Alcohol and drugs among motorcycle riders compared with car and van drivers killed in road crashes in Norway during 2001-2010

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Abstract

Background
Approximately 3.05 million motor vehicles are registered in Norway. Motorcycles and mopeds (MMs) represent 11% of the vehicles and 2% of the rides but as much as 21% of drivers killed in road traffic crashes.

Aims
To investigate the prevalence of alcohol and drugs above the legislative limits among MM riders killed in road traffic crashes and compare with killed car and van (CV) drivers.

Methods
Blood samples were selected from those routinely submitted by the police for analysis of alcohol and drugs in fatal traffic accidents during 2001-10. They were coupled with data from the Norwegian Road Traffic Accident Registry. Samples were analysed for alcohol and drugs.

Results
We received blood samples from 63% of the killed drivers for analysis of alcohol and drugs. The age distributions were different for MM and CV drivers; <25 years: 34% and 27%, 25-34 years: 27% and 22%, 35-54 years: 35% and 26%, above 54 years: 4% and 25%, respectively. Alcohol or drugs were found in samples from 40% and 27% of killed CV and MM drivers; for single vehicle (SV) accidents 64% and 45%. Alcohol was most commonly found among drivers below 25 years, illicit drugs among those 25-34 years and medicinal drugs among those 35-54 years. Amphetamines and benzodiazepines were the most frequently found illicit and medicinal drug groups. The highest prevalence of alcohol or drugs was found in samples from drivers killed in SV accidents during weekend nights.

Discussion and conclusions
MM drivers were more often involved in fatal accidents compared to the fraction of MM vehicles in normal traffic. However, the prevalence of alcohol or drugs was lower among MM drivers compared to CV drivers. One reason for the difference may be that MM drivers are less protected in an accident compared to CV drivers.

Introduction

Of the 3.05 million motor vehicles registered in Norway, MMs represent 11% of the vehicles and 2% of the rides. During the time period from 2001-10, 1517 drivers were killed in Norway; 71% were drivers of CVs and 22% of MMs. Of the killed MM riders, 44% died in SV accidents. However, the fact that MM riders were involved in one out of five fatal accidents shows that the risk for involvement in a fatal crash is significantly higher among MM riders than among CV drivers.
Several countries have reported high incidence of accidents among MM riders (NHTSA, 2007; Lin & Kraus, 2009; Moskal et al., 2012). Epidemiological studies have shown about 20 to 30-fold higher risk of fatal crash among MM riders and at least 8 times higher risk for injury in road crash compared with other vehicle accidents (NHTSA, 2007). The number of accidents among MM riders in Norway has decreased during the last years, but still the risk for traffic injury is at least six times higher than for CV drivers (Bjønskau et al., 2012).

Several risk factors may contribute to the high accident rates: the drivers are often young men with little traffic experience, the speed is often high, many drivers are risk and sensation seeking, and many drivers are not using helmet or protective suit (Villaveces et al., 2003; Lin & Kraus, 2008, Stella et al., 2002).

MM drivers have received less attention than CV drivers regarding studies of alcohol or drugs. Several studies of alcohol use among injured or killed MM drivers have been published; few studies on the use of drugs, and the number of cases included have been low (Pechansky et al., 2010; Stella et al., 2002; Kasantikul et al., 2005; Bogstrand et al., 2011).

Norway implemented legislative limits for 20 non-alcohol drugs in 2012 including both illicit drugs and medicines with warning labels (Vindenes et al., 2012). The drug concentration limits correspond to impairment comparable to the legal blood alcohol concentration (BAC) limit of 0.02 g/dl in the Norwegian Road Traffic Act.

The aim of this study was to investigate the prevalence of alcohol and drug concentrations above the Norwegian legislative limits among MM riders who died in traffic accidents during the period from 2001-2010, with specific focus on SV crashes, and compare with killed CV drivers during the same time period.

