## **BLOOD ALCOHOL CONCENTRATION LIMIT FOR DRIVING**

Policy Statement

WHEREAS critical driving performance is significantly impaired at blood alcohol concentrations (BACs) of 0.05 g/dL and above,

WHEREAS the risk of being involved in a crash increases significantly at BACs at or exceeding 0.05 g/dL,

WHEREAS lowering the illegal BAC limit for driving to 0.05 g/dL reduces alcohol-related crashes,

BE IT RESOLVED that the AAAM recommends that all countries adopt a maximum BAC of 0.05 g/dL as illegal per se for driving.

Adopted: October, 2009

#### Abstract

This chapter provides a scientific review of the evidence regarding the benefits of reducing the illegal blood alcohol concentration (BAC) limit for driving. Numerous independent studies in the United States indicate that lowering the illegal BAC limit from .10 to .08 g/dL has resulted in 5 to 16% reductions in alcohol-related crashes, fatalities, or injuries. The illegal limit is .05 BAC in numerous countries around the world and several international studies indicate that lowering the illegal per se limit from .08 to .05 g/dL BAC also reduces alcohol-related fatalities. Laboratory studies indicate that impairment in critical driving functions begins at low BACs and that most subjects are significantly impaired at .05 g/dL BAC. The relative risk of being involved in a fatal crash as a driver is 4 to 10 times greater for drivers with BACs between .05 and .07 g/dL compared to drivers with .00 g/dL BACs. There is strong evidence in the literature that lowering the BAC limit to .05 g/dL is effective. These law changes serve as a general deterrent to drinking and driving and ultimately save lives. This critical review supports the adoption of lower illegal BAC limits for driving in countries around the world.

**Keywords:** blood alcohol concentration (BAC) limits; .05 g/dL BAC limit; traffic safety; impaired driving; fatal crashes; general deterrent; effectiveness; drinking drivers

The following sections contain excerpts from this chapter which provide support for a Policy Statement from the Association for the Advancement of Automotive Medicine (AAAM) recommending that countries around the world adopt .05 BAC as illegal per se for driving.

## A. Introduction

The international trend toward lowering BAC (blood alcohol concentration) limits has been continuing for some time now, with most industrialized nations reducing their illegal limit to a BAC of .05 or lower. The illegal limit is .05 g/dL BAC in Australia, Austria, Belgium, Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Israel, Italy, the Netherlands, Portugal, South Africa, Spain, and Turkey, as examples. Japan and Poland recently adopted a .03 g/dL BAC standard. Norway, Russia, and Sweden have essentially a zero-tolerance limit of .02 g/dL BAC. This trend has not developed without merit; a myriad of studies have indicated that lowering illegal BAC limits is in the best interest of the public. For example, laboratory studies indicate that impairment in critical driving functions begins at low BACs [1, 2]. Most subjects in laboratory studies are significantly impaired regarding visual acuity, vigilance, drowsiness, psychomotor skills, and information processing by the time they reach .05 g/dL BAC compared to their performance at .00 g/dL BAC [3]. The relative risk of being involved in a fatal crash as a driver is 4 to 10 times greater for drivers with BACs between .05 and .07 g/dL, compared to drivers with .00 g/dL BACs [4]. A recent study sponsored by the National Highway Traffic Safety Administration (NHTSA) in the United States indicates that drivers at .04 g/dL BAC have a significantly higher relative risk (ratio of 1.18 to 1.00) of being involved in a traffic crash than drivers at .00 g/dL BAC [5, 6]. Leading medical, crash prevention, public health, and traffic safety organizations around the world support BAC limits at .05 g/dL or lower, including the World Medical Association, the American and British Medical Associations, the European Commission, the European Transport Safety Council, the World Health Organization, and the American College of Emergency Physicians [7].

