

Road accidents, alcohol, and drugs: An Emergency Room study in Florence, Italy

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This article describes the potential contribution of alcohol and illicit drugs to increased risk of road accidents in Italy. Blood and urine samples were taken from patients admitted to five Emergency Rooms (ER) in metropolitan Florence, Italy, due to road traffic accidents within 3 hours of the accident. Seven hundred and thirty-five patients were tested to determine if alcohol and illicit drugs (amphetamines, opiates, cocaine, methadone, and cannabis) were present in urine and blood. Approximately 22% of patients were positive for at least one substance at night-time (20:00 to 5:59), and 18% were positive on the weekends (20:00 Friday to 05:59 Monday). Almost 80% of all alcohol-positive patients had a blood-

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alcohol concentration (BAC) equal to or exceeding the legal limit. Findings indicated that alcohol and illicit drugs were important contributors to traffic accident risk and suggest prevention strategies for alcohol-related road accidents in Italy may need to follow those employed in other countries, including frequent and highly visible enforcement of drunk-driving laws.

KEY WORDS: *Road accidents, alcohol, psychoactive drugs, epidemiological study, BAC and emergency department, illicit drugs.*

Road traffic injuries are a major cause of mortality and morbidity in the Western world, and the relative contribution of alcohol to road traffic accidents has been well documented in many international studies (World Health Organization, 2008). According to findings from several studies, alcohol-involved traffic accidents comprise at least one fifth of all traffic accidents (McLeod, Stockwell, Stevens & Phillip, 1999; Movig et al., 2004) and at least one third of all fatal traffic accidents (Athanaselis et al., 1999; NIAA, 2003; Drummer et al., 2004; Connor, Norton, Ameratunga, & Jackson, 2004). Alcohol-involved road traffic accidents are typically associated with more severe injuries and fatalities (Fabbri et al., 2002; Connor et al., 2004; World Health Organization, 2008) and higher blood-alcohol concentrations (BACs) associated with fatal accidents (Holubowicz, Klaeden, & McLean, 1994; del Rio, Gomez, Sancho & Alvarez, 2002; NIAA, 2003). Road accidents in which one or more drivers had been drinking are also more likely to occur late at night and early morning as well as on weekends, times associated with periods of drinking (Peppiat, Evans, & Jordan, 1978; Schepens et al., 1998; Fabbri et al., 2002; Soffer et al., 2006; Puljula, Savola, Tuomivaara, Pribula, & Hillbom, 2007).

Although other factors such as weather, speed, and traffic patterns also contribute to road accidents, alcohol and illicit drugs increase the risk of road accidents due to their potential

to impair the skill and judgment of drivers. Much less is known about the contribution of licit and illicit drugs to the etiology of road accidents (Movig et al., 2004; Ronen et al., 2008); however, a positive correlation of cannabis (THC) use with road accidents was found when cannabis was consumed simultaneously with alcohol (Robbe & O'Hanlon, 1993; Brookoff, 1998; Ramaekers, Robbe & O'Hanlon, 2000; Lowenstein & Kaziol-McLain, 2001).

The contribution of alcohol to road accidents is reported to vary across drinking cultures (Skog, 2001; Cherpitel et al., 2003) and the level of alcohol-related risk has been shown to be related to different drinking patterns (see Norström, Hemström, Ramstedt, Rossow & Skog, 2002). In Southern European countries, and particularly Italy, alcoholic beverages (especially wine) are often consumed daily during the week with meals. In this context, control of alcohol consumption and driving have often relied on the informal social control of drinking patterns, including control of heavy drinking (Simpura, 1998; Allamani & Prina, 2007).

Road accidents and drinking and driving in Italy

The Italian National Institute for Health Statistics (ISTAT) reported low rates for alcohol-related road accidents until 2008, after which these data were no longer collected. In 2008 alcohol-related road accidents accounted for 2.1% of all road accidents (ISTAT, 2009). Such rates were lower than those found in other countries (McLeod et al., 1999; Movig et al., 2004) and are potentially explained by the fact that alcohol involvement at the time of accident was subjectively attributed by police and not based on independent BAC testing. More in keeping with the aforementioned international literature, some forensic mortality studies report that alcohol is responsible for at least one third of all fatal road accidents in Italy (Sironi, Molendini, Bernabei, & Marozzi, 1999; Bernini, Conti, De Ferrari, Fornaciari, & Saligari, 2000). A study in Northern Italy reported 30.4% of 1,399 drivers stopped on the road during night-time

on summer weekends between 1994 and 1997 on suspicion of excessive drinking had a BAC over 0.8 g/l (Ferrara et al., 2000).