**Materials and methods**

**Selection of cases**

Blood samples were selected from those routinely submitted by the police for analysis of alcohol and drugs in cases of fatal traffic accidents. The samples were collected either shortly after the accident when the drivers were still alive, immediately after death or at legal autopsy. The study included MM riders and CV drivers who died within 24 hours after the accident. Samples were analysed at the Norwegian Institute of Public Health (NIPH) for alcohol, illicit drugs and medicines. The results were recorded in the forensic toxicological database at NIPH and further coupled with the Norwegian Road Traffic Accident Registry operated by Statistics Norway, which is based on information submitted by the police. Data were coupled by using the national identification number of the drivers. The final research database contained data on age, gender, time of accident, accident site, SV accident (yes/no), time of death, time of blood sampling and analytical results. Diazepam and morphine detected as results of reported or likely emergency treatment after the accident were omitted from further evaluation. Permission for the study, including coupling of data with the Road Traffic Accident Registry, was given by the Regional Ethical Committee and the Director of Public Prosecutions.

**Analysis of alcohol and drugs**

The following compounds were included in the analytical programme (cut-off limits in parentheses): alcohol (0.02 g/dl). Stimulants: amphetamine (41 ng/ml), methamphetamine (45
ng/ml), MDMA (48 ng/ml), cocaine (24 ng/ml). Opioids: morphine (9 ng/ml), methadone (25 ng/ml). Cannabis: THC (1.3 ng/ml). Anxiolytics, hypnotics: alprazolam (3 ng/ml), clonazepam (1.3 ng/ml), diazepam (57 ng/ml), flunitrazepam (1.6 ng/ml), nitrazepam (17 ng/ml), oxazepam (172 ng/ml), zolpidem (31 ng/ml), zopiclone (12 ng/ml). Sample handling and analytical methods have been described earlier (Gjerde et al. 2013). The results from positive screening analyses were not reported if not sufficient blood volume was available for confirmation analyses.

**Results**

Blood samples were received from 63% (n=207) of the MM drivers killed on Norwegian roads, representing 198 male and 9 female drivers and 63% (n=676) of the CV drivers, representing 560 male and 116 female. Autopsy samples from two Norwegian regions were analysed at the University in Trondheim, representing about 5% of the killed drivers; results from those cases are not included in this study. The reasons why the other fatal accidents were not investigated for alcohol or drugs, might be long transport distance to legal autopsy, economical reasons or that alcohol or drugs was not suspected.

**Alcohol and drug findings**

Table 1 shows the prevalence of alcohol and drugs among all investigated MM and CV killed drivers. Alcohol or drugs were more often detected in samples from CV drivers than MM drivers and most often in samples from SV accidents because the SV drivers were in most cases culpable as no other vehicle has been involved. Amphetamines and benzodiazepines were the most commonly found illicit and medicinal drug groups.

**Age distribution and gender**

Most of the killed MM drivers were male, only 4.3% of the investigated MM drivers were female; one of them had a BAC above the legal limit, none had any drug concentration above the limit. Among CV drivers, 17.2% was female; alcohol was found in blood samples from 7.8% of those drivers, medicinal drugs in 14.7% and illicit drugs in 6.0%.

The age distributions were different for MM and CV drivers; <25 years: 34% and 27%, 25-34 years: 27% and 22%, 35-54 years: 35% and 26%, above 54 years: 4% and 25%, respectively. Among MM drivers, alcohol was most often found among killed MM drivers below 25 years, illicit drugs among drivers aged 25 to 34 years, and medicinal drugs among drivers above 55 years (Table 2). Similar pattern was found for CV different drivers, except that the prevalence of alcohol and drugs was higher than among killed MM riders.

**Time periods for accidents**

The highest prevalence of alcohol or drug related accidents were recorded for drivers killed in SV accidents during weeknights and weekend nights: 60.9% and 65.2%, respectively. The corresponding figures for CV drivers killed in SV accidents were higher: 83.9% and 89.3%, respectively.
Table 1. Prevalence (%) of alcohol, medicines, illicit drugs and combinations, among MM riders (n=207) and CV drivers (n=676) killed in road traffic accidents during the period 2001-2010.