# B. A Summary of the Evidence for Lowering the BAC Limit to .05 g/dL or Less

#### 1. Effectiveness of .05 BAC Laws

Several countries have conducted evaluations of lowering their illegal BAC limits to .05 g/dL or less. A multi-year study of the .05 g/dL BAC law in the Netherlands (adopted in 1974) concluded that it contributed to a sustained decline in the total number of drinking drivers involved in crashes [33]. A study from France evaluated the impact of lowering its BAC limit from .08 to .05 g/dL in 1996. Annual alcohol-related crash fatalities declined from approximately 100 before the legal change to 64 in 1997 in the province of Haute-Savoie, where the study was conducted [34].

In 1988, the illegal BAC limit was lowered from .08 to .05 g/dL in Austria. A study of the law found that there was an overall 9.4% decrease in alcohol-related crashes relative to the total number of crashes [35]. However, they noted that intense media and enforcement campaigns also occurred around the time that the limit was lowered, making it nearly impossible to attribute the reductions to any one of these factors, at least in the short term. Bartl and Esberger [35] concluded that "lowering the [il]legal BAC limit from .08 to .05 g/dL in combination with intensive police enforcement and reporting in the media leads to a positive short-term effect." This provided support for the view that a .05 g/dL BAC illegal limit, as part of a comprehensive approach to fighting impaired driving, can have beneficial effects.

Homel [36] found that lowering the BAC limit from .08 to .05 g/dL in New South Wales, Australia, significantly reduced fatal crashes on Saturday by 13%. Henstridge, Homel, and Mackay [37] conducted a rigorous time-series analysis of random breath testing (RBT) and .05 BAC laws in Australia, controlling for many factors including seasonal effects, weather, economic trends, road use, alcohol consumption, and day of the week. Although the primary focus of the Australian study was the impact of RBT, the findings on the effect of .05 BAC laws were also significant. The study statistically accounted for the effect of other alcohol countermeasures to determine the specific values of the declines that were attributable directly to either RBT or the lower .05 BAC limit. The study analyzed traffic data for periods ranging from 13 to 17 years and found that those Australian states lowering their BAC limits from .08 to .05 g/dL experienced meaningful declines in alcohol-related crash measures. After Queensland, Australia, reduced their per se BAC limit to .05 g/dL in 1982, they experienced an 18% reduction in fatal collisions and a 14% reduction in serious collisions. These results were not confounded by the effects of RBT, as it was not introduced until 8 years later. Similarly, the .05 g/dL BAC limit in New South Wales was estimated to have reduced serious collisions by 7%, fatal collisions by 8%, and SVN collisions by 11%. This translated into the averting of an estimated 605 serious, 75 fatal, and 296 SVN collisions per year. Although the .05 g/dL BAC limit was introduced only 2 years before RBT in New South Wales, the authors accounted for this in their analyses and attempted to determine the crash reductions specifically attributable to each of the interventions.

Smith [38] specifically evaluated the effects of lowering the BAC limit in Queensland from .08 to .05 g/dL BAC. The proxy measure of changes in nighttime crashes as compared to daytime crashes was used. There was a significant 8.2% reduction in nighttime serious injury crashes (requiring hospitalization) and a 5.5% reduction in nighttime property damage crashes associated with the .05 g/dL BAC limit in the first year. Smith partially attributes some of the crash reductions in the second and third years after the adoption of .05 g/dL BAC to increased enforcement. When lowering the illegal BAC limit stimulates increased enforcement, it should be considered a benefit of the law, not a drawback, as concluded by Smith.

In South Australia, the illegal BAC limit was not lowered to .05 g/dL until 1991. Kloeden and McLean [39] reported that the number of nighttime drivers who had been drinking was reduced by 14.1% following adoption of the law. A second study of South Australia found that the .05 g/dL BAC limit did not significantly affect the number of fatally injured drivers who were legally impaired [40]. However, it did find that the proportion of impaired drivers at BACs of .15 or greater declined from 1991 to 1993. This last finding supports other Australian research indicating that the lower BAC limit has a substantial effect on drivers with BACs higher than .15 [41]. It has been estimated that drivers with BACs higher than .15 are 244 times more likely to be involved in a fatal crash than drivers with zero BACs [42]. The study by Zador et al. [4] found that male drivers aged 21 to 34 with BACs of .15 or higher are 573 times more likely to be killed in a single-vehicle crash than sober drivers of the same age. Thus, even though a .05 g/dL BAC limit would appear to be aimed at drivers with moderate BACs, its potential effect on the behavior of high-BAC drivers has important traffic safety implications.

