Daniele Risser,[1] M.D.; Martin Stichenwirth;[1] Nikolaus Klupp,[1] M.D.; Barbara Schneider,[2] Ph.D.; Thomas Stimpfl,[1] Ph.D.; Walter Vycudilik,[1] Ph.D.; and Georg Bauer,[1] M.D.

Drugs and Driving in Vienna, Austria*

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ABSTRACT: Drugs that affect the central nervous system are generally assumed to have the potential to impair driving ability. In a retrospective survey, police files and the results of toxicological urine analysis from drivers suspected of driving under the influence of drugs in Vienna from 1993 to 1996 were investigated. Decisive for police intervention was ''unsafe driving'' (swerving, hesitating, going too slowly, etc.), driving at high speed within the city limits, driving through red lights or stop signs, and driving at night without lights. In one-fifth of the cases drivers caused a traffic accident. Casting suspicion on driving under influence of drugs was mainly caused by impaired coordination of movements, bloodshot eyes, slurred speech, drowsiness, conspicuous behavior, and changed pupils. In the majority of the study population more than two symptoms were recorded by police. In 94% of the cases police suspicions could be confirmed by toxicological urine analysis.

KEYWORDS: forensic science, forensic medicine, drug abuse, driving, impairment, urine, Vienna, Austria

Drugs that affect the central nervous system are generally assumed to have the potential to impair driving ability (1). Moreover, studies of injured drivers suggest that driving under the influence of drugs other than alcohol is a growing cause of accidents (2).

In Vienna, the capital of Austria, with about 1,600,000 inhabitants, more than 20% of teenagers have admittedly experimented with illegal drugs. Cannabis is the most common one (3). Furthermore, it is estimated that 5000 to 6000 opiate addicts live in the Austrian capital (4).

In Vienna there are about 350 officially registered motorcars per 1000 inhabitants. Every year almost 20,000 new driving licenses are issued, 90% of them to persons aged 16 to 24 years (5). Although, during the last 20 years, the percentage of female license holders has increased from about 30% to 50%, annual mileage by females is estimated to be 20% less than that by males (6). In 1995 there were 5265 officially registered road accidents with a total of 6711 persons injured and 55 killed (7).

[1] University professors, university assistant and research assistant, respectively, Institute of Forensic Medicine, University of Vienna, Sensengasse 2, 1090 Vienna, Austria.

[2] University assistant, Institute of Medical Statistics, University of Vienna, Austria.

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Driving under the influence of drugs and/or alcohol is illegal according to the Austrian Road Traffic Law. Intoxicated drivers are charged and their driving licenses confiscated on the spot (8).

However, until now, data on the involvement of illegal drugs in individuals driving vehicles have not been readily available for Vienna.

The aim of this retrospective survey is to help elucidate the current situation of driving under the influence of illegal substances in the capital of Austria.

Methods

For this purpose, police files and results of toxicological urine analysis from drivers suspected of driving under the influence of drugs in Vienna from 1993 to 1996 were investigated.

All the drivers were stopped for specific instances of reckless driving. This included ''unsafe driving'' (swerving, hesitating, going too slowly, etc.), driving at high speed within the city limits, driving through red lights or stop signs, and driving at night without lights.

Drivers who appeared intoxicated were referred to the nearest police station for breath alcohol analysis. In case of negative testing for alcohol, drivers underwent a medical evaluation by a police surgeon. Afterwards, these drivers were asked to produce a urine sample for drug screening, which was performed the following day by means of fluorescence polarization immuno assay (Abbott Diagnostics, Chicago, IL) (9). Two measured aliquots of 100 μL of urine were tested for the presence of cannabinoids, opiates, methadone, cocaine metabolites, and amphetamines. The threshold of the test was 25 ng/mL for cannabinoids, 200 ng/mL for opiates, 250 ng/mL for methadone, and 300 ng/mL for cocaine metabolites and amphetamines. Postitive results were confirmed by means of gas chromatography/mass spectrometry (GC/MS) the following day at the Institute of Forensic Medicine at the University of Vienna. The threshold of GC/MS was 1 ng/mL for 11-nor-9-carboxytetrahydrocannabinol (THC-COOH), morphine, methadone, benzoylecgonine, barbiturates, respectively, and 10 ng/mL for amphetamines. Only samples that were positive on the GC/MS test were considered positive. A multi-substance pattern of abuse was assumed if more than one drug could be determined.