Findings from a pilot study conducted in 2000-2001 in the Emergency Room (ER) of a metropolitan hospital in Florence showed that, among 70 people admitted for road accidents, 11.4% were BAC positive, and 19.1% were positive for alcohol and/or other drugs (Bardazzi et al., 2003). Another study on the presence of alcohol and drugs detected in urine in 100 ER patients involved in road accidents in Verona, Northern Italy, in 2006 (Ricci et al., 2008) found that 43% tested positive for alcohol, drugs, or both. This unexpectedly high prevalence may be explained by the use of urine for drug detection rather than blood, as well as the exclusive focus on only severe cases with a prognosis of injury duration of ≥ 7 days.

Another study investigating 2,354 patients admitted after a road traffic crash in 1998 to one ER in Forlì, Northern Italy, reported 18.5% were BAC positive (Fabbri et al., 2002). This study also showed, in keeping with the international literature, that BAC patients presented three times more frequently at night-time than during the day, and BAC presentations were almost twice as frequent during weekend nights. This study utilized data from blood drawn from trauma patients, including patients who died within 24 hours after admission to ER, and patients mostly transported to ER by ambulance, biasing the sample to more serious injuries and potentially those who might be expected to have higher BAC levels.

We report findings from an epidemiological study of five emergency departments in the Florence Health Agency covering the metropolitan area of Florence (813,077 inhabitants in 2009). Florence, the main city in the region of Tuscany in central Italy, is closely representative of Italy in terms of amounts and the patterns of drinking (Scafato, Ghirini, Galluzzo, Farchi, & Gandin, 2009). Overcoming limitations of previous Italian research, this study is one of few to collect blood (in contrast to breath) samples from the general popu-

lation of injury patients (in contrast to more seriously injured trauma patients only) and that analyzed these specimens for the presence of alcohol as well as other drugs.

Study design, aim, and methods

The study aims were: (a) to describe the extent of alcohol consumption and illicit drug intake among people who recently had a road accident and were treated in an ER in Florence; and (b) to investigate the relationship between road accidents and consumption of alcohol and illicit drugs. In keeping with recent publications, only illicit drug use was used as a drug-related exposure (Ronen et al., 2008).

The study was conducted in collaboration with a number of institutions, including: (a) the Municipality of Florence; (b) the Epidemiological Unit of the Tuscan Regional Health Agency; (c) the Forensic Toxicological Laboratory of Careggi Hospital, University of Florence; and (d) the Florentine branch of two nationwide road accident insurance companies. The study protocol was approved by the Florence Health Agency's Ethics Committee.

ERs are important sites to collect data on people injured as a result of road accidents. Italian ERs are located inside general hospitals that are usually coordinated with community health services (like ambulance services) that may provide first aid and transfer a patient from the road to the hospital. Ambulance service physicians (mainly anesthesiologists) are on call, and when there is a major road accident they attend the accident site to provide emergency treatment. There are also a large number of patients who "walk in" to the ER on their own for a number of diseases, among them minor road accident injuries. These patients are also included in this study.

The study was conducted in all the five ERs of metropolitan Florence: two are part of community hospitals (ER1—Santa Maria Nuova; ER2—Nuovo San Giovanni di Dio) in the Flo-

rence Health Agency; a third (ER3) is located within Careggi, the main hospital in the greater Florence area, where the most severe traumas are referred, while the fourth (ER4—Centro Traumatologico Ortopedico) is a trauma center, where people with a wide range of accidents are treated. The fifth hospital ER (ER5—Borgo San Lorenzo) is located in a town of 18,000 inhabitants about 35 kilometers north of Florence.

