohol levels for the purpose of statistical analysis. Seven common drugs/drug classes were examined; amphetamines, methamphetamines, benzodiazapines (usually prescribed for management of anxiety disorders or as sleeping tablets), cannabinoids (cannabis/hash/pot and breakdown products), cocaine, opiates (including heroin) and methadone (prescribed drug given to heroin addicts undergoing detoxification programs). It is not standard practice to screen for all known drugs, both legal and illegal; toxicology analysis in drivers, when conducted, concentrates

**Abbreviations:** DUID, driving under the influence of drugs; MBRS, The Medical Bureau of Road Safety on the main drugs and drug classes in use that are known to have impairing effects on driving performance. All specimens found positive were forwarded to the state laboratory for confirmatory analyses.

In this study, the term "taking drugs" is based on positive confirmatory results for the particular drugs selected for analysis. Direct calculation of the prevalence of taking drugs separately in drivers over and under the limit is presented with 95% confidence intervals (CIs). A weighted estimate had to be used for the prevalence of taking drugs in all tested drivers in the population, because of our sampling strategy. In this investigation, drivers over the limit make up only half the study sample, whereas according to recent MBRS figures, 92% of samples tested for alcohol concentration were over the limit. Using the above estimates to define the weights, a weighted logistic regression was used to examine independent factors associated with drug positivity. Odds ratios (ORs) were derived from the regression coefficients. The $\chi^2$ test was used for comparison of proportions.

## RESULTS

In all, 331 (33.1%) of the drivers under the legal limit for alcohol tested positive for one or more of the relevant drugs, and the corresponding figures in the over the limit drivers was 142 (14.2%) ($p<0.001$). Using weighted analysis, this corresponds to 15.7% (95% CI 13.5 to 18.1) of all tested drivers.

Of the 331 drivers under the limit who were taking drugs, 151 (45.6%, 95% CI 40.2 to 51.2) were taking only one drug, and the remainder were taking two or more. In the 142 drivers over the limit who were taking drugs, 117 (82.4%, 95% CI 74.9 to 88.1) were only taking one drug. For both groups of drivers, cannabinoids were the most common class of drugs (table 1), followed by benzodiazepines.

The lower the alcohol level, the higher the prevalence of taking drugs (fig 1). Among drivers who had minimal blood alcohol concentrations (<10 mg/100 ml), 67.9% (95% CI 61.2 to 74.1) were taking at least one type of drug. The prevalence of taking drugs reduced steadily as alcohol levels increased, but remained as high as 11.1% (95% CI 8.3 to 14.6) for drivers with blood alcohol concentration >200 mg/100 ml.

Most of the tested drivers were men, with little difference between the groups; 90.3% men among those under the limit and 93.1% among those over the limit. The prevalence of taking drugs was higher in male drivers than in female drivers under and over the limit; consequently, there was a small, non-significant male excess in the estimated prevalence of taking drugs in all tested drivers in the population.

A total of 37.6% of drivers under the limit were aged <25 years, compared with 21.8% of drivers over the limit ($p<0.001$). Figure 2 shows the relationship of age to the

**Table 1** Prevalence of drug positivity by drug type in drivers under and over the limit for alcohol, and weighted estimate for the population of all tested Irish drivers

| Drug detected | Under limit n = 1000 (%) | Over limit n = 1000 (%) | Weighted analysis (population estimate for all tested Irish drivers) (%) |
|---|---|---|---|
| Cannabinoids | 209 (20.9) | 85 (8.5) | 9.5 |
| Amphetamine | 84 (8.4) | 15 (1.5) | 2.1 |
| m-Amphetamine | 90 (9) | 20 (2) | 2.6 |
| Opiates | 69 (6.9) | 8 (0.8) | 1.3 |
| Cocaine | 25 (2.5) | 9 (0.9) | 1.0 |
| Methadone | 68 (6.8) | 6 (0.6) | 1.1 |
| Benzodiazepines | 90 (9) | 34 (3.4) | 3.9 |

