The Effectiveness of Reducing Illegal Blood Alcohol Concentration (BAC) Limits for Driving:

Evidence for Lowering the Limit to .05 BAC in Canada

.05

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Pacific Institute for Research & Evaluation

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Executive Summary

The purpose of this scientific review is to provide a summary of the evidence regarding the benefits of reducing the illegal blood alcohol concentration (BAC) for driving and providing a case for enacting a .05 BAC Criminal Code limit in Canada.

With regard to the effectiveness of .08 BAC laws, the research is consistent and persuasive that such laws are associated with reductions in alcohol-related crashes. Twelve independent studies have been conducted, covering 18 states that have enacted .08 BAC laws. On average, .08 BAC laws have resulted in 6-16 percent reductions in alcohol-related crashes, fatalities, or injuries.

The U.S. has taken the lead in adopting lower BAC limits for underage youth. These "zero tolerance" laws for youth lowered the illegal BAC limits for that population and have proven to be effective in reducing underage drinking driver fatal crashes. A systematic review of zero tolerance laws and their effect on alcohol-related injuries and fatalities showed reductions associated with the implementation of these laws.

The international trend continues to be to reduce illegal criminal per se limits to .05 BAC or lower. The illegal limit is .05 BAC in numerous countries including: Australia, Austria, Belgium, Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Israel, Italy, the Netherlands, Portugal, South Africa, Spain and Turkey. Russia, Sweden and Norway have a limit of .02 BAC and Poland recently went to .03 BAC. Several countries have reported studies indicating that lowering the illegal per se limit from .08 BAC to .05 BAC 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 BAC with regard to visual acuity, vigilance, drowsiness, psychomotor skills, and information processing compared to their performance at .00 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 compared to drivers with .00 BACs. Leading medical, crash prevention, public health and traffic safety organizations in the world support BAC limits at .05 or lower.

A report issued by the Traffic Injury Research Foundation (TIRF) in May 2002, entitled "The Safety Impact of Lowering the BAC Limit for Drivers in Canada," concluded that "the evaluation literature failed to provide strong, consistent and unqualified support for lowering BAC limits. At best, the results are mixed and the methodological weaknesses in the studies question the robustness and veracity of the evidence" (Beirness & Simpson, 2002). We have conducted a critical review of the Beirness & Simpson report (also referred to as the TIRF report) and find ourselves in disagreement with the TIRF conclusion for several reasons:

1. The methodological limitations cited by Beirness and Simpson in studies of the effects of lower BAC limits are present in most field studies, including those of the effects of administrative license revocation (ALR), graduated driver licensing (GDL) laws, and measures to reduce "hard core" drinking drivers, which TIRF prominently endorses. Even considering these limitations, the scientific community in general has concluded that lower BAC limits are effective, contrary to the TIRF conclusion.

2. The TIRF report fails to note that the U.S. Centers for Disease Control (CDC) reviewed the existing studies on the lowering of the BAC limit from .10 to .08 and came to the conclusion that such laws reduce alcohol-related fatalities by 7%.

3. The interpretations of the results of many of the studies reviewed by TIRF are one-sided and not representative of the body of scientific opinion. If the same interpretations were held for studies of GDL laws, for example, TIRF would have to withdraw their support for such laws.

4. There are other good reasons and other evidence for lowering the BAC limit to .05 in Canada that were not discussed by TIRF in their report (e.g., impairment and crash risk at .05 BAC).

5. Several studies which showed positive findings on the lowering of BAC limits were available to TIRF when they conducted their review but were not mentioned in their report.

In conclusion, even considering certain methodological limitations in the studies, there is strong and consistent evidence in the literature that lowering the blood alcohol concentration (BAC) limit from .10 to .08 is effective, that lowering the BAC limit from .08 to .05 is effective, and that lowering the BAC limit for youth to .02 or lower is effective. All of these measures serve as a general deterrent to drinking and driving and ultimately save lives. It is recommended that Canada strongly consider lowering their illegal BAC limit to .05.

Introduction and Purpose

INTRODUCTION

The Pacific Institute for Research and Evaluation (PIRE) was asked by Mothers Against Drunk Driving (MADD) Canada to provide a critical review of a report written by Douglas J. Beirness and Herb M. Simpson of the Traffic Injury Research Foundation (TIRF) released in May 2002, and entitled "The Safety Impact of Lowering the BAC Limit for Drivers in Canada" (Beirness & Simpson, 2002). The TIRF report was generally critical of the evaluation studies of lowering the blood alcohol concentration (BAC) limit for drivers and concluded, "[T]he evaluation literature failed to provide strong, consistent, and unqualified support for lowering BAC limits. At best, the results are mixed and the methodological weaknesses in the studies raise questions about the robustness and veracity of the evidence." This conclusion contrasted with another recent review of the evidence of lowering the BAC limit from .10 to .08 by the U.S. Centers for Disease Control and Prevention (CDC) that stated "...available studies provide strong evidence that .08 BAC laws are effective in reducing alcohol-related crash fatalities" (Shults et al., 2001). PIRE has conducted several studies of the effectiveness of lowering state BAC limits on crashes involving drinking drivers for the U.S. Department of Transportation and was invited to critically review the TIRF report because of our experience with research designs, evaluation methodologies, and the BAC limit issue. In accepting this assignment, we should make clear that our studies of the reduction of the BAC limit from .10 to .08 have shown positive results. However, we believe we can comment on the TIRF review with reasonable objectivity because we are aware of the limitations in past studies, including our own, and have conducted numerous literature reviews ourselves.

BACKGROUND

The international trend of lowering BAC limits has been continuing for some time now, with most industrialized nations of the world reducing their illegal limit to a BAC of .05 or lower. The illegal limit is .05 BAC in Australia, Austria, Belgium, Bulgaria, Croatia, Denmark, Finland, France, Germany, Greece, Israel, Italy, the Netherlands, Portugal, South Africa, Spain, and Turkey. Norway, Russia, and Sweden have a limit of .02 BAC, and Poland recently adopted .03 BAC. Several countries have reported studies indicating that lowering the illegal per se limit from .08 to .05 BAC reduces alcohol-related fatalities (e.g., Australia: Henstridge, Homel, & Mackay, 1995; Austria: Bartl & Esberger, 2000; France: Mercier-Guyon, 1998; and the Netherlands: Noordzij, 1994.).

This trend has not developed in a vacuum; 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 (Moskowitz & Fiorentino, 2000). Most subjects in laboratory studies are significantly impaired at .05 BAC with regard to visual acuity, vigilance, drowsiness, psychomotor skills, and information processing, compared to their performance at .00 BAC (Moskowitz, Burns, Fiorentino, Smiley, & Zador, 2000). 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, compared to drivers with .00 BACs (Zador, Krawchuk, & Voas, 2000). A recent study by the National Highway Traffic Safety Administration (NHTSA) in the United States indicates that drivers at .05 BAC have a 38% higher relative risk of being involved in any crash than drivers at .00 BAC (Compton et al., 2002). Leading medical, crash prevention, public health, and traffic safety organizations in the world support BAC limits at .05 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 (Chamberlain and Solomon, 2002).