In ERs 1-4 data were collected between December 2003 and May 2005, with two interruptions (July-August 2004 and December 2004-January 2005) due to temporary problems in the recruitment of health professionals for the research tasks in the ER. The collection of data in ER5 was undertaken between June and September 2007. This delay was due to administrative reasons (new elections and turnover of the province of Florence Counselors, who funded the project).

The sample consisted of participants aged 18 years and over consecutively admitted to each ER in metropolitan Florence due to road accidents during a single hospital shift (either “morning” or “afternoon” or “night”) over a 3-month period. To adequately detect alcohol and other substances potentially affecting the occurrence of the road accident, only patients with an injury that had occurred no more than 3 hours earlier were included in the study. One or two health professionals were assigned for each ER (seven physicians and two nurses) for 3 months; their task was to approach patients, interview them, and take blood. Health professionals were recruited for the morning shifts (6:00-12:59) during the first week, afternoon shifts (13:00-19:59) in the second week, and night shifts (20:00-5:59) in the third week. The study covered 5 mornings, 4 afternoons, and 4 nights during the 3-month period, with an overrepresentation of morning shifts.

After informed consent was obtained, blood and urine samples were taken from each patient to determine the presence of alcohol and/or illegal drugs. The latter were identified as cannabis metabolites, opiates, cocaine, and amphetamines, considered the most relevant substances to investigate accord-

ing to the road-traffic accident literature (Movig et al., 2004; Ronen et al., 2008). Informed consent was not asked in the cases of 15 severely injured patients, where the ER practice required taking both urine and blood samples for investigation of alcohol and illicit drugs. Data on gender, age, marital status, type and severity of injury, as well as a description of the accident (hour of the day and category of vehicle) were obtained from the hospital database; if this information was incomplete, data was supplemented by a brief interview with participants by the research personnel (complete data was available for all severely injured patients). Subject anonymity was maintained by use of coded numbers.

Patients admitted to ERs 3-5, and who were not severely injured, were also asked to complete a face-to-face questionnaire that included questions about the interviewee's average daily intake of alcohol and whether they attributed the accident to alcohol. The questionnaire was based on a standard lifestyle questionnaire currently used in population surveys in Tuscany (Allamani et al., 2003).

Blood and urine samples were stored in a freezer within the ER, then transported to the Forensic Toxicological Laboratory of Careggi Hospital, University of Florence, where they were later analyzed. Urine samples were screened initially for active components of amphetamines, opiates, cocaine, methadone, and cannabis using enzyme-linked toxicological immunoassay methods, pH-specific and solvent extraction (liquid/liquid), and a gas chromatography/mass spectrometry for the amphetamines and their derivatives. If samples returned positive screening results, these were verified by extraction techniques specific for the single molecules (liquid/liquid or otherwise solid/liquid) successively identified by gas chromatography/mass spectrometry. The blood samples were divided into two lots: (a) one to detect and measure the presence of ethyl alcohol by means of the head-space gas chromatography method, and automatic injection of samples preheated by means of an appliance equipped with a thermostat; and (b) one to detect

and measure the active presence of the illicit drug molecules specific to the positive urine sample; in this case the specific extracting technique for single molecules (liquid/liquid or otherwise solid/liquid on capillary columns) was used and successive identification and quantification were carried out using gas chromatography/mass spectrometry testing instruments. Since illicit drug metabolites may be detected in the urine some days after their use, an individual whose urine, for example, was positive for cannabis, was confirmed by blood tests to detect active molecules to assess driving impairment at the time of the accident. In keeping with the Italian Forensic Toxicologist guidelines, cut-off level for detecting blood THC was 2 ng/ml, blood cocaine and methadone was 10 ng/ml, blood amphetamine was 20 ng/ml, and blood alcohol was 0.05 gr/liter.

In addition to participants without alcohol or drug impairment detected, data were analyzed according to three groups of participants testing positive: (a) BAC positive (with and without positivity for illegal drugs), (b) illegal drug positive (with and without alcohol positivity), and (c) positive for alcohol and/or illegal drugs (i.e., participants testing BAC positive only, illegal drug positive only, and positive for both alcohol and illegal drugs—at least one substance was present in their blood at the moment of their admission to ER).