The Shapiro-Wilk test was used to determine the goodness-of-fit to a theoretical normal distribution. In the case of normal distribution, parametric tests were applied, otherwise non-parametric tests were used. Data are reported as mean and standard deviation [SD], or median and range. All p-values are the results of two-sided tests. In the case of multiple comparisons, p-values were adjusted by the Bonferroni method. Differences were considered statistically significant at $p < 0.05$. SAS 6.11® (SAS Institute Inc., Cary, NC) was used for numerical analysis (10).

Results

Study Population

The number of urine samples analyzed was 19 in 1993, 23 in 1994, 54 in 1995, and 99 in 1996. There were 22 females among a total of 205 investigated cases. The percentage of females significantly decreased from 26% in 1993 to 12% in 1996 (Chi-square test: $p < 0.023$). The age of offenders ranged from 17 to 41 years. The median age of both sexes was 25 years. 49% of drivers were officially registered because of prior offenses under drug and/or traffic law. These registered drivers were significantly older than the remainder (26 years [range 17 to 40] versus 23 years [range 17 to 41]; Wilcoxon 2-Sample Test: $p < 0.012$). In 199 cases the offender was driving a car and in 6 cases a motorcycle.

Police Intervention

Fifty-nine drivers were stopped because of ''unsafe driving,'' 57 for driving at high speed within the city limits, 42 for driving through red lights or stop signs, and 10 for driving at night without lights. In 37 cases drivers had caused a traffic accident. The proportion of accidents significantly decreased from 42% in 1993 to 19% in 1996 (Chi-square test: $p < 0.001$). Almost 53% of police intervention occurred between 8 P.M. and 4 A.M.

Drug Testing (Fig. 1)

By use of GC/MS the following substances were detected: THC-COOH in 135 cases, morphine in 90 cases, cocaine and/or benzoylecgonine in 48 cases, methadone in 28 cases, benzodiazepines in three cases, and amphetamines, barbiturates and methaqualone in two cases, respectively. The percentage of THC-COOH positive results significantly increased from 47% in 1993 to 72% in 1996 (Mantel-Haenzel Chi-square test: $p < 0.022$). Results positive for morphine significantly decreased from 58% in 1993 to about 37% in 1996 (Mantel-Haenzel Chi-square test: $p < 0.044$). In 48% of the cases more than one drug could be detected. The most common combinations were THC-COOH/morphine and THC-COOH/cocaine. In twelve urine samples no drugs could be detected.

Symptoms Recognized by the Police

Intervening police officers at the scene recognized impaired coordination of movements in 70 cases, bloodshot eyes in 68 cases, slurred speech in 46 cases, drowsiness in 41 cases, conspicuous behavior in 36 cases, and changed pupils in 17 cases.

Police surgeons diagnosed impaired coordination of movements in 161 cases, bloodshot eyes in 51 cases, slurred speech in 54 cases, drowsiness in 124 cases, conspicuous behavior in 46 cases, and changed pupils in 73 cases.

In the majority of our sample population, more than two symptoms were recorded.

Discussion

From 1993 to 1996, the number of urine samples from traffic offenders under the influence of illegal drugs analyzed at the Institute of Forensic Medicine in Vienna increased by more than 500%. In this context it is not clear whether this dramatic increase is due to a general increase in intoxicated drivers in Vienna or due to other, as yet unknown, reasons. Thus, for example, it must be taken into account that there is no information available on how rigorously the Vienna police were looking for drivers under the influence of illegal drugs during the study period. Furthermore, our sample is—like similar investigations—a highly selective one and thus not representative of the real situation. In contrast, in a roadside survey carried out in Lower Franconia, Germany, between 1992 and 1994, less than 4% of drivers' saliva samples tested positive for drugs. Furthermore, at least three-quarters of those found to be positive for opiates had in fact taken codeine as a cough remedy. The authors of this survey concluded that driving under the influence of drugs and medicaments does not yet represent a large-scale problem like, for example, alcohol (11). Finally,