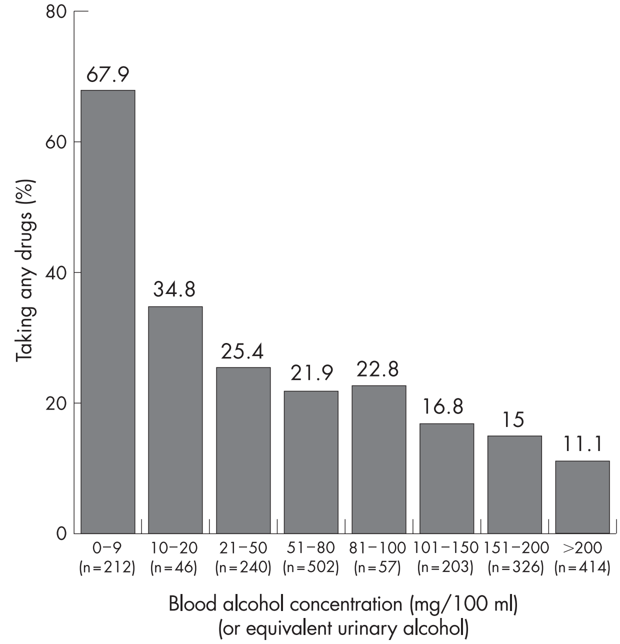


**Figure 1** Prevalence of taking drugs by blood alcohol level in tested drivers.

**Table 2** Prevalence of drug positivity by sex in drivers under and over the limit for alcohol, and weighted estimate for the population of all stopped Irish drivers

| Sex | Under limit (n = 1000), n drug positive (%; 95% CI) | Over limit (n = 1000), n drug positive (%; 95% CI) | Weighted analysis (population estimate for all tested Irish drivers) (%) |
|---|---|---|---|
| Male | 305/903 (33.8; 30.7 to 36.9) | 133/931 (14.3; 12.1 to 16.7) | 15.8 |
| Female | 26/97 (26.8; 18.6 to 36.9) | 9/69 (13.0; 6.5 to 23.8) | 14.5 |

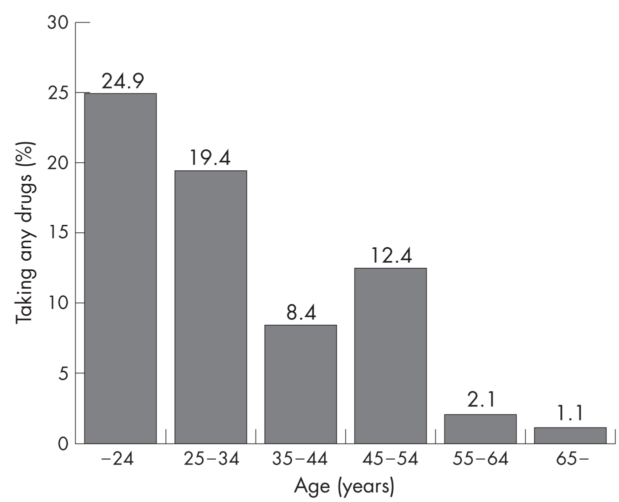


**Figure 2** Prevalence of taking any drug by age in all tested drivers.

prevalence of taking any drug in tested drivers. A strong trend of decreasing prevalence with age is apparent. The prevalence was >20 times higher in those aged <25 years than in those aged ⩾65 years.

Most of the specimens were provided between 9 pm and 6 am (79.1% of drivers under the limit and 84.2% of drivers over the limit provided specimens in this period). The proportion of drivers under the limit who provided specimens in the morning/day (6 am to 9 pm) was 9.4%; this was twice the proportion providing specimens in this period among those over the limit (4.7%). The percentage providing specimens in the evening (4–9 pm) was 11.5% of those under the limit and 11.1% of those over the limit. Table 3 shows prevalence of taking drugs by specimen provision time. The highest rates of drug positivity were seen in specimens taken between 6am and 4pm; the rates of drug positivity by time at which specimens were taken differed significantly among those under the limit for alcohol ($p<0.001$), but not among those over the limit.

Examination of whether the specimen was provided at the weekend or during the week showed no relationship with a positive drug result. A higher level of taking drugs over the weekend was not observed among the stopped drivers.

The prevalence of taking drugs was higher in drivers tested in urban areas than in the rural areas (prevalences of 46.3% (95% CI 40.1 to 52.6) versus 28.5% (95% CI 25.3 to 31.9) among drivers under the limit, and 20.8% (95% CI 15.9 to 26.7) versus 12.2% (95% CI 10 to 14.8) in drivers over the limit). Overall, 23.0% of urban drivers tested were taking drugs compared with 13.5% of rural. These data do not relate to the residence of the driver, but to the location of the police station in which the driver was tested.