Severity of injuries in ERs is usually classified according to five severity codes: red (higher severity), yellow, green, blue, and white (lower severity); ERs in this study adopted this categorization and not more detailed injury scales, such as the AIS and NISS (Osler, Baker & Long, 1997). For the purpose of our analyses, the number of severity classes was reduced to three: higher severity (corresponding to red and yellow codes), moderate (corresponding to the green code) and low (corresponding to the blue and white codes).

Chi-square analyses were conducted to assess univariate relationships between alcohol/illicit drug positivity and (a) day of admission to the ER (weekend and weekday); (b) time of day of

admission to the ER (20:00–05:59 and 06:00–19:59); (c) severity of injury (high, moderate and low severity); and (d) age and gender of patients referred to ER for road accidents during the study period. Furthermore, age and gender adjusted logistic regression models examined associations between alcohol and drug-positive subjects, day of admission, time of day of admission, and severity of injury. Data were analyzed using SPSS Statistical Analysis System, version 13.0.

Results

During the period of the study, 997 injured patients 18 years old and over admitted to five ERs in Florence after a road accident were contacted to participate in the study, of which 735 (73.7%) consented to participate and provided blood and urine samples. Participants were 62% male, with an average age of 38.1 years (range 18 to 85 years); 49.6% were married or cohabitants, and 50.4% were single, divorced or widowed.

Nonparticipants did not differ from participants by gender ($p = 0.505$); however, there was a statistically significant difference in age (greater proportion of participants aged > 55 years) and marital status (greater proportion of participants married or cohabitating with a partner) (Table 1).

TABLE 1 **Respondents ($N = 735$) and nonrespondents ($N = 262$). Study sample of injured persons who were admitted to five emergency rooms in Florence, Italy, due to road accidents, during 2003–2007 according to gender, marital status, and age class**

	<i>Respondents</i>	<i>Non Respondents</i>	<i>P</i>
<i>Females</i>	279/735 (38.0%)	100/262 (38.2%)	0.505
<i>Married/cohabitant</i>	252/508 (49.6%)	65/171 (38.0%)	0.005*
<i>Age classes</i>			
18–25 years	171/732 (23.4%)	68/261 (26.1%)	0.012*
26–35 years	213/732 (29.1%)	83/261 (31.8%)	
36–55 years	232/732 (31.7%)	90/261 (34.5%)	
> 55 years	116/732 (15.8%)	20/261 (7.7%)	

* Statistically significant ($p < 0.05$)

Among all participants, 70 (9.5% of all participants) were blood test positive for alcohol and/or illegal drugs (i.e., at least one substance was present in their blood at the moment of their admission to ER). Nine participants (13% of the 70 alcohol and/or illegal drugs positive participants) were positive both for alcohol and drugs. Fifty-two participants (7.1% of all participants) were BAC positive (17% also positive for drugs). Among the fifty-two BAC positive cases, 78.8% had a blood-alcohol concentration that matched or exceeded the legal limit (BAC equal or above 0.5 g/l). Twenty-seven participants (3.7% of all participants) were positive for drugs (33% also positive for alcohol); drug types were evenly distributed among cocaine (33.3%), THC (33.5%), and opiates (33.3%).

Males were more likely to test positive for alcohol and/or illegal drugs (12.5%) compared to females (4.7%), and more likely to test positive for alcohol, 9.9% compared to 2.5%, respectively. There was no difference in substance positivity across age groups. Participants aged 18-25 years and 36-55 years were most commonly admitted to the ER due to road accidents involving either alcohol and/or drugs (Table 2). Participants who were positive and nonpositive for alcohol and/or illegal drugs had comparable percentages by age group (data not shown).

There were no significant differences in participants testing positive for alcohol and/or illegal drugs across traffic categories. Cyclists and pedestrians (8.4%) and vehicle drivers and passengers (automobile and motorcycle/moped, 9.4% and 9.9%, respectively) had notable levels of alcohol and/or illicit drugs. Notable proportions of vehicle drivers/passengers (8.8%) and pedestrian/cyclists (8.4%) were also BAC positive. Passengers and drivers were grouped together since, at least for cars, passengers and drivers were substance-affected in relatively equal amounts (Table 2).

