ORIGINAL ARTICLE

Drivers involved in road traffic accidents in Piedmont Region: psychoactive substances consumption

R. SILIQUINI, S. CHIADÒ PIAT, M.M. GIANINO, G. RENGA
Department of Public Health, University of Turin, Italy

Key words

Road accident • Psychoactive drugs • Emergency Room

Summary

Introduction. *The role played by psychoactive substances in road safety has become object of increasing interest: these substances can reduce driving performance and increase accidents risk. Aims of the study are to establish the dimension of the problem and to describe the characteristics of people involved in accidents under psychoactive substance effects.*

Methods. *Target population consists of people from 18 to 60 years old involved in accidents afferent in Emergency Rooms. Subjects were interviewed by surveyors and a urines was collected for psychoactive substances screening.*

Results. *In 18.5% of people we found substance consumption. Cocaine was the most frequently detected substance (9.5%), then*

benzodiazepines (7.5%), methadone, morphine and marijuana (THC) (3.5%). In 5.5% of subjects more then one substance was found. Considering only illegal substances detected, female have a higher risk to be consumers (OR = 1.36) and the young age (18-35 years) seems to be at higher prevalence and risk for substance use (OR = 1.86).

Discussion. *Considering all psychoactive substances detected, clearly the problem about substances consumption and driving is not restricted to youngest but involves all age groups.*

Conclusions. *In order to decrease the number of accidents due to substance use, new prevention programmes able to involve also middle age groups should be planned.*

Introduction

Many studies have already discussed the role of alcohol in impairing driving skills and increasing the accident risk [1-3] but only in the recent past, the role played by other psychoactive substances in road safety has become object of increasing interest [4, 5].

The use of marijuana (THC), cocaine, opiates, etc. can reduce driving performance [6-10]. Thus, the frequent use and misuse of these substances and related risk behaviours cannot be ignored in perspective to reduce the high costs related to road accidents [11-13].

Many reports have showed a growing and worldwide presence of psychoactive substances in drivers involved in road accidents [14-17].

In Norway there has been a marked increase in the number of drivers suspected of being influenced by drugs. The most commonly detected drugs are tetrahydrocannabinol, amphetamine, benzodiazepines, opiates while multi-drug use is frequently found; the presence of amphetamine and heroin is considerably increased [18].

A case-control study has showed, in France, a high prevalence of cannabis and opiate (licit or illicit) use in young drivers (aged 18 to 35) involved in road accidents; cocaine and amphetamines do not appear to be a major problem, unlike the experience in other countries [19].

In The Netherlands, the most frequently detected drugs in blood samples of 993 drivers involved in crashes were cannabinoids, benzodiazepines and cocaine [20].

A recent Australian study has reported an increasing prevalence of drugs in drivers killed in road traffic crashes, particularly cannabis and opiates [21].

Despite the considerable amount of data, the hypothesis that drug-taking drivers have an higher risk to be involved in road accidents has not yet been satisfactorily determined [22, 23]. Studying this phenomenon under experimental conditions is very complex [24] and the relationship between drug use and crash risk is still weak [25, 26].

Since in Piedmont Region (more than 4 millions inhabitants) annual mortality rate for road accident is 1.38/10,000, an evaluation of problem dimension was required in order to plan Public Heath interventions.

Aims of our study are to evaluate the consumption of psychoactive substances in subjects involved in road accidents, to describe the most related socio-demographic variables and to assess the risk thought a comparison with the prevalence of substance use in general population.

Methods

Piedmont is a North Western Italian Region, highly populated (4.3 millions inhabitants).

The target population consists of drivers 18-60 years old involved in road accidents and recruited in Hospital Emergency Rooms (ER).

In November 2005 we kept under observation three hospitals selected because of the presence of ERs of first and second level and their location close to the regional streets at major risk of road accidents. The study protocol was evaluated and approved by Hospitals' Ethical Review Boards.

Medical personnel, out of hospital members, has been specifically trained for conducting the study, but ERs staff has been informed about study aims and agreed to facilitate surveyors work.