Deshapriya and Iwase [43] determined that the .05 g/dL BAC limit adopted in Japan in 1970 had a substantial effect on drunk driving fatalities, nonfatal alcohol-related crashes and driving while intoxicated in Japan using multi-year trend analyses of crash and survey data. Bernhoft and Behrensdorff [44] found an increase in the proportion of drivers who reported that

they would have no alcohol or restrict themselves to one drink within two hours in the first year after Denmark lowered their BAC limit to .05 g/dL BAC (from 71 to 80%). However, they did not find a decrease in alcohol-related crashes in the first year after the law was adopted.

Table 1 summarizes the research on lowering the BAC limit to .05 g/dL.

Table 1. Studies of the Effects of Lowering the Illegal BAC Limit	
to .05 g/dL in Various Countries	

Study	Results
Noordzij (1994) [33] "Decline in Drinking and Driving in the Netherlands"	Percentage of drivers with BACs $\geq$ .05 g/dL from roadside surveys decreased from more than 15% in the years before the .05 limit to 2% in the first year and then leveled off at 12% for 10 years after the law change.
Mercier-Guyon (1998) [34] "Lowering the BAC Limit to 0.05: Results of the French Experience"	Alcohol-related traffic crash fatalities decreased from 100 before the limit to 64 in 1997, after the law change in the French Province where the study was conducted.
Bartl and Esberger (2000) [35] "Effects of Lowering the Legal BAC Limit in Austria"	Found 9.4% decrease in alcohol-related crashes. "Lowering the legal BAC-limit from .08% to .05% in combination with intense police enforcement and reporting in the media leads to a positive short-term effect."
Henstridge et al. (1995) [37] "The Long-Term Effects of Random Breath Testing in Adelaide"	Queensland (Australia) experienced an 18% reduction in fatal crashes and a 14% reduction in serious crashes associated with lowering the BAC limit to .05 g/dL. These results were not confounded with the effects of random breath testing. New South Wales showed an 8% reduction in fatal cases, a 7% reduction in serious crashes, and an 11% reduction in SVN crashes associated with lowering the BAC limit to .05 g/dL.
Smith (1988) [38] "Effect on Traffic Safety of Introducing a 0.05% Blood Alcohol Level in Queensland, Australia"	Significant 8.2% reduction in nighttime serious injury crashes and a 5.5% reduction in nighttime property damage crashes associated with lowering the limit from .08 to .05 g/dL. Partly the result of increased enforcement.
Deshapiya and Iwase (1998) [43] "Impact of the 1970 Legal BAC 0.05 mg% Limit Legislation on Drunk-Driver-Involved Traffic Fatalities, Accidents, and DWI in Japan"	Trend analyses indicate that the .05 BAC law has reduced both alcohol-related traffic crashes and DWI drivers in Japan.

Study	Results
Bernhoft and Behrensdorff (2003) [44] "Effect of lowering the alcohol limit in Denmark"	When the BAC limit was lowered from .08 to .05 g/dL in 1998 in Denmark, there was a significant increase in the proportion of drivers who reported that they would not drink at all or would have only one drink if they were driving (71% before to 80% after).

#### 2. Impairment and Crash Risk at .05 g/dL BAC

Howat, Sleet, and Smith [49] conducted a review of the literature from experimental and laboratory research on the impairment effects at .05 g/dL BAC. Many of the studies reviewed showed statistically significant decrements in driving performance at a BAC of .05 g/dL or lower. The authors concluded that young and inexperienced drinkers appear to be at the greatest risk at .05 g/dL BAC. They recommended that setting a uniform .05 g/dL BAC statutory limit should be one measure in a comprehensive approach to reducing impaired driving including other legal, social, behavioral, and environmental strategies to deal with the problem. Ferrara et al. [1] concluded in a review of the research literature that driving performance changes initially begin with any departure from a .00 g/dL BAC.

