# Prevalence of alcohol-impaired drivers based on random breath tests in a roadside survey in Catalonia (Spain)

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## ARTICLE INFO

## ABSTRACT

Sobriety checkpoints are not usually randomly located by traffic authorities. As such, information provided by non-random alcohol tests cannot be used to infer the characteristics of the general driving population. In this paper a case study is presented in which the prevalence of alcohol-impaired driving is estimated for the general population of drivers. A stratified probabilistic sample was designed to represent vehicles circulating in non-urban areas of Catalonia (Spain), a region characterized by its complex transportation network and dense traffic around the metropolis of Barcelona. Random breath alcohol concentration tests were performed during spring 2012 on 7596 drivers. The estimated prevalence of alcohol-impaired drivers was 1.29%, which is roughly a third of the rate obtained in non-random tests. Higher rates were found on weekends (1.90% on Saturdays and 4.29% on Sundays) and especially at night. The rate is higher for men (1.45%) than for women (0.64%) and it shows an increasing pattern with age. In vehicles with two occupants, the proportion of alcohol-impaired drivers is estimated at 2.62%, but when the driver was alone the rate drops to 0.84%, which might reflect the socialization of drinking habits. The results are compared with outcomes in previous surveys, showing a decreasing trend in the prevalence of alcohol-impaired drivers over time.

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## 1. Introduction and scope

Excessive alcohol consumption among drivers results in a significantly increased risk of motor vehicle accidents (WHO, 2011). Moreover, a large body of literature highlights the presence of alcohol and drugs in drivers that have been either severely or fatally injured in traffic accidents (Holmgren et al., 2005; Wagenaar et al., 1995; Ahlm et al., 2009). In response, road safety policies, in which the maximum level of alcohol permitted to drivers has become a key issue, have been devised aimed at reducing alcohol-related traffic accidents worldwide.

Ensuring that these alcohol limits are not exceeded is the responsibility of the police who can set up sobriety checkpoints to control the alcohol consumption of drivers. Such checkpoints are known to act as a deterrent on both the drinking behavior and drug use of drivers (Löbmann, 2002). The authorities are able to identify particularly dangerous locations (near centers selling alcohol, such as clubs and discotheques, for example) and high risk days and

time frames, and intensify the number of sobriety checkpoints at such locations, and on such days and hours accordingly. In addition, alcohol tests can be administered when an individual is suspected of driving under the effects of alcohol, or following an accident in which people have been injured. Yet, although data on levels of alcohol concentration provided by non-random alcohol checkpoints or obtained from drivers involved in accidents with victims are a source of valuable information, they cannot be extrapolated to the general driving population as they are generated by a biased information collection process.

Here we present a case study in which the prevalence of alcohol-impaired drivers is estimated for the general population of drivers in Catalonia (Spain) in 2012. This research project was promoted by the Catalan Traffic Authority, which had previously carried out three similar studies in 2007, 2009, and 2010. Our case study comprises a roadside survey implemented during spring 2012 with the collaboration of the regional traffic agents who are responsible for traffic law enforcement, road security, and the prevention of traffic accidents in Catalonia. The sample was designed to be representative of Catalonia's driving population, which involved implementing a complex statistical sampling procedure and an equally complex statistical inference process. However, the methodology reported should be of interest for similar studies of general driving populations.

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A total of 7596 breath alcohol tests were performed on randomly selected drivers, being representative of the population of vehicles circulating in non-urban areas. The standard alcohol breath testing procedure was followed to measure alcohol levels. The test estimates the blood alcohol concentration (BAC) by measuring the amount of alcohol in the air exhaled by the driver. The aim of this study is to estimate the prevalence of alcohol-impaired drivers in the general population circulating in non-urban areas of Catalonia. The standard legal BAC limit is 0.50 g of alcohol per liter of blood. The main objectives of the analysis are:

1) to provide an accurate estimate of alcohol concentration in a sample of drivers that is representative of the general population of drivers;
2) to estimate the percentage of alcohol-impaired drivers by road type, day of the week, time of the day, and other factors;
3) to compare the estimated percentage of alcohol-impaired drivers in the general population with the estimated percentage of alcohol-impaired drivers according to non-random checkpoints, and
4) to find evidence that the percentage of drivers with a BAC level above the legal limit presents a decreasing trend when compared to the outcomes of surveys conducted in 2007, 2009, and 2010.

The article is organized as follows. A literature review is undertaken in the next section. In Section 3 the methodology used in the design of the sample is explained. The results are reported in Section 4 and our conclusions are summarized in Section 5.

## 2. Literature review

Alcohol-impaired driving is the cause of a significant percentage of injuries and fatalities associated with road traffic accidents in most developed countries, where considerable efforts have been invested in seeking to understand the phenomenon and in designing and implementing adequate deterrence policies. As a result, the academic literature examining the issue is very extensive. However, most articles tend to concern themselves with one or more of the following issues: (a) studying the driving impairment attributable to alcohol consumption and its interaction with other drugs; (b) identifying the percentage number of motorists that drive under the influence of alcohol; (c) estimating the percentage number of road traffic accidents associated with excessive (i.e., over the legal limit) alcohol consumption; (d) identifying high-risk groups; (e) evaluating the effects of different deterrence policies; and (f) methodological considerations.