Low-severity cases were 50.2% and high severity cases were 14.5% of all the cases. There was a significant association between alcohol and/or illegal drugs and severity of injury,

with a larger proportion of high-severity injuries (18.4%) compared to moderate (6.4) and low-severity injuries (7.6%) associated with alcohol and/or illegal drugs (Table 2).

The percentage of injury patients during the weekends (20:00 Friday to 05:59 Monday) who were positive for alcohol and/or illicit drugs, compared to injury patients during the rest of the week, was 17.6% compared to 6.8%. Road accident patients who were alcohol positive on the weekend comprised 15.9% of respondents compared to 4.0% on weekdays. Both differences were statistically significant. Regarding the distribution of accidents by time of day and days of week among all accidents occurring during the day (i.e., 06:00 to 19:59), 5.9% were positive for alcohol and/or illegal drugs and 3.5% for alcohol. However, 22.1% of all accidents occurring at night (i.e., 20:00 to 5:59) were positive for alcohol and/or drugs, while 19.6% were positive for alcohol alone; the difference in positivity between night and day was statistically significant (Table 2). More specifically, 25.6% of participants injured during the weekend between 20:00 and 5:59 and the majority (61%) of participants injured on the weekend were positive for alcohol and/or illicit drugs (data not shown).

Table 3 shows odds for day of admission, time of day, and severity of injury, adjusted for age and gender. Compared to weekdays, admissions on weekends were over three times more likely to involve alcohol and/or illegal drugs. Compared to daytime, admissions at night were over four times more likely to involve alcohol and/or illegal drugs. Compared to low severity of injury, high-severity injury admissions were over two-and-a-half times more likely to involve alcohol and/or illegal drugs (Table 3).

A subsample of 567 road injury patients in two ERs were asked to answer face-to-face questions regarding the interviewee's usual daily intake of alcohol and whether (s)he attributes the accident to alcohol consumed before the accident; 401 (70.7%) consented to complete surveys and 343 agreed to have their blood taken. The average per day consumption of

TABLE 2

Patients who were positive (a) for alcohol and/or illegal drugs, and (b) separately for alcohol and for illegal drugs, in the sample of people admitted to five emergency rooms in Florence, Italy, during 2003-2007, due to road accidents, by age group, gender, traffic category, severity of injury, days of week and time of day of admission to ER (N = 735)

		Respondents	Positive for Alcohol and/or illegal Drugs	Alcohol Positive	Illegal Drug Positive
<i>Gender</i>					
Total		735	<i>Age Groups</i>		
M		456	70 (9.5)	52(7.1)	27(3.7)
F		279	57(12.5)	45(9.9)	19(4.2)
			13 (4.7)	7(2.5)	8(2.9)
	<i>P-value</i>		< 0.001*	< 0.001*	0.424
Total		732	<i>Age</i>		
18-25		171	69 (9.4)	52(7.1)	26(3.6)
26-35		213	18(10.5)	13(7.6)	7(4.1)
36-55		232	19 (8.9)	13(6.1)	10(4.7)
55		116	24(10.3)	19(8.2)	8(3.4)
			8 (6.9)	7 (6)	1(0.9)
	<i>P-value</i>		0.475	0.568	0.576
Total		719	<i>Traffic category</i>		
Pedestrian, cyclist		95	68(9.5)	51(7.1)	25(3.5)
Car driver, car passenger		294	8(8.4)	8(8.4)	0(0)
Motorcycle/moped driver/passenger		330	29(9.9)	26(8.8)	9(3.1)
			31(9.4)	17(5.2)	16(4.8)
	<i>P-value</i>		0.915	0.173	0.066