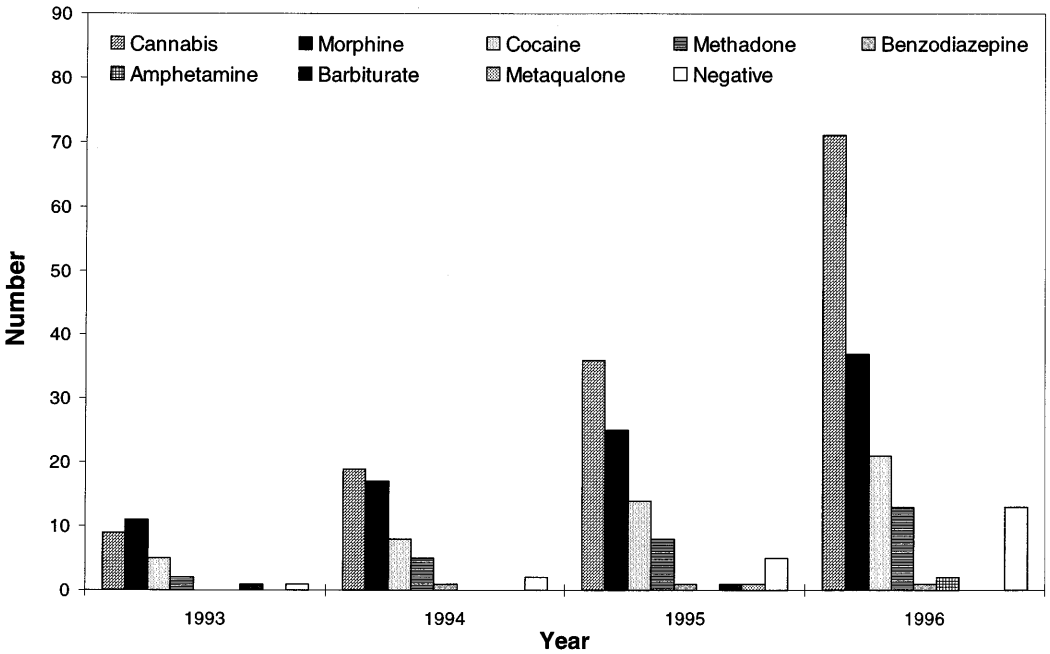

FIG. 1—*Toxicological findings from drivers suspected of driving under the influence of drugs, Vienna, 1993–1996.*

in Denmark, medical and narcotic drugs, although potentially hazardous, were not found to be of any major importance in causing accidents (12).

In our sample the percentage of female traffic offenders, at around 12%, was almost the same as in samples of drivers under the influence of drugs investigated at the Forensic Institute of Lausanne (13), and in Memphis, TN (2). Furthermore, it was almost the same as in a sample of drug-related deaths investigated at the Viennese Institute of Forensic Medicine (14). Moreover, only 11% of females in our sample were involved in a traffic accident. This percentage was almost the same as in a sample of Danish crash drivers under the influence of drugs (15). The low number of females in our study population probably results from the fact that Austrian women are less likely to take illegal drugs. Thus, for example, out of a total of about 22,000 people charged under the drug law in 1996, less than 4000 were female (16).

Cannabis was the most commonly abused drug in our study population, a finding similar to the results of studies performed in other European countries and the United States (2,12,17–20). Cannabis use has been shown to produce changes in cognitive and perceptual abilities and changes in the ability to perform complex integrated and coordinated psychomotor tasks (21,22). Cannabis increases the pulse rate, an effect which was parallel to increased braking time in simulated car driving (23). In this context it must also be considered, that today, for example, the content of delta-9-tetrahydrocannabinol (THC) in marijuana can be as much as 18%, which is significantly higher than that used in laboratory studies. However, plasma levels of THC, the major psychoactive cannabinoid, have been shown to fall rapidly within an hour of smoking (24). THC-COOH, a non-psychoactive metabolite, reportedly appears in blood in higher concentrations for a number of hours, but well after the psychoactive effects have worn off. Thus, the detection of the major urinary metabolite THC-COOH, as in our sample, may not even necessarily indicate recent use of cannabis (25).