Each subject admitted in ERs for the consequences of a road accident in Friday and Saturday night was identified by surveyors and a sample of urines was collected. All samples were screened with a Multi Drug stick: one step test device of different lateral flow chromatographic immunoassays for the qualitative detection of psychoactive substances metabolites in human urine at specific cut-off concentrations. The test device contains mouse monoclonal antibody-coupled particles and drug-protein conjugates.

The overall accuracy of the test is 93.25%. The accuracy is 96% for cannabinoids, 96% for cocaine metabolites, 100% for opiates and 81% for amphetamines [27].

Generally the cut-offs of the Multi Drug stick allow to detect a consumption happened within 48 hours. The substances detected were amphetamines (Cut Off Limit Value = 1,000 ng/mL), barbiturates (Cut Off Limit Value = 75 ng/mL), benzodiazepines (Cut Off Limit Value = 100 ng/mL), cocaine (Cut Off Limit Value = 700 ng/mL), ecstasy (Cut Off Limit Value = 300 ng/mL), methadone (Cut Off Limit Value = 300 ng/mL), methamphetamines (Cut Off Limit Value = 1,000 ng/mL), morphine (Cut Off Limit Value = 300 ng/mL), antidepressants (Cut Off Limit Value = 200 ng/mL) and THC (Cut Off Limit Value of 11-nor - Δ - THC – 9 COOH = 50 ng/mL). The results were read in 10 minutes by medical personnel: the substance presence was positive if no red line appeared in the specific test region of the device. At the same time an anonymous questionnaire was submitted to patients for collecting some socio-demographic data, driving habits and accident circumstances. If patients were sedated or unconscious, the same information was asked to friends or relatives. Finally, the same code, rigorously anonymous, was reported on questionnaire and on urine test result. Because of the anonymity of the data, and the non-invasivity of the test performed, no informed consent, following the Italian law, was asked. Since informed consent was not necessary, there were not missed urine samples. The ER personnel was not aware of the substance screening results. If screening for substance use was required by ER personnel for diagnostic and treatment reason, it followed a parallel path.

Statistical analysis of the data was conducted using SAS software. To describe the distribution of variables under study, proportions and 95% confidence intervals were calculated. In order to investigate the relation between socio-demographic variables and substance use, odds ratio and 95% confidence intervals were estimated [28].

Results

200 drivers involved in road accidents presented to ERs. 77.8% out of the 200 subjects were male. Almost half of the subjects (44.5%) belonged to 18-25 age group and 76%

belonged to 18-35 age group. The average age was 29.9 (DS ± 10.3). Regarding the age of driving licence, 33.5% had less then 5 years of driving history and 29.5% more then 10 years. The majority of the subjects (55.5%) got their driving licence less than 10 years before (Tab. I).

Tab. I. Socio-demographic variables of the study population (n = 200).

		n	%
Gender			
	male	156	77.8
	female	44	22.2
Age			
	18-35	152	76.0
	36-60	48	24.0
	18-25	89	44.5
	26-35	63	31.5
	36-45	33	16.5
	45-55	4	2.0
	> 55	11	5.5
Scholarity			
	no title	0	0
	primary school	4	2.0
	secondary school	56	28.0
	high school	89	44.5
	degree	15	7.5
	missing	36	18.0
Current occupation			
	student	19	9.5
	employed	122	61.0
	unemployed	4	2.0
	retired	0	0
	missing	55	27.5
Driving age			
	0-5 years	67	33.5
	6-10 years	44	22.0
	11-15 years	15	7.5
	> 15 years	44	22.0
	missing	30	15.0

Tab. II. Prevalence of psychoactive substance use detected in the study population (n = 200).

Total	n	%
No substance	163	81.5
Any substance	37	18.5
Amphetamines	0	0
Benzodiazepines	15	7.5
Cocaine	19	9.5
Ecstasy	0	0
Methadone	7	3.5
Methamphetamines	0	0
Morphine	7	3.5
Tricyclic Antidepressants	0	0
Marijuana	7	3.5

Table II shows the different psychoactive substances found in urine samples of subjects involved in accidents. In 18.5% of people, treated in ER after a road accident, we found substance consumption.