Total High Moderate Low	<i>Severity of injury</i>		
	711	62 (8.7)	49(6.9)
	103	19(18.4)	13(12.6)
	251	16 (6.4)	16(6.4)
	357	27 (7.6)	20(5.6)
<i>P-value</i>		0.003*	0.043*
Days of week of admission to ER			
Total weekend weekdays	735	70 (9.5)	52 (7.1)
	188	33(17.6)	30(16.0)
	547	37 (6.8)	22 (4.0)
<i>P-value</i>		< 0.001*	< 0.001*
Time of day of admission to ER			
Total 20:00-5:59 6:00-19:59	735	70 (9.5)	52 (7.1)
	163	36(22.1)	32(19.6)
	572	34 (5.9)	20(3.5)
<i>P-value</i>		< 0.001*	< 0.001*

* Statistically significant ($p < 0.05$)

TABLE 3

Patients who were positive for alcohol and/or illegal drugs, in the sample of people admitted to five emergency rooms in Florence, Italy, during 2003-2007. Odds ratio for day of admission to ER, time of day of admission to ER, and severity of injury, adjusted for age and gender

<i>Variable</i>		<i>OR</i>	<i>CI 95%</i>	<i>Reference</i>
	Weekend	3.016	1.813-5.018*	Weekday
<i>Day of admission to ER</i>	Female	0.33	0.175-0.621*	Male
	Age	0.992	0.975-1.009	
<i>Time of day of admission to ER</i>	20:00-5:59	4.307	2.581-7.189*	6:00-19:59
	Female	0.368	0.194-0.698*	Male
	Age	0.998	0.980-1.015	
<i>Severity of injury</i>	Moderate	0.95	0.518-1.743*	Low
	High	2.6	1.379-4.900*	
	Female	0.347	0.184-0.654*	Male
	Age	0.987	0.968-1.005	

* Statistically significant ($p < 0.05$)

alcohol beverages was 13 grams per capita and 18 participants (5.2%) were BAC positive. Among the BAC positive participants, 56.3% reported their usual intake of alcohol was an average of 20 or less grams of alcohol per day and 43.7% more than 20 grams of alcohol per day (range, 21 to 95 grams). Among the 325 (85.5%) who were BAC negative, 86.6% reported their usual intake of alcohol was an average of 20 or less grams of alcohol per day and 13.4% reported more than 20 grams of alcohol per day. No BAC positive respondents believed that drinking had anything to do with their road accidents.

Discussion

This study was based on the general Emergency Room populations of five hospitals in the Florence province and provides new data on the epidemiology of alcohol and drug involvement in road accidents in Italy. The study is based on blood

testing and thus gives more accurate assessments of the level of alcohol than breath tests or self-report and offers a rare opportunity to document the presence of drugs among patients injured in road accidents in Italy.

The percentage of injury patients who were positive for alcohol and/or drugs and for alcohol alone was significant and suggests alcohol, and to some extent drugs, are important contributors to the risk of traffic-crash injury in one Italian metropolitan area considered representative of drinking patterns in other Italian regions (Scafato et al., 2009). In comparison to other studies conducted in Northern Europe or in English-speaking countries (McLeod et al., 1999; Movig et al., 2004), the proportion of this sample testing positive for alcohol (7.1%) appears low; however it is similar to other ER road accident samples that were alcohol positive from other Mediterranean countries, such as Greece (7.9%), France (10.6%), and previous studies in Florence (11.4%) (Petridou et al., 1998; Kintz, Cirimele, Mairot, Muhlmann, & Ludes, 2000; Bardazzi et al., 2003). The Italian study in Forlì (Fabbri et al., 2002) found higher rates, with 18.5% of BAC positive ER traffic-accident patients testing positive for alcohol; however this study collected data from patients with more serious traumas than those observed in a general ER, as was the case in our study.

Almost 80% of all alcohol-positive patients had a BAC equal to or exceeding the legal limit (0.5 g/l) at the time of admission to ER. The finding that about half of the respondents to the questionnaire who were found BAC positive reported drinking more than 20 grams of alcohol per day on average suggests that they were habitually hazardous drinkers. On the other hand, drinkers of 20 grams or less per day could be considered more moderate drinkers and may be more careful about the effect of alcohol on driving.

The categories at risk of harm due to use of alcohol and other drugs were almost equally distributed among car drivers/passengers and motorcycle and moped drivers/passengers, even with a

more notable contribution of illegal drugs to the latter. It is important to note that motorcycle and moped drivers and passengers represented nearly half of those injured in road accidents. These findings make motorcycle and moped accident traumas involving alcohol and/or illicit drugs a special concern for prevention in Florence.