Morphine, the second most commonly abused substance identified in our study population, produces numbness, elongation of reaction-time, and a contraction of pupils, symptoms which are assumed to be of major concern in drivers (26). However, morphine was shown to have only a slight and selective effect on functions related to driving in cancer patients receiving long-term morphine treatment (27).

Furthermore, the authors of an Austrian study on methadone-substitution and driving ability conclude that the formal assertion that addiction equals driving-inability is incorrect (28).

In our sample, amphetamines played only a minor role, in contrast to findings in the United Kingdom and Switzerland (12,29). There the increase in the number of drivers under the influence of amphetamines was assumed to be connected with a rising number of ''rave-parties'' in the early 1990's.

The percentage of multisubstance abuse in our sample was high, a finding similar to the results of studies performed in Finland and Switzerland (12,30).

In our sample, police suspicion about driving under the influence of drugs was confirmed by toxicological urine analysis in 94%, a finding similar to the results of a Swiss study (12). In the remainder the urine screening test indicated the presence of a compound which could not be confirmed by GS/MS. Thus, the symptoms recognized by the police were obviously due to other reasons. Furthermore, the symptoms recognized by the police were unspecific and could be attributed to a number of causes unrelated to drug use, especially since over 50% of drivers were stopped at night.

In conclusion, it must be taken into account that the testing of drugs or drug metabolites in urine is only of qualitative value in indicating some prior exposure to specified drugs (1). Therefore, the most accurate procedure would be to take a blood sample from the suspected driver as soon as possible (29,31). Nevertheless, the mere presence of drugs or drug metabolites in body fluids cannot be construed as evidence of impairment. Thus, further tests under conditions that resemble real-life driving experiences after exposure to various acute and chronic dosage regimens of a drug, or a combination of drugs, are required.

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References

1. Concensus Development Panel. Drug concentrations and driving impairment. JAMA 1985;254:2618–21.
2. Brookoff D, Cook CS, Williams C, Mann CS. Testing reckless drivers for cocaine and marijuana. N Engl J Med 1994;331:518–22.
3. Public Health Administration of Vienna. Viennese Drug Use Study 1995. Vienna: Public Health Administration of Vienna, 1996.
4. Public Health Administration of Vienna. Viennese Drug Report 1996. Vienna Public Health Administration of Vienna, 1997.
5. Republik Österreich, Österreichisches Statistisches Zentralamt. Statistisches Handbuch fur die Republik Österreich 1989. Wien: Österreichische Staatsdruckerei, 1989.
6. Risser A. Fahrleistungen. Untersuchungen uber Fahrleistungen in Österreich, Deutschland und der Schweiz im Uberblick. Wien: Kuratorium fur Verkehrssicherheit, 1996, Heft 21.
7. Kuratorium fur Verkehrssicherheit. Unfallstatistik 1995. Wien: Kuratorium fur Verkehrssicherheit, 1996, Heft 19.
8. ÖAMTC. Die ösrerreichische Straβenverkehrsordnung nach der 19. Novelle. Wien: ÖAMTC, 1994.
9. Jolly ME, Stroupe SD, Schwenzer KS. Fluorescence polarization immunoassay III. An automated system. Clin Chem 1981;27: 1575–9.
10. Altman DG. Practical statistics for medical research. 1st ed. London: Chapman & Hall, 1994.
11. Krüger HP, Schulz E, Magerl H. Detection of medicaments and drugs in drivers without motoring offences-Roadside survey. Bergisch Gladbach: Berichte der Bundesanstalt fur Straβenwesen, 1996, Heft M 60.
12. Hansen AC, Bayer Kristensen I, Dragsholt C, Brangstrup Hansen JP. Alcohol and drugs (medical and illicit) in fatal road accidents in a city of 300,000 inhabitants. Forensic Sci Int 1986;79:49–52.
13. Augsburger M, Rivier L. Drugs and alcohol among suspected impaired drivers in Canton de Vaud (Switzerland). Forensic Sci Int 1997;85:95–104.
14. Risser D, Schneider B. Drug-related deaths between 1985 and 1992 examined at the Institute of Forensic Medicine in Vienna, Austria. Addiction 1994;89:851–7.
15. Christensen LQ, Nielsen LM, Nielsen SL. Traffic accidents and drivers suspected for drug influence. Forensic Sci Int 1990;40: 273–80.
16. Federal Ministry of Internal Affairs. Austrian Drug Report 1996. Vienna: Federal Ministry of Internal Affairs, 1997.
17. Christophersen AS, Gjerde H, Bjorneboe A, Sakshaug J, Morland J. Screening for drug use among Norwegian drivers suspected of driving under the influence of alcohol or drugs. Forensic Sci Int 1990;45:5–14.
18. Crouch DM, Birky MM, Gust SW, Rollins DE, Walsh JM, Moulden JV, et al. The prevalence of drugs and alcohol in fatally injured truck drivers. J Forensic Sci 1993;38(6):1342–53.
19. Joó S. Proof of drug and use of pharmaceuticals in impaired drivers. Blutalkohol 1995;35:84–91.
20. Logan BK, Schwilke EW. Drug and alcohol use in fatally injured drivers in Washington State. J Forensic Sci 1996;41(3):505–10.