<table>
<thead>
<tr>
<th>Substance</th>
<th>MM drivers</th>
<th>CV drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All accidents</td>
<td>SV accidents</td>
</tr>
<tr>
<td>Alcohol</td>
<td>17.4</td>
<td>32.5</td>
</tr>
<tr>
<td>Alcohol + drug(s)</td>
<td>3.9</td>
<td>8.4</td>
</tr>
<tr>
<td>Medicinal drugs</td>
<td>7.7</td>
<td>14.5</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>6.3</td>
<td>13.3</td>
</tr>
<tr>
<td>Illicit drugs</td>
<td>9.2</td>
<td>13.3</td>
</tr>
<tr>
<td>Amphetamines</td>
<td>6.3</td>
<td>10.8</td>
</tr>
<tr>
<td>One or more drugs</td>
<td>13.5</td>
<td>20.5</td>
</tr>
<tr>
<td>Alcohol or drugs</td>
<td>27.1</td>
<td>44.6</td>
</tr>
</tbody>
</table>

Table 2. Prevalence of alcohol, medicines, illicit drugs and combinations in different age groups of killed MM and CV drivers.

<table>
<thead>
<tr>
<th>Substance</th>
<th>MM drivers</th>
<th>CV drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;25</td>
<td>25-34</td>
</tr>
<tr>
<td>Alcohol</td>
<td>20.0</td>
<td>17.9</td>
</tr>
<tr>
<td>Alcohol + drug(s)</td>
<td>4.3</td>
<td>5.4</td>
</tr>
<tr>
<td>Medicinal drugs</td>
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<td>10.7</td>
</tr>
<tr>
<td>One or more drugs</td>
<td>10.0</td>
<td>19.6</td>
</tr>
<tr>
<td>Alcohol or drugs</td>
<td>25.7</td>
<td>32.1</td>
</tr>
</tbody>
</table>

Discussion

The prevalence of alcohol and drugs among MM drivers killed in road accidents in Norway was lower than among killed CV drivers (Table 1). Thus, other risk factors in addition to alcohol or drugs may play an important role. A Norwegian study of accident risk among MM riders based on questionnaires and analyses of accidents concluded that the most important risk factors were low age, low experience, risky behaviour and unsafe attitudes (Bjørnskau et al., 2012). Questions or investigation of alcohol or drugs use were not included in that study. Another Norwegian study on the prevalence of alcohol and other drugs among injured patients in an emergency department, including MM riders and other vehicle drivers, showed similar total prevalence for any substance found in blood samples from the two groups of drivers (approximately 25%). However, the number of MM riders was low. Other studies have shown higher prevalence of alcohol among accident involved MM riders compared to our results, varying from 30% to 49% (Kasantikul et al., 2005; Villaveces et al., 2003; CDC, 2004). Drug related accidents have not been included in those studies. In a roadside study in Brazil, saliva samples were analysed and showed higher prevalence of certain drugs among MM riders compared to CV drivers, but lower prevalence of other drugs (Pechansky et al., 2010). When comparing findings of alcohol and different drug groups among MM and CV riders...
accident riders in our study, no significant differences in drug use patterns were found for killed MM compared with CV drivers, except that the prevalence was lower among MM riders (Table 1). The comparison of different age groups of MM and CV drivers also show very similar pattern of alcohol, medicines, illicit drugs and their combinations in the individual age groups with lower prevalence for all MM age groups, except for medicinal drugs among those above 55 years; however, the number of the latter cases was very small.

**Conclusion**

Alcohol and other drugs was frequently found in blood samples from MM and CV drivers killed in road crashes, although lower among MM riders. Even with helmet and other sufficient protective devices, the MM riders are less protected when involved in an accident compared to CV drivers. Drivers and riders killed at night-time had more often used alcohol or drugs. This fact should be taken into consideration by the police when planning time for controls.

**References**