Figures 3 and 4 show the age-specific prevalences for the various classes of drugs analyzed in all tested drivers (weighted analysis; note the different scales in these two figures). Use of each class of cannabinoids, amphetamines and m-amphetamines was highest in those aged <25 years, and subsequently decreased with age. Use of benzodiazepines rose to a peak in those aged 45–54 years and decreased thereafter. The age-specific patterns for use of the remaining classes of drugs were not fully consistent. Use of cocaine and methadone peaked in the 25–34-year age group and reduced thereafter. Use of opiates increased to a peak in the 45–54-year age group and then declined, although use in those aged 35–44 years was also low.

Table 4 shows, for the factors shown, unadjusted and adjusted ORs for drug positivity in apprehended drivers. Examining the adjusted ORs, being under the limit for alcohol, stopped in a city area, stopped between 6 am and 4 pm or 4 pm and 9 pm, and being of a younger age were each independently associated with drug positivity.

**Table 3** Prevalence of taking drugs by time at which specimens were provided among drivers under and over the limits for alcohol

| Time specimen provided | Drivers under limit, number positive/number of samples; % (95% CI) | Drivers over limit, number positive/ number of samples; % (95% CI) |
|---|---|---|
| 6 am–4 pm | 48/94; 52.1 (41.6 to 62.4) | 10/47; 21.3 (11.2 to 36.1) |
| 4 pm–9 pm | 47/115; 40.9% (31.9 to 50.4) | 18/111; 16.2 (10.1 to 24.7) |
| 9 pm–6 am | 236/791; 29.8 (26.7 to 33.2%) | 114/842; 13.5 (11.3 to 16.1) |

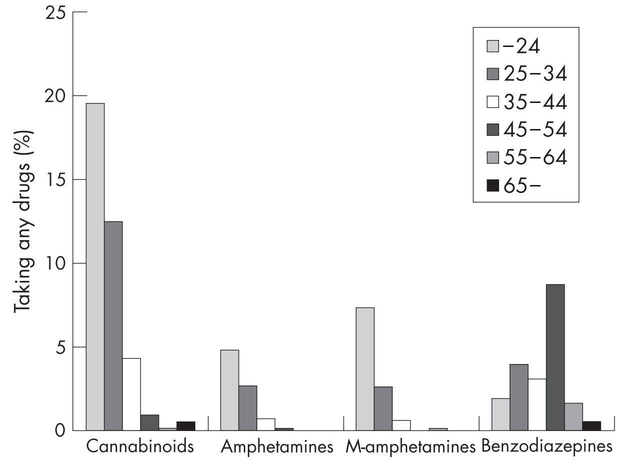


**Figure 3** Prevalence of taking drugs (cannabinoids, amphetamines, m-amphetamines and benzodiazepines) by age and class in all tested drivers.