PURPOSE OF REVIEW

The purpose of this review of the TIRF report is to provide a separate critical review of the evidence regarding the potential benefits of enacting a .05 BAC Criminal Code limit in Canada. The first section of this review discusses methodological issues concerning studies of this nature. The second section summarizes the evidence, including the most recent studies, for lowering the BAC limit from .10 to .08. The third section covers the available evidence for lowering the BAC limit to .05. The fourth section reviews the evidence for lowering the BAC limits for drivers younger than 21 years of age. The last section conveys the current authors' conclusion based upon this independent review of the evidence.

Discussion of "Methodologically Rigorous Studies"

The basic assertion of the TIRF report is that all (or most) of the studies of lower BAC limits are compromised by methodological problems. Because the opportunity to study the impact of a law lowering the illegal BAC limit only occurs when a country, state, or locality enact such legislation, all studies involve "natural experiments" where the research scientist has little, if any, control over the conditions under which the experiment occurs. Therefore, it is a feature of nearly all field research that it is less than perfectly controlled and the results are likely to be open to a number of criticisms. In general, the issues raised by the TIRF authors are typical of those that have been made of other studies involving "natural experiments," some of which have involved safety measures that TIRF strongly supports, including safety belt programs and graduated licensing programs for beginning drivers.

The effectiveness of any law is highly dependent on the extent to which it is enforced and the intensity and publicity surrounding that enforcement. When an evaluation of a new impaired-driving law is conducted, it is very difficult to control for changes in enforcement activities, changes in public information, changes in other laws, and changes in alcohol consumption, all of which could affect the outcome. When researchers have the opportunity to study multiple applications of the same law, there almost always are cases where one or two of the jurisdictions will show no benefit or might even experience an increase in the problem. These exceptions to the more general finding of a benefit will often be seized by critics to use in opposing the policy. Thus, it is important to consider the preponderance of evidence provided by all the available studies.

It is interesting to note that the TIRF authors have accepted much less critically the outcome of research that is more limited than that available on the reduction of BAC limits. On page 21 in *The First Five States* section of the TIRF report, the authors state: "Research has shown that ALR laws are associated with a decrease in alcohol-related collisions (Ross & Gilliland, 1991) and reduced DWI recidivism (Stewart & Ellingstad, 1989)." On page 2 in the Background section of the TIRF report, the authors state: "A variety of programs and policies for dealing efficiently and effectively with this group of high risk drinking drivers has been developed and implemented in a number of jurisdictions-e.g., mandatory assessment and treatment, vehicle impoundment, alcohol ignition interlocks. Many of these programs have proven effective (e.g., Beirness, Simpson, Mayhew, & Jonah, 1997; Voas, Tippetts, & Fell, 2000; Wells-Parker, Bangert-Drowns, McMillen, & Williams, 1995) and, should they become widespread, hold considerable potential to have a substantial impact on the problem." We agree with these statements, but note that the studies that TIRF cites for their effectiveness have the very same limitations to those TIRF raises in its critique of lower BAC limit studies. The limitations are typical of field research, and because new laws cannot be tested in the laboratory, such limitations are likely to be a feature of all studies of the efficacy of new legislation. TIRF's authors apparently have a double standard in their interpretation of research findings.

New public health programs and policies go through several development phases before reaching full implementation throughout a country (Holder, Flay, Howard, Boyd, & Voas, 1999). Canada adopted its current .08 BAC Criminal Code limit in 1969. Utah and Oregon were the first two U.S. states to lower their illegal limit from .10 to .08 per se BAC. By September 1999, 18 states and the District of Columbia had lowered the illegal limit from .10 to .08 BAC. During that time, nine evaluations of .08 laws involving 11 states had been conducted in the United States. A scientific review by a committee of experts formed by the U.S. Centers for Disease Control indicated that the median treatment effect detected by the

studies they reviewed was a 7% reduction in alcohol-related fatal crashes (Shults et al., 2001). The evidence for the effectiveness of lowering the illegal BAC limit produced a consensus among highway safety advocates on the value of the .08 law. This resulted in the U.S. Congress providing a sanction that will withhold a portion of a state's highway construction funds for states not adopting .08 laws by October 1,2003.

Studies of the effects of lowering BAC limits have various research designs and methodologies. The effectiveness measure and the analysis procedure have varied from investigator to investigator. Contemporaneous changes in other laws and policies - such as the enactment of an administrative license suspension (ALS) or an administrative license revocation (ALR) law permitting officers to seize the licenses of impaired drivers at the time of arrest - were not fully considered in some of the studies. A review by the U.S. General Accounting Office (General Accounting Office (GAO), 1999) found that the .08 law was effective, but generally only when combined with an ALS/ALR law. To test the significance of an ALS/ALR law, Hingson et al. (2000) compared states in which the two laws were implemented at about the same time with states where an ALS/ALR law had been in place for some time prior to the adoption of a .08 law. They found that the .08 law made a significant difference in states where the ALS/ALR law had been in place for some years. Because of differences in effectiveness measures or analysis techniques, Foss, Stewart, & Reinfurt (1998) found no significant change because of the .08 law in North Carolina, whereas Apsler, Char, Harding, & Klein (1999) did find a significant reduction in alcohol-related crashes in North Carolina associated with the .08 BAC law. Research and Evaluation Associates (REA) (1991) reported a reduction in alcohol-related fatal crashes in California; conversely, Rogers (1995), in a later analysis, did not find a significant reduction in fatal crashes in California attributable to the .08 law, but did find a reduction in nighttime injury crashes in California due to the .08 law.

Voas et al. (2000) considered the .08 BAC law as one of several alcohol safety measures in a study that included all 50 states plus the District of Columbia over a 16-year period. This study, which applied a common methodology to all the states from 1982 to 1997, found an 8% treatment effect similar to the CDC (Shults et al., 2001) finding of a 7% median treatment effect. The Voas et al. (2000) study was the most comprehensive study of lower BAC limits to date and did control for potentially confounding factors such as safety belt legislation and the economy. This study passed the so-called TIRF test for methodological "robustness and veracity," yet received very light treatment and was not endorsed by TIRF. Their reasons were not given.

A significant limitation in the interpretation of all field studies of the implementation of new laws is the varying analytical methods and criterion measures used by different investigators. With this in mind, PIRE has conducted identical individual analyses of 19 U.S. jurisdictions with .08 laws using a common dataset, the same effect measure, and an identical analytical procedure (Tippetts, Voas, & Nichols, 2003, under review). This permitted a more direct comparison of the effectiveness of the .08 law in each jurisdiction where it was implemented, and supported a meta-analysis of the effect sizes in each of the 19 jurisdictions to derive an overall effectiveness measure for the .08 law. The meta-analysis provided an estimate that the enactment of laws lowering the BAC limit from .10 to .08 reduced the proportion of drivers in fatal crashes who were drinking by 14.8%. Based on this percentage reduction, had the other states in the United States adopted a .08 law in 2000, 947 lives might have been saved. This study, once again, verifies that lowering the illegal BAC limit from .10 to .08 in the United States has a significant safety impact.