In eleven subjects (5.5%) a policonsumption was found. In Table III the different distribution of substances detected according to socio-demographic characteristics is shown. Between the consumers of cocaine and THC the major part (78.9% and 100%) belonged to 18-35 age group, while for benzodiazepines the major part of consumers belonged to 36-45 age group.

Comparing the use of any psychoactive substance and no use, females have a higher risk to be consumers then males (OR = 1.67, 95% CI = 0.69-3.97); younger subjects (18-35 age) have lower risk to be consumers than 36-60 age group (OR = 0.69, 95% CI = 0.29-1.66). The same situation was found for subjects with few years of driving licence age (data not shown).

Considering only illegal substances detected (all but benzodiazepines) females remain at higher risk (OR = 1.36, 95% CI: 0.48-3.77) but the young age (18-35) seems to be at higher prevalence and risk for substance use in people involved in vehicle accidents (OR = 1.86, 95% CI: 0.56-6.77) (data not shown).

In order to quantify the role of psychoactive substances in road traffic accidents we compared the prevalence of psychoactive substance use in the study population with the results of similar studies carried out in Europe.

A Dutch study collected information on drug use among 993 drivers 15-90 years old involved in road accidents [29] (Tab. IV). The consumption of cannabinoids (3.5% vs 17.0%, PR = 0.2) and benzodiazepines (7.5% vs

Tab. III. Socio-demographic characteristics of the population according to the psychoactive substances detection (n = 37).

	Total		Benzodiazepines		Cocaine		Methadone		Morphine		Marijuana	
	n	%	n	%	n	%	n	%	n	%	n	%
Total*	37	100.0	15	40.5	19	51.3	7	18.9	7	18.9	7	18.9
Sex												
male	26	70.3	11	73.3	19	100.0	7	100.0	4	57.1	4	57.1
female	11	29.7	4	26.7	0	0	0	0	3	42.9	3	42.9
Age												
18-35	26	70.3	4	26.7	15	78.9	3	42.9	7	100.0	7	100.0
36-60	11	29.7	11	73.3	4	21.1	4	57.1	0	0	0	0
18-25	11	29.7	4	26.7	4	21.1	0	0	0	0	4	57.1
26-35	15	40.6	0	0	11	57.8	3	42.9	7	100.0	3	42.9
36-45	11	29.7	11	73.3	4	21.1	4	57.1	0	0	0	0
45-55	0	0	0	0	0	0	0	0	0	0	0	0
> 55	0	0	0	0	0	0	0	0	0	0	0	0
Driving licence age												
0-5 years	11	29.7	4	26.7	4	21.0	0	0	0	0	4	57.1
6-10 years	4	10.8	0	0	4	21.0	0	0	0	0	0	0
11-15 years	11	29.7	4	26.7	4	21.0	0	0	4	57.1	3	42.9
> 15 years	4	10.8	4	26.7	0	0	0	0	0	0	0	0
others	7	19.0	3	19.9	7	37.0	7	100.0	3	42.9	0	0

* the total amount of psychoactive substances detected is > 100% because some subjects are poly-abusers

Tab. IV. Comparison between the prevalence of psychoactive substance use in our study population and in Dutch and French study population.

Psychoactive substances	Use in our study population (%)	Use in Dutch study population (%) [29]	Use in French study population (%) [30]	Prevalence Ratio (Italy - France)	Prevalence Ratio (Italy-Netherlands)
Marijuana	3.5	17.0	13.9	0.2	0.3
Cocaine	9.5	7.0	1.0	1.4	10.0
Opioids	3.5	4.0	10.5	0.9	0.4
Benzodiazepines	7.5	10.0	—	0.7	—

10.0%, PR = 0.7) in subjects treated in ER after a road accident is lower than the consumption in the Dutch study population while the ratio is inverted if we consider cocaine (9.5% *vs* 7.0%, PR = 1.4); for opioids (3.5% *vs* 4.0%, PR = 0.9) the consumption is quite similar.