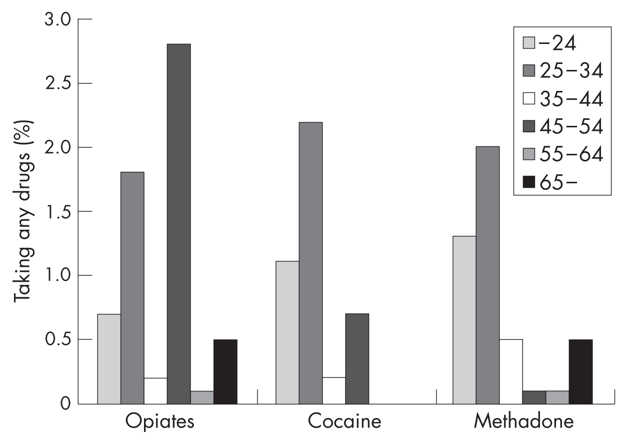


**Figure 4** Prevalence of taking drugs (opiates, cocaine and methadone) by age and class in all tested drivers.

**Table 4** Logistic regression examining independent factors for drug positivity

| Variable | Positive for any drug (%) | Unadjusted OR | Adjusted OR (95% CI) |
|---|---|---|---|
| Under the limit | 33.1 | 3.0 (2.1 to 4.3) | 2.7 (1.8 to 4.0) |
| Over the limit | 14.2 | 1.0 | 1.0 |
| City | 23 | 1.9 (1.5 to 2.5) | 1.9 (1.4 to 2.5) |
| Rural | 13.5 | 1.0 | 1.0 |
| Time | | | |
| 6 am–4 pm | 25.7 | 1.9 (1.2 to 3.1) | 2.0 (1.2 to 3.3) |
| 4 pm–9 pm | 18.3 | 1.2 (0.9 to 1.8) | 1.7 (1.1 to 2.6) |
| 9 pm–6 am | 14.8 | 1.0 | 1.0 |
| Age (years) | | | |
| ⩽35 | 21 | 12.3 (3.9 to 39.2) | 13.7 (4.3 to 44.1) |
| 36–55 | 9.7 | 5.0 (1.5 to 16.2) | 5.4 (1.7 to 17.7) |
| >55 | 2.1 | 1.0 | 1.0 |

## DISCUSSION

This is the first comprehensive nationwide study on drugs and driving in the Republic of Ireland, and confirms a serious drugged driving problem; this is to some extent what would be expected, given the growth in drug use in the general population.[7 8] Official Irish statistics under the Road Traffic Acts do not distinguish between convictions owing to impairment by alcohol only, drugs only or a combination of both, and so the size of the problem is hidden;[9] this study is therefore an important addition. This is one of the larger studies carried out internationally on drugs and driving and adds to the body of knowledge as recommended by the Pompidou group[10] on drugs and driving—that is, evidence-based research.

During the period of the study, there was no provision for collection of specimens from a motorist without evidence of impairment (ie, no random testing), therefore the blood and urine samples were taken from drivers apprehended by the police and suspected of driving under the influence of an intoxicant. As in all studies of this nature, there is a limitation on the information obtained, as it does not provide a full picture of use of drugs in the general driving population.

It has been established that there is an increased risk of road crashes for drivers under the influence of drug misuse and prescribed psychoactive drugs.[1 11] Drugs affect driving behavior by disturbing the information-processing mental function or by increasing response time. Amphetamines belong to the first category and may encourage risk-taking behavior, whereas benzodiazepines and cannabis can reduce capability. Cannabis produces a major decrease in attention and ability to react to sudden, unexpected emergencies.[12] The fact that the prevalence of taking drugs was substantially higher in those under the limit for alcohol in this study suggests that incapacity caused by taking drugs may be a reason why these drivers were stopped in the first place. Apart from the acute detrimental effects of drugs, epidemiologic data seem to suggest that drivers who misuse drug are more likely to engage in other high-risk behaviors, including high-risk driving, on a long-term basis.[12 13]

Drivers who took drugs and were under the limit for alcohol were more frequently taking a cocktail of drugs than those over the limit. Drug interaction, often unpredictable, represents a major and inadequately characterized problem.[12] Epidemiologic evidence shows that the combination of alcohol and cannabis is over-represented among dead and injured drivers, and particularly among those drivers responsible for the injuries.[14] Habitual cannabis use has been found to be strongly related to serious car crashes after adjustment for several risk factors, including overuse of cannabis.[15]

Overall, the highest prevalence of taking drugs was among the relatively small group who provided a specimen during the day between 6 am and 9 pm (25.7%), and the lowest prevalence was among those providing a specimen during the night (14.8%). This higher rate of drug use in those providing a specimen in the morning/day may explain the higher proportion of those providing a specimen who were under the limit in this period. The long half-life of many benzodiazepines is of concern,[16 17] particularly among older drivers, which may manifest as problematic daytime driving.

Detection of drugged driving requires a strong focus on the problem. Greater attention to the problem is one of the explanations of documented high rates of drugged driving in Norway compared with other Nordic countries, despite similar rates of drug use in the general population.[4 5] The strong male majority found in this study may reflect the type of people Gardai are more likely to stop, but is in line with studies in other countries.[18] Demographically young men are over-represented among drug drivers.[19]

This survey highlights the need for education and awareness in relation to DUID. The focus should be on three target groups: the general population of road users; those responsible for enforcement and oversight, which includes legislators, Gardai, forensic doctors/scientists and the courts; and finally the medical profession, which includes prescribing medical/dental practitioners and pharmacists. The focus to date has centered on illegal drugs, and little attention has been given to prescribed drugs. Specific educational programs should be set up for the different target groups and a general media campaign should be initiated as soon as possible.