21. Mason AP, McBay AJ. Ethanol, marijuana, and other drug use in 600 drivers killed in single-vehicle crashes in North Carolina, 1978–1981. J Forensic Sci 1984;29:987–1026.
22. Block RI. Does heavy marijuana use impair human cognition and brain function? JAMA 1996;275:560–1.
23. Rafaelson OJ, Bech P, Christiansen J, Christrup H, Nyboe I, Rafaelson L. Cannabis and alcohol: effects on simulated car driving. Science 1972;179:920–3.
24. Sunshine I. Monograph: Marijuana (THC). Marion Laboratories, Inc. 1985.
25. Asselin M, Leslie JM, McKinley B. Direct detection of drugs of abuse in hemolysed blood using EMIT d.a.u. urine assays. J Anal Toxicol 1988;12:207–15.
26. Iten PX. Fahren unter Drogen- oder Medikamenteneinfluβ. Forensische Interpretation und Begutachtung. Zurich: Institut fur Rechtsmedizin der Universität Zurich, 1994.
27. Vainio A, Ollila J, Matikainen E, Rosenberg P, Kalso E. Driving ability in cancer patients receiving long-term morphine analgesia. Lancet 1995;346:667–70.
28. Rossier H, Battista HJ, Deisenhammer F, Gunther V, Pohl P, Prokop L, et al. Methadone-substitution and driving ability. Forensic Sci Int 1993;62:63–6.
29. George S, Braithwaite RA. Drugs of abuse screening in the west Midlands: a 6 year retrospective survey of results. Ann Clin Biochem 1994;31:473–8.
30. Lillsund P, Korte T, Michelson L, Portman M, Pikkarainen J, Seppala T. Drug usage of drivers suspected of driving under the influence of alcohol and/or drugs. A study of one week's samples in 1979 and 1993 in Finland. Forensic Sci Int 1996;77:119–29.
31. Schutz H, Weiler G. Problems in establishing threshold values for ''driving under the influence'' of centrally acting compounds from the pharmacokinetic and pharmacodynamic view. Blutalkohol 1993;30:137–57.

Additional information and reprint requests:
Daniele Risser, M.D.
Institute of Forensic Medicine
University of Vienna, Sensengasse 2
A-1090 Vienna, Austria
Phone: +43(0) 1 402405 1 /32
Fax: +43(0) 1 4052726
e-Mail: Daniele Risser@univie.ac.al