Considering the comparison with French study data, where the population was constituted of 296 drivers 18-35 years old involved in road accidents [30] (Tab. IV), the consumption of cannabinoids (4.0% *vs* 13.9%, PR = 0.3) and opioids (4.0% *vs* 10.5%, PR = 0.4) in Italy seems lower the ratio is inverted for cocaine (10.0% *vs* 1.0%, PR = 10.0).

Discussion

A cross-sectional study has been conducted on a sample of 200 persons involved in road accidents in order to describe the prevalence of psychoactive substance use.

The device used for assessing the substance use is a on site screening urine test: these drug sticks are normally less sensitive than chromatographic methods but, on the other hand, they are less expensive, do not need sophisticated instrumentation, can be used also in a not sanitary setting and by not specialized personnel [27, 31].

The overall accuracy of this kind of device is not 100%, so false positive and false negative are sometimes identified. Thus such devices need to be used with caution because a rapid but unconfirmed result may lead to misdiagnosis and inappropriate treatment [31, 32].

Nonetheless for our study purpose, where population is completely anonymous and the results of drug test are not used for clinical reasons, we think that the 93% accuracy of the device is balanced by the easiness of the performance [33].

Generally speaking urine test is weak compared to blood one: detection time of drug in blood/serum/plasma is at least half of the detection time in urine [34] and the risk is to overestimate the role of substances in road accidents.

In our study, we evaluated only urine samples because blood ones would have required (as invasive technique) a formal consent that could lead to an objective difficulty in obtaining informed consent from consumers involved in road accidents. Clearly they aim to protect themselves from legal problems. Thanks to the anonymity of data and the utilization of not invasive techniques, no informed consent was required by Italian law and we did not select the population missing the substances users.

Moreover the detection time is influenced by many factors: doses, route of administration, acute *vs* chronic consumption, cut-off of the analytical technique and, often, there are many differences among countries and also laboratories in the use of cut-off values [35].

The cut-off for the different substances of the device used is enough high to detect a consumption happened within the former 36-48 hours. These levels of substances in urine sample are considered dangerous by Italian Street Code and also by the majority of the other European legislations. For these reasons many countries use non-instrumented urine drug testing devices for on-site.

Even if the study design can produce only hypothesis about the quantitative correlation between psychoactive substances consumption and road accidents, the results offer a real framework of the week-end road accidents. The limited number of hospitals included could be a limit of the study design, but data previously collected showed that 80% of people involved in road accident in our Region refers to these 3 ER.

The period of the year considered and the day time monitored by the study can also be predictive, according to the Regional data collected, for a representative and not selected sample of the week-end population involved in road accidents.

The major part (77.8%) of drivers involved in road accidents were men and young and this fact reflects the Italian percentage of men driving and young using cars during week-end nights.

Obviously, for the young age, the major part of subjects has a short driving history.

The results show a very high percentage (18.5%) of subjects that have previously taken psychoactive substances. These data, taking in consideration the limitations of the study, could underestimate the dimension of the problem: the percentage of subjects consuming alcohol is probably higher and extremely worrying.

The comparison between our study and other similar in other countries (Netherlands and France) shows that our drivers involved in road accident seem to have an higher risk of cocaine consumption.

Considering separately the different psychoactive substances in our pattern, the prevalence of cocaine reflects a shift towards new substances compared to the recent past [36, 37], while the high percentage of benzodiazepines detected (7.5%) shows that use of legal psychoactive substances is really diffused in general population.

Even if the results are not significant due to the limited sample, it's clear that the problem about psychoactive substances consumption and driving is not restricted to youngest but involves all age groups, with higher risk for subjects older than 35 years with a longer driving history.

Conclusions

We can argue that a culture of responsibility toward substances consumption and driving is not yet completely absorbed by the population, even if the law in Italy is particularly severe. It seems that youngest persons, perhaps because the prevention programs are mostly focused on them, obey the law to a greater extent. Also the massive and uncontrolled use of benzodiazepines and cocaine (too expensive for younger persons) shifts the substance consumption towards older age groups.