There are immediate implications for the evidential breath alcohol program and for checkpoints; in the event of a nil or low alcohol reading being obtained, the police should be aware of the major likelihood that the driver's impairment could be owing to the presence of a drug or drugs other than alcohol. This is an important message for all those countries where drug use is rising in the population in general, as in Ireland. In this case, a separate blood or urine specimen should be sought for analysis; toxicologic analysis is now routinely carried out on all samples received where the alcohol level is below the legal limit.

Although legislative provision for mandatory alcohol testing was passed in Ireland in July 2006, one of the outcomes of this study will be an evidence-based review of the legislation for DUID; the need for such legislation is recognized worldwide. Although research is being carried out into the impairing effects of individual drugs, the list of such drugs is extensive. In contrast with alcohol, it is much more complex to establish dose concentration–effect relationships for other drugs. The long half-life of drugs such as cannabis further complicates matters; cannabis may be detected long after ingestion, and therefore associating consumption of this drug with resultant driving impairment may be difficult to establish. The levels of drugs above which driving should be prohibited are still difficult to establish. Some countries, including Sweden and Switzerland have introduced zero tolerance for illicit drugs.[18] In Switzerland, this excludes benzodiazepines and methadone, but includes all the most commonly detected drugs in that jurisdiction.[18] Zero tolerance in this context means that any level found in the driver is illegal, and no evidence of impairment is required. It is not a reflection on the limit of detection or limit of quantification of the drugs found in analyses. There is considerable debate as to the relevant benefits and deficiencies of zero tolerance of drugs in driving and the requirement to show impairment. In the enforcement field, the goal of producing a valid, reliable and convenient roadside testing device for drugs is still paramount, and not yet achieved.[20] Oral fluid testing has undergone steady progress, but further work is required especially in the areas of sensitivity and reliability of on-site screening devices, knowledge about passive contamination and more generalized proficiency testing.[21]

## Implications for prevention

The role of drugs in injuries caused by road traffic is likely to be underestimated internationally, as the predominant focus has been on detecting drunk drivers. A greater focus on drugged driving and its detection, particularly among those drivers with a low alcohol reading, could have an important effect on injury prevention on our roads.

## ACKNOWLEDGEMENTS

We thank S Moane, K Flynn, G Harrington, P Furney, M Coughlan (MBRS) B Brady, S Stokes, U McArdle and all analytical staff, Toxicology Section, State Laboratory; and C O'Donohue, and L Murray (Garda National Traffic Bureau).

## Authors' affiliations

**P Fitzpatrick, L Daly,** UCD School of Public Health & Population Science, University College Dublin, Dublin, Ireland

**C P Leavy, D A Cusack,** Medical Bureau of Road Safety, University College Dublin, Dublin, Ireland

Funding: This study was funded by the Department of the Environment and Local Government (responsibility transferred to the Department of Transport in June 2002).

## Key points

- In Ireland, at the time of this study, testing of drivers was non-random; the police must form the opinion the driver is under the influence of an intoxicant before they can stop and test a driver.
- One third of stopped drivers under the legal limit for alcohol tested positive for drugs; this was markedly greater than in drivers over the limit. Using weighted analysis, this corresponds to 15.7% of all tested drivers.
- Being under the limit for alcohol, stopped in a city area, stopped between 6 am and 4 pm or 4 pm and 9 pm, and being of a younger age were each independently associated with drug positivity.
- Detection and prevention of drugged driving has not received the attention given to drunken driving. A greater focus on drugged driving has potential for a major preventive effect on injuries caused by road traffic.

Competing interests: None.