A Summary of the Evidence for Lowering the BAC Limit from .10 to .08

HISTORY IN THE UNITED STATES

Important to the issue at hand is briefly documenting the history and process that has taken place in the United States concerning the lowering of illegal BAC limits. At the start of the 1970s, when the first U.S. national effort at controlling alcohol-impaired driving began, even those states that based their laws on the BACs of drivers merely specified BACs at which it was "presumed" that a person was intoxicated. The presumption could be rebutted by other evidence. The presumptive levels generally were set at .15 BAC, although a few states had BAC levels of .12 or .10. Beginning in the 1970s, the U.S. Department of Transportation (DOT) used its authority under the Highway Safety Act of 1966 to encourage all states to adopt .10 BAC as the level for intoxicated or impaired driving. DOT also urged the states to enact laws that made it a violation per se to drive with a BAC of .10 or higher. From the outset of the movement to adopt .10 BAC as the national standard, there were advocates for even lower BAC levels. By 1983, this sentiment had resulted in the enactment of .08 BAC per se laws in Oregon and Utah. A strong grassroots movement started in the early 1980s that has had a significant effect on state laws, including .08 BAC laws. The most visible organization in this movement is Mothers Against Drunk Driving (MADD), founded in the U.S. in 1980 by a mother whose 13-year-old daughter had been killed by a hit-and-run driver with a long record of alcohol offenses. In 1986, DOT took its first formal step toward advocating a lower illegal limit by including a .08 BAC law as one of the regulatory criteria for a supplemental alcohol traffic-safety grant under the program authorized by the U.S. Congress (23 U.S.C. 408).

In 1988, NHTSA released a review of the scientific literature on the impairment of driving-related skills at low BACs, based on laboratory testing of dosed subjects (Moskowitz & Robinson, 1988). This report documented that impairment of driving-related skills starts at low BACs. Also, in 1988, MADD started to conduct public policy workshops in the United States (an effort that continued through 1995). Based on the 1988 literature review noted above on driving impairment at low BACs, a separate NHTSA literature review on the state of knowledge on alcohol-impaired driving, a study conducted by the Insurance Institute for Highway Safety on the relative crash risk of driving with BACs higher than .00, and the experiences of other western industrialized countries, MADD initiated its advocacy of .08 BAC laws. Additional states began to consider .08 BAC levels, and three more states adopted the new level: Maine in 1988, California in 1990, and Vermont in 1991. California's 1990 legislation lowered the state's per se limit from .10 to .08 BAC and established an ALR law a short time later. In 1991, NHTSA conducted a study of the effects of these new laws in California and found that the lower BAC level and the new ALR law combined resulted in a 12% decrease in alcohol-related fatalities (Research and Evaluation Associates, 1991).

In 1991, the U.S. Congress passed the Intermodal Surface Transportation Efficiency Act (ISTEA) and adopted the first statutory incentive grant criterion for .08 BAC, which was inserted into the drunk-driving prevention program under 23 U.S.C. 410. Under this program, states could qualify for basic and supplemental grant funds if they met certain criteria, one of which was adoption of a per se statute. To meet this criterion, ISTEA provided that the state needed to adopt at least a .10 BAC limit in the first 3 years after receiving a grant and, subsequently, must adopt a .08 BAC limit to continue receiving the grant. ISTEA provided also that, if a state adopted a .08 limit during the first 3 years of being awarded a basic grant, it could also receive additional supplemental grant funds. Also in 1991, NHTSA submitted a

report to Congress in response to a Congressional mandate to study the BAC at which a driver should be considered under the influence. The report was entitled "Alcohol Limits for Drivers: A Report on the Effects of Alcohol and Expected Institutional Responses to New Limits" (National Highway Traffic Safety Administration, 1991). The report was based on a review of existing literature on BAC limits and data collected on expected institutional responses to alternative limits. It concluded that, until a final recommendation is developed, .08 per se should be adopted by jurisdictions considering lowering their limits. In 1992, pursuant to direction from Congress (Section 9003(a) of PL. 100-690), DOT issued "Driving Under the Influence: A Report to Congress on Alcohol Limits" (National Highway Traffic Safety Administration, 1992). This report declared, "states should be encouraged to enact .08 as the BAC level at and above which it is a per se criminal offense to drive" (p. iv).

Between 1992 and 1998, 10 additional states adopted .08 BAC per se laws: Kansas and North Carolina (1993); Florida, New Hampshire, New Mexico, and Virginia (1994); Alabama and Hawaii (1995); and Idaho and Illinois (1997). The movement toward a national standard for .08 BAC received renewed attention in the 105th Congress.

On June 9, 1998, Congress enacted the Transportation Equity Act for the 21st Century (TEA-21) into law (P.L.105-178). Unlike previous NHTSA-administered grant programs, which provided for modest amounts of grant funds, this grant program provided for the distribution of $500 million over a period of 6 years to states with qualifying .08 BAC per se laws.

On June 15, 2000, the Senate passed H.R. 4475 (the DOT Appropriations Bill for FY 2001) that included a general provision sponsored by Senator Lautenberg encouraging states to adopt .08 BAC laws by withholding a portion of a state's federal highway funds, beginning in FY 2004, for states that do not adopt .08. The final .08 BAC Bill (Section 351) was adopted by Congress and signed by the President shortly after that. Table 1 shows the U.S. states that have lowered their illegal per se limit to .08 BAC, the date the law was enacted, and the date the law was (or will be) effective.

Table 1. States With .08 BAC Per Se Laws (as of January 2003).

STATES WITH LAW	ENACTMENT DATE	EFFECTIVE DATE
UTAH	3/19/83	8/1/83
OREGON	8/4/83	10/15/83
MAINE	4/28/88	8/4/88
CALIFORNIA	1989	1/1/90
VERMONT	6/6/91	7/1/91
KANSAS	4/22/93	7/1/93
NORTH CAROLINA	7/5/93	10/1/93
NEW MEXICO	3/19/93	1/1/94
NEW HAMPSHIRE	4/15/93	1/1/94
FLORIDA	4/27/93	1/1/94
VIRGINIA	4/6/94	7/1/94
HAWAII	6/30/95	6/30/95
ALABAMA	7/31/95	10/1/95
IDAHO	3/17/97	7/1/97
ILLINOIS	7/2/97	7/2/97
WASHINGTON STATE	3/30/98	1/1/99
DISTRICT OF COLUMBIA	1999	3/27/99
TEXAS	5/28/99	9/1/99
KENTUCKY	4/21/00	10/1/00
RHODE ISLAND*	7/13/00	7/13/00
NEBRASKA	3/1/01	9/1/01
ARKANSAS	3/5/01	8/14/01
MARYLAND	4/10/01	9/30/01
ARIZONA	4/10/01	8/31/01
GEORGIA	4/16/01	7/1/01
INDIANA	5/9/01	7/1/01
OKLAHOMA	6/8/01	7/1/01
MISSOURI	6/12/01	9/29/01
LOUISIANA**	6/26/01	9/30/03
ALASKA	7/3/01	9/1/01
SOUTH DAKOTA	2/27/02	7/1/02
WYOMING	3/11/02	7/1/02
MISSISSIPPI	3/18/02	7/1/02
TENNESSEE***	7/4/02	7/1/03
CONNECTICUT	7/1/02	7/1/02
34 STATES + DC.		

