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Associations between driving under the influence of alcohol or drugs, speeding and seatbelt use among fatally injured car drivers in Norway

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ABSTRACT

Since 2005, all fatal road traffic crashes in Norway have been analyzed in-depth by multidisciplinary investigation teams organized by the Norwegian Public Roads Administration (NPRA). During the period 2005–2010, 608 drivers of cars or vans were killed in road traffic crashes. Blood samples were collected from 372 (61%) of the drivers and analyzed for alcohol and a large number of psychoactive drugs at the Norwegian Institute of Public Health (NIPH). After coupling the analytical results with the NPRA crash database, 369 drivers with a fatal outcome were identified and included. Alcohol or drug concentrations in blood above the legal limits were found in 39.8% of the drivers who were investigated for alcohol or drug impairment; 33.9% had blood alcohol concentrations above 0.5 g/L or concentrations of drugs above the equivalent Norwegian legal impairment limits or concentrations of amphetamines above 200 μg/L. Among drivers with a fatal outcome who had been impaired by alcohol or drugs, 64.6% were unbelted and 71.7% were speeding when the crash occurred; whereas 24.2% and 33.2% of the sober drivers were unbelted or speeding, respectively. Statistically significant associations were found between impairment by alcohol or amphetamines and driving unbelted or speeding. Excessive speeding is one of the main reasons for road traffic crashes and together with being unbelted the main reasons for a fatal outcome. This behavior might in many cases be due to increased risk-taking or negligence of safety measures as a result of alcohol or drug use.

1. Introduction

A large proportion of road traffic crashes (RTC) are related to speeding or driving under the influence (DUI) of alcohol or drugs and a large proportion of injured drivers or passengers with or without a fatal outcome in RTCs are unbelted (WHO, 2004).

The use of alcohol or drugs may impair a number of driving skills, such as attention, tracking, reaction time, information processing, perception, psychomotor skills, visual function and increased risk-taking (Ogden and Moskowitz, 2004; Penning et al., 2010). Norway introduced, as the first country in the world, a legal limit for DUI of alcohol in 1936. The limit for the blood alcohol concentration (BAC) was at that time 0.5 g/L and it was reduced to 0.2 g/L in 2001. After more than 70 years of strong enforcement of the DUI law, relatively harsh punishment and many information campaigns, the prevalence of BAC above 0.2 g/L among random Norwegian drivers was only about 0.2% in 2008–2009 (Gjerde et al., 2013a,b,b). *Per-se* limits equivalent to BACs of 0.2 g/L were introduced for 20 non-alcohol drugs in 2012 (Vindenes et al., 2012). The prevalence of drugs above these limits among random drivers in Norway was estimated to be about 2% (Gjerde et al., 2013a,b,b).

In Norway, seat-belts have been compulsory in front seats of cars since 1971 and in back seats since 1984. A fine was introduced for being unbelted in the front seats in 1979, and in back seats in 1985 (if seat-belts were installed). In a study of almost 200,000 drivers in 2012, about 5% were unbelted (Nygaard, 2012).

The number of fatal road traffic accidents in Norway has been declining during the last decades. After 2010, less than 200 persons have died in RTCs per year, corresponding to less than 4 per 100,000 inhabitants. Investigation of fatal traffic accidents during

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the period 2005–2010 concluded that the majority of the RTCs were related to inadequate driving skills (55%), speeding (48%), and/or use of alcohol or drugs (22%) (Haldorsen, 2011). However, in a large number of cases, influence of alcohol or drugs was not investigated. This means that the proportion of alcohol or drug related RTCs is probably somewhat higher.

Findings from a recent study showed that blood samples were taken in only 63% of drivers with a fatal outcome, and alcohol or drug concentrations above the *per-se* limits were found in about 40% of these samples (Christophersen and Gjerde, 2014). Another study found that about 44% of the fatally injured drivers or passengers were unbelted during 2005–2010 (Haldorsen, 2011).

Previous studies of crash-involved drivers have found that drunk drivers had higher speed than sober drivers when they crashed (NHTSA, 2009, 2012; Phillips and Brewer, 2011; Stübig et al., 2012), and were less frequently belted (NHTSA, 2009; Phillips and Brewer, 2011; Tison et al., 2010). Similar associations between DUI and driving unbelted or speeding have also been found in different surveys (Briggset al., 2008; Foss et al., 1994; Golias and Karlaftis, 2002; Kweon and Kockelman, 2006; Maron et al., 1986; Oleckno and Blacconiere, 1990; Sahai et al., 1998).

The most commonly found psychoactive substances in blood samples from drivers with a fatal outcome in RTCs in Norway are alcohol, amphetamines, benzodiazepines and cannabis. The aim of this investigation was to study the association between DUI of those substances with speeding and seat-belt use among drivers with a fatal outcome in RTCs.

2. Methods

2.1. Setting

This was a retrospective, observational, cross sectional, multi-site study of 369 drivers who were fatally injured in RTCs in Norway during 2005–2010.