In order to decrease the number of road accidents partially or completely due to substance use, new prevention programmes able to awake also middle age groups should be planned.

Furthermore other studies should be carried out for estimating the problem dimension also during the week days when the population of drivers is more representative of general population.

Acknowledgements

References

[1] Ostrom M, Eriksson A. *Single-vehicle crashes and alcohol: a retrospective study of passenger car fatalities in northern Sweden*. Accid Anal Prev 1993;25:171-6.

[2] Reynaud M, Le Breton P, Gilot B, Vervialle F, Falissard B. *Alcohol is the main factor in excess traffic accident fatalities in France*. Alcohol Clin Exp Res 2002;26:1833-9.

[3] Keall MD, Frith WJ, Patterson TL. *The contribution of alcohol to night time crash risk and other risks of night driving*. Accid Anal Prev 2005;37:816-24.

[4] Kruger HP, Bud MW, Huessy FB, Mettke M. *Illicit drugs in road traffic: overview of the legal provisions, difficulties faced by police, and analysis of prevention attempts in selected European countries*. Strasbourg: Road Traffic and Drugs, Council of Europe 1999, p. 63-85.

[5] Holmgren P, Holmgren A, Ahlner J. *Alcohol and drugs in drivers fatally injured in traffic accidents in Sweden during the years 2000-2002*. Forensic Sci Int 2005;151:11-7.

[6] Honkanen R, Ertama L, Linnoila M. *Role of drugs in traffic accidents*. Br Med J 1980;281:1309-12.

[7] Ramaekers JG. *Behavioural toxicity of medicinal drugs. Practical consequences, incidence, management and avoidance*. Drug Saf 1998;18:189-208.

[8] Riedel WJ, Vermeeren A, Van Boxtel MPJ, Vuurman EFP, Verhey FRJ, Jolles J, et al. *Mechanisms of drug-induced driving impairment: a dimensional approach*. Hum Psychopharmacol Clin Exp 1998;13:S49-63.

[9] Morland J. *Driving under the influence of non-alcohol drugs*. Forensic Sci Rev 2000;12:80-105.

[10] Movig KL, Mathijssen MP, Nagel PH, van Egmond T, de Gier JJ, Leufkens HG, et al. *Psychoactive substance use and the risk of motor vehicle accidents*. Accid Anal Prev 2004;36:631-6.

[11] Webb E, Ashton CH, Kelly P, Kamali F. *Alcohol and drug use in UK university students*. Lancet 1996;348:922-5.

[12] Siliquini R, Faggiano F, Geninatti S, Versino E, Mitola B, Ippolito R. *Patterns of drug use among young men in Piedmont (Italy)*. Drug Alcohol Depend 2001;64:329-35.

[13] Kelly E, Darke S, Ross J. *A review of drug use and driving: epidemiology, impairment, risk factors and risk perceptions*. Drug Alcohol Rev 2004;23:319-44.

[14] Walsh JM, Flegel R, Cangianelli LA, Atkins R, Soderstrom CA, Kerns TJ. *Epidemiology of alcohol and other drug use among motor vehicle crash victims admitted to a trauma center*. Traffic Inj Prev 2004;5:254-60.

[15] Wylie FM, Torrance H, Seymour A, Buttress S, Oliver JS. *Drugs in oral fluid Part II. Investigation of drugs in drivers*. Forensic Sci Int 2005;150:199-204.

[16] Walsh MJ, Flegel R, Atkins R, Cangianelli LA, Cooper C, Welsh C, et al. *Drug and alcohol use among drivers admitted to a Level-1 trauma center*. Accid Anal Prev 2005;37:894-901.

[17] Giovanardi D, Castellana CN, Pisa S, Poppi B, Pinetti D, Bertolini A, et al. *Prevalence of abuse of alcohol and other drugs among injured drivers presenting to the emergency department of the University Hospital of Modena, Italy*. Drug Alcohol Depend 2005;80:135-8.

[18] Christophersen AS, Morland J. *Drugged driving, a review based on the experience in Norway*. Drug Alcohol Depend 1997;47:125-35.