*   Rhode Island does have a .08 BAC per se law; however, it does not meet federal
     requirements to avoid sanctions in 2003 under the federal .08 law.

**   Louisiana does have a .08 BAC per se law; however, it does not go into effect until
     2003 and contains a repeal clause.

*** Tennessee's law does not go in effect until 2003.

EARLY STUDIES OF THE EFFECTIVENESS OF .08 BAC LAWS IN THE U.S.

The following four early studies of the impact of lowering the BAC limit to .08 were conducted before 1999:

1. A NHTSA study of the California .08 BAC law (Research and Evaluation Associates, 1991).

2. A NHTSA staff study of California, Maine, Oregon, Utah, and Vermont, five of the first states to enact .08 BAC laws (Johnson & Fell, 1995).

3. A California Department of Motor Vehicles study of its .08 BAC and ALR laws (Rogers, 1995).

4. A Boston University study of the five early states to enact .08 BAC laws (Hingson, Heeren, & Winter, 1996).

These studies controlled for many extraneous factors and provided initial evidence of the benefit of .08 BAC laws on alcohol-related crashes. One factor that was confounded in these studies was the possible interaction of .08 BAC and ALR laws enacted in close temporal proximity in some states. However, these studies provided credible evidence of the impact of the .08 law, particularly in combination with the ALR law. NHTSA recognized the need for more replications on which to base conclusions. It recognized that in the two California studies, it was very difficult to isolate the effects of the .08 BAC and ALR laws, which were implemented within 6 months of each other.

On pages 21-22 in *The First Five States* Section of the TIRF report, the authors comment about the Johnson and Fell (1995) study that:

"...it is noteworthy that the vast majority (21) of the measures showed no change associated with the lower limit, so the results are inconclusive at best."

In an objective review of that early study, we believe that it is more noteworthy that, of the 30 different measures used to determine effectiveness of the .08 BAC law, 26 of the measures showed decreases, with 10 of the decreases showing statistical significance. When TIRF says that 21 measures showed no change (it was actually 20 in a closer review of the paper), they failed to say "statistically significant changes." Sixteen of the 20 changes that were not statistically significant were actually decreases. Thus, this early study showed directional changes that were indicative of .08 BAC having an effect. This finding is very similar to findings of the effects of ALR (Zador et al., 1988; Klein, 1989) and minimum legal drinking age of 21 in the United States (DuMouchel, Williams, & Zador, 1987).

RECENT STUDIES OF THE EFFECTIVENESS OF .08 BAC LAWS

Three additional studies of the effects of lowering the limit to .08 BAC were released by NHTSA in early 1999:

• A study of North Carolina's .08 BAC law (Foss et al., 1998);

• A study of 11 states with .08 BAC laws (Apsler et al., 1999); and

• A 50-state study of three important impaired driving laws-ALR, .08 BAC, and zero tolerance for youth (Voas & Tippetts, 1999; see also Voas et al, 2000).

The results of these three high-quality studies of the .08 BAC laws' effects provided additional evidence to support the effectiveness of .08 BAC laws. When combined with the previously conducted studies, these studies provided consistent and persuasive evidence that .08 BAC laws are associated with reductions in alcohol-related fatalities. The 50-state study, for example, was a high-quality study that controlled for more extraneous variables than any other study to date. It showed a significant (8%) reduction in the involvement of low- and high-BAC drivers in fatal crashes. The 11-state study found that .08 BAC laws were associated with reductions in alcohol-related fatalities in 7 of the 11 states studied, either alone or in conjunction with ALR laws. Also in this study, 32 of 39 outcomes directionally supported a conclusion that .08 BAC laws, when added to existing laws and programs, are associated with reductions in alcohol-related traffic fatalities. The North Carolina study found no "clear" effect of its .08 BAC law. However, alcohol-related fatalities had been decreasing before implementation of the law, and they continued to decline after the law was adopted. Several of the study's outcomes were directionally consistent with suggesting that the law had an effect over and above the decline in alcohol-related fatalities that began before .08 BAC was enacted.

In aggregate, these three studies clearly provide additional support for the hypothesis that .08 BAC laws help to reduce alcohol-related fatalities, particularly when they are implemented in conjunction with other impaired-driving laws and programs. Nearly all of the findings of these and previous studies show directional changes suggesting that .08 BAC legislation (as well as .10 BAC per se and ALR laws) has contributed to the trend toward reduced alcohol-related crashes and fatalities experienced across the United States from 1982 through 1995. Implementing .08 BAC laws and the publicity surrounding them helps remind the public about the dangers of drinking and driving and catalyzes enforcement, judicial, and licensing efforts to reduce alcohol-impaired driving. That this law works best when accompanied by other complementary efforts (e.g., ALR laws, swift and certain penalties, sobriety checkpoints, and publicity) is consistent with our experience in other areas of highway safety-the more effort and action that is directed at a problem, the greater the likelihood that an effect will be observed. A .08 BAC law is an important contributor to any effort to reduce alcohol-related deaths and injuries.

A study by Voas et al. (2000) analyzed the effects of illegal per se BAC laws (.08 and .10 BACs) and ALR laws in all 50 states over a 16-year period. After controlling for a variety of factors that could potentially influence alcohol-related fatalities (something that TIRF advocated), Voas and his colleagues found that all three laws were associated with reductions in the involvement of drinking drivers in fatal crashes. They estimated that .08 BAC laws had an 8% effect in reducing fatal crashes involving drivers at both higher BACs (.10 or greater) and lower BACs (.01-.09) in those states where the laws were implemented. Voas and colleagues estimated that .08 BAC laws resulted in 275 fewer fatalities in those 16 states where they were in effect in 1997. If all 50 states had .08 BAC laws in effect in 1997, Voas and colleagues estimated that an additional 590 fatalities could have been prevented. The authors pointed out that these are likely conservative estimates. All three laws were associated with reduced alcohol (beer) consumption levels. This study clearly reached the opposite conclusion about .08 BAC laws that the TIRF report did - while adhering to the TIRF "robustness and veracity" principles.

The second multi-state study (Apsler et al., 1999) analyzed the effects of .08 BAC and ALR laws in 11 states. In all of the states studied, the rate of alcohol involvement in fatal crashes had declined. Further, the .08 BAC laws were associated with significant reductions in alcohol-related fatalities, either alone or in conjunction with ALR laws in 7 of the 11 states studied. In five of seven states (Florida, Kansas, Minnesota, North Carolina, and Vermont), implementation of the.08 BAC law itself was followed by significantly lower rates of alcohol involvement among fatalities. These results take into account any pre-existing downward trends the states were already experiencing, due possibly to other factors such as the presence of other laws, use of sobriety checkpoints, or any societal trend for reduced alcohol consump-

tion. In two states (California and Virginia), significantly lower rates of alcohol involvement in fatal crashes followed the combination of .08 BAC and ALR laws that were implemented within 6 months of each other. Aspler and colleagues also found evidence of reduced alcohol (beer) consumption in several states following implementation of .08 laws.