Young adults (18-35 years old) represented the largest numbers—more than 50%—of injured patients treated in the ER due to road accidents, and constitute the most ER-injured individuals with alcohol and/or drug positive tests. These figures suggest that traffic safety prevention should especially target persons 35 years and younger. These findings may reflect a change in drinking behavior in Italy over the past 20 years, where teenagers have tended to drink more similarly to youth in other countries over time (e.g., higher consumption during a drinking event). Until the 1980s, youth drinking in Italy mainly followed the reported Mediterranean patterns of drinking moderately at meals, but more recently evidence has emerged indicating a trend toward convergence with the reported drinking patterns of Northern European countries (Beccaria, 2010).

Approximately 22% of patients presenting between 20:00 to 5:59 on weekdays in our study were substance positive (alcohol, drugs, or combined), and approximately 18% were positive on the weekends when the highest risk of drunk driving has been reported in other studies (Schepens et al., 1998; Puljula et al., 2007). Moreover, the rate of people injured during the weekend between 20:00 to 5:59 who were substance positive was about 26%. These results are consistent with those from other Italian and international studies (Peppiat et al., 1978; Schepens et al., 1998; Fabbri et al., 2002; Soffer et al., 2006).

In addition, the greater frequency of alcohol-related accidents during the night rather than daytime confirms the findings of the Forlì and other alcohol-and-road-accident studies (Schepens et al., 1998; Fabbri et al., 2002; Soffer et al., 2006), and

may reflect ongoing changes in drinking patterns in Italy. In contrast, a previous study (1989-1990) of 475 generic injury patients arriving at the ER of Trieste, northeast Italy, showed that positive breathalyzer reading and self-reported consumption rates of participants were similar between weekday and weekend evenings, with about one third showing evidence of drinking during the preceding 6 hours (Cherpitel, Flaminio & Poldrugo, 1993). There is some evidence that current urban drinking patterns may involve less drinking at lunchtime, while drinking at dinner or in the evenings appears to be retained (Tusini, 2007). This also suggests that moderate drinking styles that may have been considered “protective” are changing in Italy.

However, the awareness that drinking is a problem was limited in our sample. All BAC positive participants consenting to interviews did not acknowledge any relationship between the alcoholic beverages they had drunk and their road accidents. This may be due to the persistent positive value that is still attributed to wine and other alcoholic beverages in Italy that may exclude its causal relationship with accidents. Another explanation may be that people who previously drove on the weekend are part of subgroups that drink more, and are more likely to take risks while driving. Whereas people drinking less may tend to stay home, preferring not to drive, and would therefore be less exposed to driving-accident risks.

Our study also shows a notable number of people affected by illegal drugs among those injured in road accidents, and that one third were also BAC positive. This percentage is somewhat consistent with data from general population surveys; the use of any kind of illicit drug among tested subjects from working populations in Italy was 1.15% in 2009 (Dipartimento delle Politiche Antidroga, 2011). Further, in our study the prevalence of illegal drugs was concentrated among the ages 18-35. These results suggest that future prevention of substance-involved road accident injuries should address drug use as well as alcohol consumption.

Our study findings are in keeping with those reported in other studies indicating that alcohol involvement increases with the severity of injury (Levy et al., 2004; Wilde et al., 2004; Macdonald et al., 2006). Our data clearly indicate that substance use (alcohol, illegal drugs, or combined) contributes disproportionately to higher-severity injuries than to lower-severity injuries. These figures are consistent with findings of the European project DRUID, indicating about 22% of drivers seriously injured or killed in Italy during 2006-2010 had consumed alcohol and drugs and/or medication (European Integrated Project DRUID, 2012).

It should be noted that the self-reported average daily consumption of the interviewee subsample was 13 grams of pure alcohol per capita day (equal to 5.9 liters of pure alcohol per year), which is lower than the average estimated alcohol consumption of the Italian population aged 15 years or over (8.59 liters of pure alcohol in 2003 and 7.81 in 2007) (World Health Organization, 2009). This finding may suggest that individuals involved in road accidents underreport the amount of alcohol they drink in front of the interviewer, possibly overlooking the link between drinking and accidents.