It is widely accepted that alcohol consumption has a broad range of impairing effects on the skills required for driving. Specifically, it leads to a worsening of psychomotor skills, reaction times, the ability to keep a vehicle within traffic lanes, speed control, and hazard perception, among others (Moskowitz and Fiorentino, 2000; Downey et al., 2013). Other legal and illegal psychoactive drugs have also been found to impair the ability to drive significantly (Woratanarat et al., 2009). Moreover, two or more psychoactive drugs combined can have a more than additive effect on the deterioration of driving skills (Downey et al., 2013).

As such, there is a broad consensus in the literature regarding the important quantitative effect of drink driving on accident fatalities. For instance, 45,000 casualties and 1500 deaths can be related to drink driving in Germany each year (Löbmann, 2002). Similarly, according to official statistics for 2001, 8.4% of all injuries suffered in accidents and 10% of all fatal road traffic accidents in Belgium were alcohol-related (Vanlaar, 2005). The author notes that this figure might be negatively biased, given that not all accidents are recorded

and drivers involved in an accident are not always tested for alcohol. However, the magnitude of the bias is thought to be relatively small. Likewise, 25% of serious injuries produced in road traffic accidents were related to alcohol in the Netherlands (Mathijssen, 2005). On a more positive note though, most articles report a decreasing trend in the number of alcohol-related road traffic accidents (Peek-Asa, 1999; Vanlaar, 2005; Mathijssen, 2005; Williams, 2006; Vanlaar et al., 2012). For instance, while 57% of motor vehicle deaths were related to alcohol in the United States in 1982, this percentage had fallen to 40.9% in 1996 (Peek-Asa, 1999). More recently, a 2007 survey estimated that this figure had fallen to 33% (Bergen et al., 2011). This trend seems to be present in data for most developed countries, with significant falls in the number of alcohol-related accidents during the 1990s and 2000s.

Although the contribution of excessive alcohol consumption to the number of road traffic accidents is considerable, most studies note that the proportion of motorists who actually drive under the effects of alcohol is relatively small. For instance, 1.80% of U.S. adults reported episodes in which they have driven drunk (Bergen et al., 2011), while 3.31% of all drivers in Belgium were estimated in one study to have a BAC level above the legal limit (Vanlaar, 2005). In this study, Vanlaar (2005) estimates that the percentage of alcohol-impaired drivers rises to 7.68% on weekend nights. Yet, the percentage of alcohol-impaired drivers has also decreased steadily over time. For example, in the Netherlands, the share of drivers with a BAC above the legal limits fell from 15% in 1970 to 4.5% in 2000. Nevertheless, a surprisingly high proportion of alcohol-impaired drivers present a BAC above 1.3 g/l, which is almost three times higher than the legal limit in most developed countries, typically around 0.5 g/l (Mathijssen, 2005). This remains one of the challenges for future deterrence policy design.

Most studies report that a significantly high proportion of alcohol-impaired drivers are male. In the 2010 U.S. Behavioral Risk Factor Surveillance Survey, as many as 81% of the respondents that reported episodes of drunk–driving were men (Bergen et al., 2011). In the Netherlands, men aged 18–24 constitute a very high risk group, given that they represent less than 5% of the country's population but are responsible for almost 25% of accidents (Mathijssen, 2005). A study performed using data from the 2007 edition of the National Roadside Survey (NRS) in the U.S. reaches a similar conclusion (Kelley-Baker et al., 2013). In this case, individuals aged 21–24 were 4.5 times more likely to drink-drive than other age groups, while the percentage of alcohol-impaired drivers was significantly higher for men than for women. A description of the methodology employed in the 2007 U.S. National Roadside Survey to estimate the prevalence of alcohol-impaired driving is found in Lacey et al. (2011).

There is no conclusive evidence regarding differences in the rate of alcohol-impaired driving across different types of vehicle. For instance, Peek-Asa and Kraus (1996) note that motorcycle drivers exhibit the highest rate of alcohol use amongst all road users. Chongsuvivatwong et al. (1999) arrive at a similar conclusion for the case of Thailand. By contrast, Sun et al. (1998) report a mean BAC level for motorcyclists that is significantly lower than that for drivers of four-wheeled vehicles. They argue that this might be attributed to the fact that riding a motorcycle requires greater coordination and balance. In any case, all of these estimates should be considered with care due to the fact that they are often obtained from samples of individuals who suffered a traffic accident. Thus, they may be subject to a relatively large sample selection bias.

Surprisingly, a study performed among drivers in Brazil between 2005 and 2007 found that individuals who considered drunk driving as a serious social offense were more likely to engage in such behavior than their counterparts. Similarly, individuals who identified themselves as regular alcohol consumers were three times as likely to exceed the legal BAC limit (Campos et al., 2013). Moreover,