In the TIRF report, considerable time is spent discussing the Apsler et al. (1999) study (pp. 44-47). Although Apsler and colleagues clearly state that the significant decreases found in 5 of the 11 states in the ratio of drinking drivers to non-drinking drivers indicate an effect of .08 BAC laws, the TIRF report states, "Only 2 of 11 states-Vermont and Florida-revealed a significant decrease in alcohol-involved fatalities associated with lower BAC limits." Alcohol-related fatalities include crashes caused by impaired pedestrians who are unaffected by .08 legal limit for drivers. This is why the most persuasive studies have employed drinking drivers in crashes as the criterion measure. In the case of North Carolina, this selection of a criterion measure resulted in an entirely different result: the Apsler et al. study found a significant effect of .08 BAC in North Carolina, whereas the Foss et al. (1998) study (see below) did not. By stating that "Only 2 of 11 states . . .revealed a significant decrease...," TIRF has mischaracterized the basic premise and the conclusion of the study, as stated by the original authors. The .08 law was concluded to be effective by the authors, especially in combination with ALR laws.

The third study (Foss et al., 1998) analyzed the effects of a .08 BAC law implemented in North Carolina, a state that had already been experiencing a significant decline in alcohol-related fatalities. Foss and colleagues concluded that there appears to have been little clear effect of the lower BAC limit in North Carolina. The data clearly showed that North Carolina experienced significant reductions in alcohol-related crashes and fatalities both before and after implementation of the .08 BAC legislation. The results in North Carolina directionally supported a conclusion that .08 BAC laws, when added to existing laws and programs, are associated with reductions in alcohol-related fatalities.

More recently, another study has been released by Boston University (Hingson, Heeren, & Winter, 2000). This study analyzed the effectiveness of .08 BAC laws in six states enacting .08 laws in 1993 and 1994. They found an overall 6% reduction in alcohol-related deaths in these six states and estimated that 400 to 500 additional lives could be saved each year if every state had had a .08 BAC law. This study took into account many of the criticisms of previous studies by the same authors. The TIRF report (p. 39) states the following concerning the Hingson et al. study: "Nevertheless, the consistency of the findings in the individual states and the overall significant effect of the aggregate data suggest that the lower BAC limit, when combined with ALR, may have a beneficial impact on alcohol-related fatal crashes." Apparently, the TIRF authors conceded some effect of .08 BAC laws from this study.

Two other studies of the effectiveness of lowering the illegal BAC limit to .08 have recently appeared in the literature (Dee, 2001; Eisenberg, 2001). Dee (2001) used somewhat novel, panel-based evaluations of .08 laws, which in many respects address methodological limitations of previous studies. Fourteen states that adopted .08 BAC laws between 1982 and 1998 were analyzed and compared to the rest of the states that did not adopt .08 laws using traffic fatality rates as the key measure. Alaska, Hawaii, and the District of Columbia were excluded from the analyses. The regression analyses controlled for the potential effects of .10 BAC laws, administrative license revocation laws, dram shop laws, mandatory jail time for first DUI offenses, zero tolerance laws for youth, mandatory seat belt laws (primary and secondary enforcement, separately), raising the speed limit on interstate highways to 65 and 70 miles per hour (mph), vehicle miles traveled in the state, state unemployment rate, and state personal income per capita. A statistically significant reduction of 7.2% in traffic fatality rates was associated with the adoption of .08 BAC laws. The author estimated that 1200 lives could be saved annually if the additional 23 states with ALR laws also adopted .08 BAC laws.

Eisenberg (2001) conducted a baseline analysis of the effects of .08 laws similar to that of Dee (2001). but with the addition of controls for graduated driver licensing (GDL) laws and the presence of MADD in the state. Eisenberg's analysis showed that the .08 BAC limit is associated with a 5% reduction from the mean traffic fatality rate and that .10 BAC limit laws are associated with a 2.4% reduction. This estimate suggests that lowering the limit from .10 BAC to .08 BAC would garner a further reduction of 2.6% from the mean total fatal crash rate. This is a statistically significant reduction ($p<.05$).

The TIRF report did not mention either of the above recent reports on the positive effectiveness of .08 BAC. These studies were certainly available before TIRF published their critical review.

GAO REVIEW OF .08 BAC LAW EFFECTIVENESS

A report by the U.S. Government Accounting Office (GAO, 1999) reviewed the .08 BAC studies available at that time and concluded that, although the evidence of impact of .08 BAC laws, by themselves, is not conclusive, "there are, however, strong indications that .08 BAC laws, in combination with other drunk driving laws (particularly license revocation laws), sustained public education and information efforts, and vigorous and consistent enforcement, can save lives." The GAO also concluded that a .08 BAC law can be an important component of a state's overall highway safety program. GAO's conclusion that the evidence of the effectiveness of the .08 BAC laws "by themselves" was not "conclusive" has been misconstrued in the TIRF report (p. 82) to say that GAO concluded that the laws were not effective. It does not say that. It simply says that the evidence is not conclusive that these laws are effective by themselves. In response to this suggestion, we must point out that all research is equivocal (and, therefore, inconclusive), and no law ever operates by itself. The U.S. Department of Transportation reviewed the same studies cited by GAO and characterized the evidence of effectiveness of .08 BAC laws as "consistent and persuasive." GAO, in the final paragraph of its 1999 report (p. 24), stated that "although we characterize the strength of the study results differently, we and DOT reach essentially the same conclusion regarding the effectiveness of .08 BAC laws, both by themselves and in combination with other measures."

SUMMARY OF .08 BAC LAWS

The scientific evidence is clear. Virtually all drivers, including experienced drinkers, are significantly impaired by the time they reach .08 BAC with regard to critical driving tasks such as choice reaction time, braking, steering, lane changing, judgment, and divided attention. A 1988 review of 177 studies clearly documented this impairment (Moskowitz & Robinson, 1988), and a 2000 review of 112 more recent studies provided even stronger evidence of impairment at .08 BAC (Moskowitz & Fiorentino, 2000). Together, these two reviews have summarized the findings of nearly 300 studies of impairment at low-BAC levels, and the findings are remarkably consistent.

A comprehensive laboratory study examined driving skills among 168 subjects of both sexes and various ages and drinking histories. This study not only confirmed significant impairment in all measures of performance at a .08 BAC, it also found that impairment was present in relatively consistent levels across all age groups, sexes, and drinker types (Moskowitz et al., 2000).

The results of studies of crash risk are just as clear. These studies compare the distribution of BAC levels among crash-involved drivers with the distribution of BAC levels among drivers using the roadways but not involved in crashes. This epidemiological research has consistently shown that the risk of being involved in a crash begins to increase at very low BACs, is significantly elevated at .05 to .08 BACs (particularly for young male drivers), and rises very rapidly thereafter. In fact, a new epidemiological

study, which compared data from a national roadside survey with data from all drivers involved in fatal crashes over a 2-year period, showed that the risk of being killed in a single-vehicle fatal crash at .08 BAC is 11 to 52 times as great as it is at .00 BAC. That same study indicated that the risk of dying in a single-vehicle crash at .05 BAC was 4 to 17 times that of drivers at .00 BAC (Zador et al., 2000).