## REFERENCES

1 **Mura P**, Kintz P, Ludes B, *et al.* Comparison of the prevalence of alcohol, cannabis and other drugs between 900 injured drivers and 900 control subjects: results of a French collaborative study. *Forensic Sci Int* 2003;**133**:79–85.
2 **Marquet P**, Delpla PA, Kerguelen S, *et al.* Prevalence of drugs of abuse in urine of drivers involved in road accidents in France: a collaborative study. *J Forensic Sci* 1998;**43**:806–11.
3 **Carmen del Rio M**, Alvarez FJ. Presence of illegal drugs in drivers involved in fatal road traffic accidents in Spain. *Drug Alc Dep* 2000;**57**:177–82.
4 **Christophersen AS**, Morland J. Drugged driving, a review based on the experience in Norway. *Drug Alc Dep* 1997;**47**:125–35.
5 **Christophersen AS**, Ceder G, Kristinsson J, *et al.* Drugged driving in the Nordic countries - a comparative study between five countries. *Forensic Sci Int* 1999;**106**:173–90.
6 **Commission of the European Communities**. Halving the number of road accident victims in the European Union by 2010: a shared responsibility. Communication from the European Commission Road Safety Action Programme 2003;**311**:20.
7 **Flanagan E**, Bedford D, O'Farrell A, *et al.* Smoking, alcohol & illicit drug use among young people in a health board region in 1997 and 2002: a comparative study. *Ir Med J* 2004;**97**:230–4.
8 **Smyth BP**, O'Brien M. Children attending addiction treatment services in Dublin, 1990–1999. *Eur Addict Res* 2004;**10**:68–74.
9 An Garda Siochana, Annual report 2004. Ireland: An Garda Siochana, 2004.
10 **Pompidou Group**. Road traffic and psychoactive substances. *Proceedings of Seminar*, 18–20 June 2003, Strasbourg. Pompidou Group, 2004.
11 **Movig KLL**, Mathijsen MPM, Nagel PHA, *et al.* Psychoactive substance use and the risk of motor vehicle accidents. *Accid Anal Prev* 2004;**36**:631–6.
12 **Petridou E**, Moustaki M. Human factors in the causation of road traffic crashes. *Eur J Epidemiol* 2000;**16**:819–26.
13 **Laumon B**, Gadegbeku B, Martin JL, *et al.* Cannabis intoxication and fatal road crashes in France: population based case-control study. *BMJ* 2005;**331**:1371–7.
14 **Ramaekers JG**, Berghaus G, Van Laar M, *et al.* Dose related risk of motor vehicle crashes after cannabis use. *Drug Alc Dep* 2004;**73**:109–19.
15 **Blows S**, Ivers RQ, Connor J, *et al.* Marijuana use and car crash injury. *Addiction* 2005;**100**:605–11.
16 **Madhusoodanan S**, Bogunovic OJ. Safety of benzodiazepines in the geriatric population. *Expert Opin Drug Saf* 2004;**3**:485–93.
17 **Barbone F**, McMahon AD, Davey PG, *et al.* Association of road-traffic accidents with benzodiazepine use. *Lancet* 1988;**352**:1331–6.
18 **Augsburger M**, Donze N, Menetrey A, *et al.* Concentration of drugs in blood of suspected impaired drivers. *Forensic Sci Int* 2005;**153**:11–15.
19 **Kelly E**, Darke S, Ross J. A review of drug use and driving: epidemiology, impairment, risk factors and risk perceptions. *Drug Alc Rev* 2004;**23**:319–44.
20 **Verstraete AG**, Raes E. Rosita-2 final report. http://www.rosita.org (accessed 7 Oct 2006).
21 **Verstraete AG**. Oral fluid testing for driving under the influence of drugs: history, recent progress and remaining challenges. *Forensic Sci Int* 2005;**150**:143–50.

# LACUNAE

### Helmets for all?

In safety-conscious America, experts are beginning to question the benefits of the ''helmetization'' of sports from pole-vaulting to surfing. Since 2000, the American Society for Testing and Materials, a standards development organization, has approved 13 headgear standards for sports including martial arts, short-track speed skating, horseback riding, bull riding and soccer. Twenty years ago, bicycle helmets were the first to garner national attention after the publication of a study which showed that 85% of bicycle head injuries could be prevented by helmets. Since 1994, when California passed its bicycle helmet law, severe head injuries among children have dropped by 18%. However, not all helmets show such clear evidence of effectiveness. Many others have been developed not because of a large number of injuries but because of campaigns led by the parents of injured children. Head injury experts are concerned that data do not clearly show the need for such protection, and that badly designed helmets might do more harm than good. ''Some might argue that some protection is better than none. That's not always the case'', said Dr Tony Strickland, director of the Sports Concussion Institute in Marina del Rey, California, USA. For example, former Olympian Jan Johnson has been highly critical of proposed helmets for pole-vaulting, because of worries that they may cause spinal injuries by hyper-flexing a vaulter's neck. The US Soccer Federation was similarly concerned that helmets could create more injuries for soccer players, but recently conceded that headgear provides a ''measurable benefit'' in head-to-head impacts (from Los Angeles Times, contributed by Ian Scott).