Moskowitz and Fiorentino [2] reviewed 112 scientific articles regarding the effects of alcohol on driving-related skills published between 1981 and 1997. They concluded that, by the time subjects reach .05 g/dL BAC, the majority of experimental studies examined reported significant impairment. After testing 168 drivers, Moskowitz et al. [3] concluded that the majority of the driving population is impaired in at least some important measures at BACs as low as .02 g/dL BAC.

Recent epidemiological studies [4, 5, 6] of the relative risk of being involved in a crash at various positive BAC levels indicate that the risk of crashing is substantially higher at .05 g/dL BAC compared to drivers at .00 g/dL BAC. Zador et al. [4] estimated that the risk of being involved in a fatal crash for drivers at BACs as low as .02–.04 g/dL is anywhere from two times to five times higher than for drivers with BACs=.00 g/dL, depending upon age and gender. That same study concluded that the risk of being killed as a driver in a single-vehicle crash is 6 to 17 times greater for drivers at BACs between .05 and .07 g/dL compared to drivers with BACs of .00 g/dL, and that the risk of just being involved as a driver in a fatal crash is 4 to 10 times greater at BACs between .05 and .07 g/dL than drivers with BACs=.00 g/dL. As mentioned earlier, Compton et al. [5] and Blomberg et al. [6] concluded that the risk of being involved in any crash of any severity (property damage, injury, or fatal) for drivers with BACs at .04 g/dL or higher was significant (18% higher than for drivers at .00 g/dL). Further, drivers with a BAC of .05 g/dL have a 38% higher risk of crashing than drivers with BACs=.00 g/dL. At .06 BAC, that risk is 63% higher, and at .07 g/dL BAC, the risk is 109% higher than for drivers with BACs=.00 g/dL.

### C. Conclusion

Mann, Macdonald, Stoduto, Bondy, and Shaikh [61] reviewed all of the available scientific evidence in assessing the potential impact of lowering the BAC limit to .05 g/dL. They

assessed research on the effects of alcohol on driving performance; epidemiological research on the risk of collision involvement at various BACs; research on the impact of lowering the BAC limit in other countries and jurisdictions; and other possible issues such as public acceptance, police discretion, and judicial outcomes. This review concluded that the adoption of a .05 g/dL BAC could potentially reduce the motor vehicle crash fatalities by 6 to 18% in Canada. In a subsequent international review, Mann, Macdonald, Stoduto, Bondy, Jonah and Shaikh [62] concluded that most, but not all, studies showed beneficial effects on traffic safety measures due to lowered BAC limits. They suggest that most of the effects of such laws are due to general deterrence.

Chamberlain and Solomon [7] conducted an extensive review of all of the issues surrounding a .05 g/dL BAC limit. The review summarized the effects of low doses of alcohol on driving behavior, the relative risk of a crash at various BAC levels, and the experience in other countries with lowering BAC limits, and presented a compelling case for a .05 g/dL BAC limit around the world.

The scientific evidence accumulated over the past 50 years indicates a direct relationship between rising BAC levels and the risk of being involved in a motor-vehicle crash and documents that driving performance begins to deteriorate significantly at .04–.05 g/dL BAC [63, 64, 65]. Because alcohol has been shown to have a wide variation of effects from subject to subject, special attention needs to be given to the selection of a BAC level in which the vast majority of drinking drivers are likely to be affected. This level appears to be .05 g/dL BAC. When all of the international evidence on lowering BAC limits is assembled, reviewed, and summarized, it is concluded that lowering the illegal BAC limit to .05 g/dL (or lower for countries that have had .05 g/dL limits for several years) is an effective strategy in reducing impaired driving.

The general public does not think people should drive after two or three alcoholic drinks. This translates to .04 or .05 g/dL BAC for most people. Laboratory research shows that most people's critical driving skills are significantly impaired at .04-.05 g/dL BAC. The World Health Organization [66] recommends an upper limit of .05 g/dL BAC for the general driving population and .02 g/dL BAC for young drivers as the best practice at this time.

#### **D.** Acknowledgement

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