The research is consistent and persuasive that lowering the BAC limit to .08 is effective in reducing alcohol-related crashes. A number of independent studies have been conducted on most of the 18 states that have enacted .08 BAC laws and where evaluation data are available. These studies have shown that .08 BAC laws are particularly effective in conjunction with ALR laws, which already have been enacted in 41 states in the United States. The 1999 GAO review of these studies, cited above, confirmed this relationship. On average, .08 BAC laws have resulted in 6% to 16% reductions in alcohol-related crashes, fatalities, or injuries. The most comprehensive (50-state) study found an average 8% impact. This study, like several others, found that .08 BAC laws were just as effective in reducing alcohol-related fatalities involving high-BAC drivers as they were in reducing fatalities involving low-BAC drivers.

Another study, published in 2000 by the Boston University School of Public Health (Hingson et al., 2000), found that .08 BAC laws in six states enacting such laws in 1993 and 1994 resulted in an average 6% reduction in fatalities involving a driver with a BAC of .10 or greater. Three studies-two conducted at Boston University (Hingson et al., 1996; Hingson, 2000) and one conducted by PIRE (Voas et al., 2000)-have estimated that .08 BAC laws, if enacted in all remaining states, could save an average of approximately 500 additional lives each year. These estimates have been remarkably consistent in spite of different analytical methods.

Perhaps most importantly, an independent task force, supported by the Centers for Disease Control (CDC), conducted an extensive and systematic review of all of the available studies of the effectiveness of .08 BAC laws (Shults et al., 2001). This task force found a median 7% reduction in measures of alcohol-related fatal crashes associated with .08 BAC laws. Because of this review, the CDC task force strongly recommended the enactment of .08 BAC laws as a measure for reducing alcohol-related fatalities and injuries. CDC's review was published in November 2001; the TIRF report was published in May 2002. Why wasn't this objective, comprehensive meta-analysis conducted by a CDC task force of prominent scientists who found a significant effect for .08 BAC laws included in the TIRF assessment of lower BAC limits? It was certainly available to the TIRF authors before their report was issued.

Figure 1 (an update of Shults et al., 2001, figure 2) summarizes the effectiveness of .08 laws in graphic form. It shows a consistency and direction in the change in alcohol-related traffic fatalities that has occurred after .08 laws were adopted in the various states.

Figure 1. Effectiveness of .08 BAC Laws in the United States.
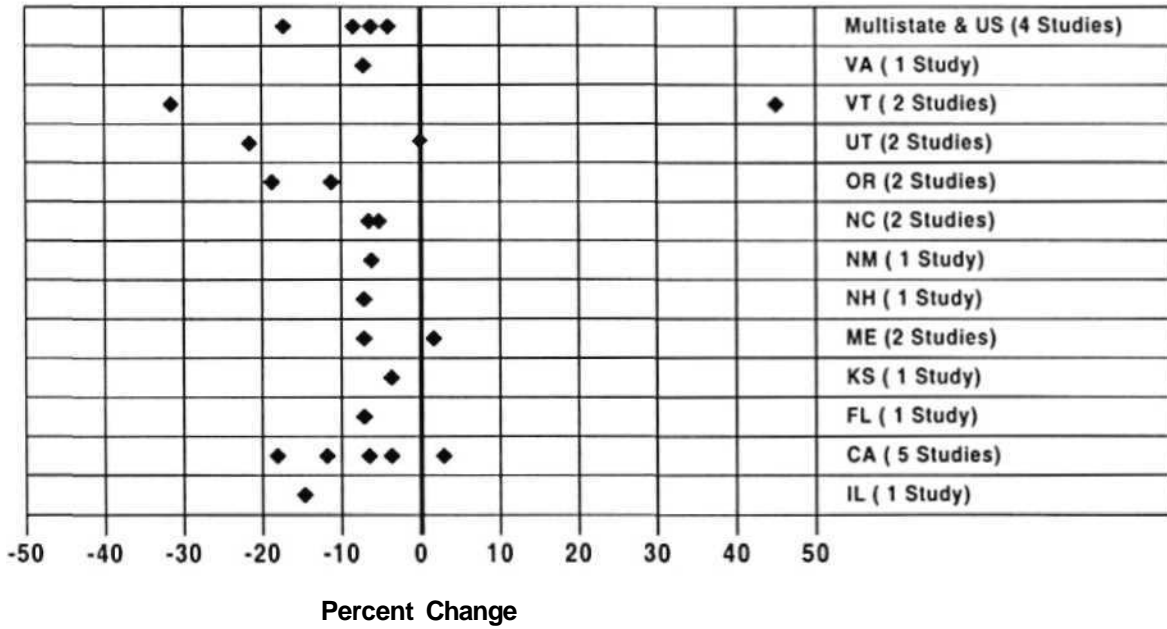

Percent Change

Figure 1. Percentage change in alcohol-involved motor vehicle fatalities
following enactment of .08 laws.

Table 2 summarizes all of the studies of the effectiveness of .08 BAC laws in the U.S. The first two columns in Table 2 list the individual studies and summarize the main results. The last two columns address any TIRF criticism of the studies, as appropriate.

Table 2. Studies of the Effects of Lowering the Illegal BAC Limit
from .10 to .08 in the United States

STUDY	RESULTS	TIRF CRITICISM	COMMENTS
Research and Evaluation Associates (1991). "The Effects following the Implementation of a 0.08% Limit and Administrative Per Se Law in California."	12% reduction in alcohol-related traffic fatalities associated with the .08 and ALR laws.	Results based on only one year after adoption of law. Could not separate effects of .08 law and ALR law.	Numerous studies that TIRF endorses look initially at the first year after law adoption, and then follow up with more long-term evaluation.
Johnson & Fell (1995). "The Impact of Lowering the Illegal BAC Limit to .08 in Five States in the U.S."	Significant reductions in alcohol-related fatal crashes in 4 of 5 states ranging from 4 to 40%.	The majority (21) of the measures showed no change associated with the lower limit, so the results are inconclusive at best.	TIRF failed to state that 26 of the 30 measures showed decreases associated with .08 BAC, with 10 measures showing significant reductions.
Rogers (1995). "The General Deterrent Impact of California's 0.08% Blood Alcohol Concentration Limit and Administrative Per Se License Suspension Laws."	7% reduction in nighttime fatal and serious injury crashes. No significant decrease in alcohol-related fatal crashes.	Close proximity of .08 BAC and ALR laws renders it virtually impossible to identify a unique independent effect of either one alone.	TIRF did not mention the 7% reduction in fatal and serious injury crashes found by Rogers. Why?
Hingson, Heeren & Winter (1996). "Lowering State Legal Blood Alcohol Limits to .08 Percent: The Effect on Fatal Motor Vehicle Crashes."	16 to 18% reduction in proportion of fatal crashes involving fatally injured drivers with BACs > .08 and BACs>.15.	The results of the study are not significantly compelling to form the basis for policy without further replication using a stronger research design. (Nine pages of criticism devoted to this study.)	Follow-up study using stronger research design did show significant reductions due to .08 BAC.
Apsler, Char, Harding, & Klein (1999). "The Effects of .08 BAC Laws."	The .08 BAC law is associated with significant reductions in alcohol-related fatal crashes, alone or in conjunction with ALR, in 7 of 11 states.	Every state that experienced a decrease in alcohol-involved fatalities had ALR in effect. This suggests that, by itself, a lower BAC limit had little impact on alcohol-involved fatalities.	The .08 BAC law like all drinking/driving laws act in conjunction with other state laws, such as ALR, implied consent, vehicle impoundment, etc. to reduce deaths related to fatal crashes. Testing a law in isolation is impossible.
Foss, Stewart & Reinfurt (1999). "Evaluation of the Effects of North Carolina's 0.08% BAC Law."	No clear effect of .08 BAC law on already declining alcohol-related fatalities.	The analysis of a variety of indicators revealed no significant decrease in alcohol-related crashes in North Carolina that could unambiguously be attributed to the introduction of a lower BAC limit.	Apsler et al. (1999) did find a significant decrease in alcohol-related fatalities attributed to the .08 law in North Carolina.