Study limitations

While these data provide valuable information about the association of alcohol and drugs with road accidents in Florence, there are important limitations in this study. First, this study is not a case-control study and like many other prior studies does not have the ability to uniquely attribute alcohol and/or other drugs as the single causal factor. However, this was not the major goal of this study, which was to document the actual level of alcohol and drug involvement in road accidents in Florence.

Second, investigating only illicit drugs instead of all drugs missed other types of substances. This may bias findings towards an underlying assumption that illicit drugs are more relevant to traffic incidents than other drugs, like prescribed medication. According to the findings of the European project

DRUID, implemented between 2006 and 2010, the use of prescription medication (benzodiazepines and medicinal opioids) and illicit drugs among drivers seriously injured or killed in Italy was about 2%, and 4%, respectively (European Integrated Project DRUID, 2012).

Third, the data collected extended over 45 months across five ER sites were not completed consistently at each ER during the same month or year. The sampling of months was opportunistic and was conditioned on the availability of the ER staff and of clinical researchers, as well as by the administrators' timeliness in providing funds to the study. Also, in each ER some overrepresentation of morning shifts occurred within the 3 months when the data were collected. Thus, there may be seasonal or monthly biases that might have affected the results.

Fourth, since injury patients were asked to provide blood and urine samples, the percentage of refusals was over 25%. We have to take into account that our sample was taken from the general-injury population, not only from serious or trauma patients for whom blood would be routinely drawn. In any case, participants and nonparticipants were not comparable for age and marital status. Younger people may have refused to participate because of their substance-use patterns prior to their traffic accident, possibly due to a fear that alcohol and/or drug tests would be made available to police, and that they would be charged according to the Italian law (sanctioning drivers with BAC above 0.5 g/l and drug-positive test). Thus, the results may represent an underestimate of road accidents in which alcohol or drugs was a contributor.

As previously noted, analysis of blood provided results for alcohol comparable to findings in other countries typically measuring alcohol consumption using breath samples. However, the collection of blood data provides more confidence about the accuracy and validity of the results but does raise a practical question of whether the more complex and expensive collection of body fluids is necessary. This study does

not provide a final answer to that question but does suggest that blood results are comparable to breath data on alcohol collected in other studies. A limitation of this suggestion is that breath testing cannot be used to measure illicit drugs and that body fluids are required.

This study demonstrates that alcohol is the substance making the greatest contribution to both driver and passenger road accidents in the Florence metropolitan area, but that in some cases, the presence of illegal drugs was notable, especially in conjunction with drinking. In these cases, the likelihood to be involved in more severe injuries is higher. Weekend drivers, pedestrians, and passengers were four times as likely to be alcohol involved than weekday injury patients. This study provides an important foundation for other epidemiological research as well as prevention.

One public health policy implication suggested by this study is that prevention strategies for alcohol-related road accidents in Italy need to be more similar to those employed in other countries. These results and other studies of changes in Italian drinking patterns (especially among young people) suggest that an overreliance on informal social control to limit heavy acute drinking associated with driving may be misguided. More frequent and highly visible enforcement of drunk driving laws coupled with efforts to support bars and restaurants to limit excessive serving of alcohol, especially in the evenings and weekends when the crash risk is much higher, would be valuable (see Babor et al., 2010).

Finally, the study was generally well accepted by the ER personnel. However, meetings held by researchers in each ER at the end of the project to communicate study findings were largely unable to mobilize staff around the problem of alcohol and road accidents—a secondary goal of the project. Part of the problem here was the quite low rate of attendance of medical and nursing staffs at ER meetings, where the project was presented at the start of the survey and the feedback of

the results at its completion. Nevertheless, the study may have contributed to opening discussions among ER physicians and nurses in Florence. It should be noted that for the Italian culture, including that of health professionals, “alcohol dependence” is the immediate translation of “alcohol problem” and “risky drinking.” Any shift from the former to the latter concept is considered a success for any alcohol-education approach.

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