[19] Marquet P, Delpla PA, Kerguelen S, Bremond J, Facy F, Garnier M, et al. *Prevalence of drugs of abuse in urine of in France: a collaborative study*. J Forensic Sci 1998;43:806-11.

[20] Smink BE, Ruiter B, Lusthof KJ, de Gier JJ, Uges DRA, Egberts ACG. *Drug use and the severity of a traffic accident*. Accid Anal Prev 2005;37:427-33.

[21] Drummer OH, Gerostamoulos J, Batziris H, Chu M, Caplehorn JRM, Robertson MD, et al. *The incidence of drugs in drivers killed in Australian road traffic crashes*. Forensic Sci Int 2003;134:154-62.

[22] Del Rio MC, Alvarez FJ. *Illegal drugs and driving*. Traffic Med 1995;23:1-5.

[23] Del Rio MC, Alvarez FJ. *Presence of illegal drugs in drivers involved in fatal road traffic accidents in Spain*. Drug Alcohol Depend 2000;57:177-82.

[24] Ramaekers JG, Robbe HWJ, O'Hanlon JF. *Marijuana, alcohol and actual driving performance*. Hum Psychopharmacol Clin Exp 2000;15:551-8.

[25] Longo MC, Hunter C, Lokan RJ, White JM, White MA. *The prevalence of alcohol, cannabinoids, benzodiazepines and stimulants amongst injured drivers and their role in driver culpability. Part I: The prevalence of drug use in drivers, and characteristics of the drug-positive group*. Accid Anal Prev 2000;32:613-22.

[26] Mura P, Kintz P, Ludes B, Gaulier JM, Marquet P, Martin-Dupont S, 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.

[27] Byrne AG, Pierce A. *Evaluation of six point of care tests for drugs of abuse in urine*. Int Assoc Forensic Toxicologists Bull 2003;33:69-75.

[28] Armitage P, Berry G. *Statistical methods in Medical Research, Second Edition*. Cambridge: Blackwell Scientific Publication 1987.

[29] Smink BE, Ruiter B, Lusthof KJ, de Gier JJ, Uges DRA, Egberts ACG. *Drug use and the severity of a traffic accident*. Accident Analysis and Prevention 2005;37:427-33.

[30] Marquet P, Delpla PA, Kerguelen S, Bremond J, Facy F, Garnier M, et al. *Prevalence of drugs of abuse in urine of in France: a collaborative study*. J Forensic Sci 1998;43:806-11.

[31] Leino A, Saarimies J, Gronholm M, Lillsunde P. *Comparison of eight commercial on-site screening devices for drugs-of-abuse testing*. Scand J Lab Invest 2001;61:325-32.

[32] S. George S, Braithwaite RA. *Use of On-site testing for drugs of abuse*. Clin Chem 2002;48:1639-46.

[33] De La Torre R, Domingo-Salvany A, Badia R, Gonzalez G, Mc-

Farlane D, San L, et al. *Clinical evaluation of the Triage analytical device for drugs-of-abuse testing*. Clin Chem 1996;42:1433-8.

[34] Verstraete AG. *Detection times of drugs of abuse in blood, urine and oral fluid*. Ther Drug Monit 2004;26:200-5.

[35] Badia R, De La Torre R, Corcione S, Segua J. *Analytical approaches of European Union laboratories to drugs of abuse analysis*. Clin Chem 1998;44:790-9.

[36] Bellis MA, Hughes K, Bennett A, Thomson R. *The role of an international nightlife resort in the proliferation of recreational drugs*. Addiction 2003;98:1713-21.

[37] Zuccato E, Chiabrando C, Castiglioni S, Calamari D, Bagnati R, Schiarea S, et al. *Cocaine in surface waters: a new evidence-based tool to monitor community drug abuse*. Environmental Health 2005;4:14.

■ Correspondence: Roberta Siliquini, Department of Public Health, University of Turin, via Santena 5 bis, 10126 Turin, Italy - Tel. +39 011 6705875 - Fax +39 011 6705889 - E-mail: roberta.siliquini@unito.it