STUDY	RESULTS	TIRF CRITICISM	COMMENTS
Voas, Tippetts & Fell (2000). "The Relationship of Alcohol Safety Laws to Drinking Drivers in Fatal Crashes."	The .08 BAC laws are associated with 8% reduction in fatal crashes involving drinking drivers. If all states adopt a .08 BAC, an estimated 590 lives could be saved.	Important factors such as changing attitudes and norms surrounding drinking and driving, increased activism, greater use of sobriety checkpoints, and extensive media coverage were not modeled. All of these factors may well have contributed to the overall reduction in alcohol-related crashes.	The same holds true for all of TIRF's studies of ALR and GDL. This study controlled for as many factors as possible.
Hingson, Heeren & Winter (2000). "Effects of Recent 0.08% Legal Blood Alcohol Limits on Fatal Crash Involvement."	6% reduction in alcohol-related fatal crashes associated with .08 BAC laws in six states. If all states adopt .08 BAC, an estimated 400 to 500 lives could be saved.	Many of the same criticisms raised in reference to the earlier Hingson et al. (1996) study can be applied to this study. Nonetheless, the consistency of the findings in the individual states and the overall significant effect of the aggregated data suggest that a lower BAC limit, when combined with ALR, may have a beneficial effect on alcohol-related fatal crashes.	Many of the outcomes of the first study were taken into account in the second study. We agree with the TIRF conclusion that .08 BAC may have a beneficial effect.
Voas, Taylor, Kelley Baker & Tippetts (2000). "Effectiveness of the Illinois .08 BAC Law." Voas, Tippetts and Taylor (2001)	The .08 law reduced the number of drinking drivers in fatal crashes by 13.7% in first 12 months. Follow-up study confirmed 13.7% reduction over 30 months after .08 law adopted in 1997.	The authors indicated that the magnitude of the reduction (13.7%) was likely to wane in subsequent years.	The follow-up study in Illinois revealed a 13.7% reduction up to 30 months after the adoption of the .08 BAC law. Why was this not mentioned?
Shults, Elder, Sleet, Nichols, Alao, Carande-Kulis, Zaza, Sosin & Thompson (2001). "Reviews of Evidence Regarding Interventions to Reduce Alcohol-Impaired Driving."	Median 7% reduction in measures of alcohol-related fatal crashes associated with .08 BAC laws. CDC strongly recommends all states adopt .08 BAC laws.	Although this study was cited in the references of the TIRF report, there was no discussion of it in the text.	Very important study, but was overlooked by TIRF. Why?
Dee (2001). "Does Setting Limits Save Lives? The Case of 0.08 BAC Laws"	Statistically significant 7.2% reduction in the traffic fatality rate associated with the adoption of .08 laws in 14 states	Not reviewed or referenced by TIRF.	Very important study with positive findings on the effectiveness of .08 BAC laws. Why was it overlooked by TIRF?
Eisenberg (2001) "Evaluating the Effectiveness of a 0.08% BAC Limit and Other Policies Related to Drunk Driving."	Statistically significant reduction of 2.6% in the fatal crash rate associated with .08 BAC laws in 14 states.	Not reviewed or referenced by TIRF.	Another important study overlooked by TIRF.

A Summary of the Evidence for Lowering the BAC Limit to .05 or Less

Several countries have conducted evaluations of lowering their illegal BAC limits to .05 or less. For example, a long-term study of the .05 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 (Noordzij, 1994). Another study from France evaluated the impact of lowering its BAC limit from .08 to .05 in 1996. Annual alcohol-related crash fatalities fell from approximately 100 before the legal change to 64 in 1997 in the province of Haute-Savoie, where the study was conducted (Mercier-Guyon, 1998).

Sweden's more recent lowering of their limit to .02 BAC also showed positive results. Although Sweden adopted a .05 BAC limit in the 1950s, the move to an even lower limit in 1990 further improved traffic safety. Norstrom and Laurell (1997) reported that in the 6 years following the introduction of the .02 BAC limit, there was a 9.7% reduction in fatal crashes, an 11% reduction in single-vehicle crashes, and a 7.5% reduction in all crashes. Norstrom and Laurell noted that the most significant effects occurred in fatal and single-vehicle crashes, the two categories in which alcohol is most likely to be involved. This suggests that crash reductions cannot be attributed solely to existing trends but were caused, in part, by the lower BAC limit. These results were supported by another study that estimated that the .02 BAC limit resulted in an approximate 10% decrease in fatal crashes and a 12% decrease in severe personal injury crashes (Borschos, 2000).

In 1988, the illegal BAC limit was lowered from .08 to .05 in Austria. A recent study of the new law found that there was an overall 9.4% decrease in alcohol-related crashes relative to the total number of crashes (Bartl & Esberger, 2000). 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 concluded that "lowering the [il]legal BAC-limit from .08 to .05% in combination with intensive police enforcement and reporting in the media leads to a positive short-term effect." This provides support for the view that a .05 BAC illegal limit, as part of a comprehensive approach to fighting impaired driving, can have beneficial effects.

Henstridge et al. (1995) conducted a rigorous time-series analysis of random breath testing (RBT) and .05 BAC laws in Australia, controlling for many factors that the TIRF report implied had not been considered. The Australia study controlled for 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 experienced meaningful declines in alcohol-related crash measures. After Queensland, Australia, reduced its per se BAC limit to .05 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 BAC limit in New South Wales was estimated to have reduced serious collisions by 7%, fatal collisions by 8%, and single-vehicle nighttime collisions by 11%. This translated into the averting of an estimated 605 serious, 75 fatal, and 296 single-vehicle nighttime collisions per year. Although the .05 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 and Kraus (1988) evaluated the effects of lowering the BAC limit in Queensland from .08 to .05 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 hospitahzation) and a 5.5% reduction in nighttime property damage crashes associated with the .05 BAC limit in the first year. The authors attribute some of the crash reductions in the second and third years after the adoption of .05 BAC to, in part, increased enforcement. When lowering the illegal BAC limit results in increased enforcement, it should be considered a benefit of the law, not a drawback, as implied by Smith and Kraus.