2.2. Data sources and measurements

Data were collected by coupling of data from three different sources: (a) the Norwegian Road Accident (NRA) Registry operated by Statistics Norway, (b) the Forensic Toxicology (FT) Database operated by the Norwegian Institute of Public Health (NIPH), and (c) the Crash Investigation Team (CIT) Database operated by the Norwegian Public Roads Administration (NPRA).

The police submit data on all serious road traffic crashes on a regular basis to the NRA Registry. This registry contains the unique national identification number of involved drivers in addition to time, place, type of crash, and more.

Blood samples are taken for alcohol and drug testing in about 60–70% of the traffic crashes where the drivers is fatally injured. The samples are either taken at the accident site, after arrival to the emergency department at the hospital, or as part of a forensic autopsy. About 95% of all blood samples from fatally injured drivers are analyzed at NIPH, and results of alcohol and drug tests are entered into the FT Database.

Since 2005, all fatal road traffic accidents in Norway have been analyzed in-depth by multidisciplinary CITs. When a RTC with suspected or confirmed death is reported to the Norwegian National Road Traffic Centre, the regional CIT member examines the crash site and compiles a detailed technical report of the crash, which also includes photo documentation of the vehicles involved and accident surroundings. Police reports and autopsy reports are retrieved and analyzed qualitatively by the CIT. The CIT consist of experts regarding measures relevant for road- and road conditions, motor vehicles and the driver (i.e., driving skills, distraction, and drugs). In addition a medical doctor is included in the expert panel. Crash data and conclusions from the CIT are entered into the CIT Database.

Though vehicle telematics may prove a helpful tool in the future, there is currently no precise, objective way of estimating the velocities of vehicles on impact. Therefore, the CITs approximated the velocities of vehicles on impact using a combination of information from the speedometer, deformation of the motor vehicle, direction of impact, tire marks form the deceleration, on-scene speed limits. 'Speeding' encompassed excessive (driving above the speed limit) or inappropriate speeding (driving too fast for the conditions, but within the limits) (OECD/ECMT, 2006).

A research database was generated by first coupling the FT Database with the NRA Registry using the unique national identification number of drivers of cars and vans who were fatally injured in RTCs during 2005–2010. Cases with time lapse between accident and death of more than 24 h were excluded. In some cases the exact time of the accident or death was not recorded, only the date. These cases were excluded if the time lapse between accident and death was more than one day. This research database was then coupled with the CIT Database. The national identification number was not available in the CIT Database; the cases were instead identified using the date, time and place for the accident in combination with age and gender of the fatally injured driver.

Information on age and gender was obtained from the NRA Registry, alcohol and drug findings from the FT Database, and information on seatbelt use (yes/no) and speeding (yes/no) from the CIT Database.

2.3. Alcohol and drug testing

The blood samples were analyzed for alcohol and 15 commonly used drugs (Table 1). Blood samples were screened for medicinal or illicit drugs using an immunological method and/or high-performance liquid chromatography with mass spectroscopy detection (LC–MS). Drug findings were confirmed and quantified using gas chromatography with mass spectroscopy detection (GC–MS) or LC–MS by accredited forensic toxicology methods as described previously (Gjerde et al., 2013a,b,b) and the results were entered into the FT Database. BAC above the legal limit of 0.2 g/L (yes/no), above 0.5 g/L (yes/no), concentrations of 15 illegal drugs and psychoactive medicinal drugs above the legislative limits (yes/no for each drug) and concentrations above the *per-se* limits corresponding to BAC of 0.5 g/L (yes/no). Analytical findings of

Table 1
Legislative limits corresponding to blood alcohol concentration (BAC) of 0.2 g/L and impairment limits corresponding to BAC of 0.5 g/L for the psychoactive substances included.

Substance	Legislative limit	Impairment limit
Alcohol	0.2 g/L	0.5 g/L
Alprazolam	3 μg/L	6 μg/L
Amphetamine[a]	41 μg/L	ND[a]
Clonazepam	1.3 μg/L	3 μg/L
Cocaine[a]	24 μg/L	ND
Diazepam	57 μg/L	143 μg/L
MDMA (Ecstasy)[a]	48 μg/L	ND[a]
Flunitrazepam	1.6 μg/L	3 μg/L
Methadone	25 μg/L	ND
Methamphetamine[a]	45 μg/L	ND[a]
Morphine	9 μg/L	24 μg/L
Nitrazepam	17 μg/L	42 μg/L
Oxazepam	172 μg/L	430 μg/L
Tetrahydrocannabinol[a]	1.3 μg/L	3 μg/L
Zolpidem	31 μg/L	77 μg/L
Zopiclone	12 μg/L	23 μg/L

ND: not defined in the Road Traffic Act. 200 μg/L was used as impairment limit for amphetamines.
[a] Defined as illicit drugs in this study.