In South Australia, the illegal BAC limit was not lowered to .05 until 1991. Kloeden and McLean (1994) reported that the number of nighttime drivers who had been drinking was reduced by 14.1% following the adoption of the law. A second study of South Australia found that the .05 BAC limit did not signifi-cantly affect the number of fatally injured drivers who were legally impaired (McLean, Kloeden, McColl, & Laslett, 1995). 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 (Brooks & Zaal, 1992). Given that drivers at high-BAC levels are at the greatest relative risk of being involved in a crash, such reductions would substantially affect the number of alcohol-related deaths and injuries in Canada. TIRF has 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 (Simpson, Mayhew, & Beirness, 1996). The recent study by Zador et al. (2000) 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 BAC limit would appear to be aimed at drivers with moderate BACs, its potential effect on the behavior of high-BAC drivers has very important traffic safety implications.

The evidence on .05 BAC limits indicates that if Canada adopts a Criminal Code .05 limit, and the new law is publicized and enforced, substantial reductions in crashes involving drinking drivers could be realized.

Table 3 summarizes the research on lowering the BAC limit to .05. It is noteworthy that TIRF did not even address three of the five known studies.

Table 3. Studies of the Effects of Lowering the Illegal BAC Limit to .05

STUDY	RESULTS	TIRF CRITICISM	COMMENTS
Noordzij (1994). "Decline of drinking and driving in the Netherlands."	Percent of drivers with BACs > .05 from roadside surveys decreased from over 15% in the years prior to the .05 limit to 2% in the first year and then leveling off at 12% for 10 years after the law change.	Not referenced. Not discussed.	Study was published in 1994.
Mercier-Guyon (1998). "Lowering the BAC limit to 0.05: Results of the French experience."	Alcohol-related traffic crash fatalities decreased from 100 prior to lowering the limit to 64 in 1997 right after the law change in the French Province where the study was conducted.	Not referenced. Not discussed.	Study was presented at the Transportation Research Board Meeting (TRB) in 1998. TIRF was present at that meeting.
Bartl & Esberger (2000). "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."	Not referenced. Not discussed.	Published in 2000 at ICADTS. TIRF was present at that meeting.
Henstridge, Homel, & Mackay (1997). "The long-term effects of random-breath testing in Adelaide."	Queensland experienced an 18% reduction in fatal crashes and a 14% reduction in serious crashes associated with lowering the BAC limit to .05. 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 single-vehicle night-time crashes associated with lowering the BAC limit to .05.	Surrogate measures (of alcohol) had to be used because data on alcohol involvement was not available. Although the lower BAC limit in New South Wales appears to have had an impact, the conclusion appears tenuous in the absence of more direct data.	TIRF uses these surrogate measures in many reports, including their "hard-core" drinking driver analyses. This is a double standard. Single-vehicle nighttime crashes are an accepted surrogate for alcohol-related crashes especially when BAC data on drivers involved in crashes is not available or is not complete.
Smith (1999). "Effect in 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. Partly the result of increased enforcement.	The study suffered from a weak design and lack of information about alcohol in the crash data.	Using nighttime crashes as a proxy or surrogate for alcohol is an acceptable scientific method and has been used in numerous studies including those conducted by TIRF.

A BRIEF SUMMARY OF THE LITERATURE ON IMPAIRMENT AT .05 BAC

Howat, Sleet, and Smith (1991) conducted a review of the literature from experimental and laboratory research on the impairment effects at .05 BAC. Many of the studies reviewed showed statistically significant decrements in driving performance at .05 BAC or below. The authors concluded that young and inexperienced drinkers appeared to be at the greatest risk at .05 BAC. They recommended that setting a uniform .05 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.

Moskowitz and Fiorentino (2000) reviewed 112 scientific articles regarding the effects of alcohol on driving related skills that were published between 1981 and 1997. They concluded that by .05 BAC the majority of experimental studies examined reported significant impairment. After testing 168 drivers, Moskowitz et al. (2000) concluded that the majority of the driving population is impaired in some important measures at BACs as low as .02 BAC.

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 .05 BAC (Moore & Gerstein, 1981; DHHS, 1987; TRB, 1987). 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 BAC.

A BRIEF SUMMARY OF THE LITERATURE ON THE RISK OF A CRASH AT .05 BAC

Two recent epidemiological studies (Zador et al., 2000; Compton et al., 2002) 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 BAC compared to drivers at .00 BAC. Zador et al. (2000) estimate that the risk of being involved in a fatal crash for drivers at BACs as low as .02-.04 is anywhere from 2 times to 5 times higher than for drivers with BACs = .00, 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 compared to drivers with .00 BACs, 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 than drivers with BACs = .00.

As mentioned earlier, Compton et al. (2002) estimated that the risk of being involved in any crash for drivers with BACs at .05 is 38% higher than drivers with BACs = .00. At .06 BAC, that risk is 63% higher, and at .07 BAC the risk is 109% higher than drivers with BACs = .00.

A Summary of the Evidence for Lowering BAC Limits for Youth

The United States has taken the lead in adopting lower BAC limits for underage youth. In 1984, the U.S. Congress adopted measures to sanction states that did not raise their minimum legal drinking age to 21. By 1988, all states had enacted such laws. Because it was illegal for those younger than 21 to drink any alcohol, it seemed logical that underage drivers should have no alcohol in their systems when they drove. In 1995, the U.S. Congress passed a law requiring states to adopt so-called zero tolerance laws for drivers younger than 21. By 1998, all states had passed laws making it illegal for any driver younger than 21 to have a positive BAC. In some states, any BAC at .02 or greater is illegal for youth; in some states, the level is set at .01 BAC or greater; in the remaining states, any BAC higher than .00 is considered illegal for drivers younger than 21. These zero tolerance laws for youth lowered the illegal BAC limits for that population and have proven to be effective in reducing underage-drinking-driver fatal crashes.

A study of zero tolerance laws in Florida, Maine, Oregon, and Texas was recently conducted by Mid-America Research Institute under a NHTSA contract. Nighttime single-vehicle crashes were reduced by as much as 36% in Maine and 40% in Oregon, as little as 5% in Florida, and not at all in Texas for drivers subject to the new zero tolerance laws. Maine and Oregon, which had more experience with the law and had higher levels of enforcement and publicity, had the higher levels of effectiveness, as would be expected (Lacey, Jones, & Wiliszowski, 2000).

The Maryland .02 BAC law for drivers younger than 21 was evaluated by Dunlap and Associates, Inc., under a NHTSA contract with the primary objective of determining the effects of the law. The law went into effect on January 1, 1989. The number of drivers younger than 21 involved in crashes who "had been drinking" was collected from 1985 through 1990. An 11% decrease was found comparing the before and after crash data associated with the zero tolerance law. Further, this reduction was not associated with a general reduction in alcohol-involved crashes or in all crashes involving drivers younger than 21 (Blomberg, 1992).

Hingson, Howland, Heeren, and Winter (1992) from the Boston University School of Public Health compared four states that passed zero tolerance laws before 1989 (Maine, New Mexico, North Carolina, and Wisconsin) with four nearby states that had no such law (Massachusetts, Arizona, Virginia, and Minnesota, respectively). Equal numbers of pre- and post-law years were examined in each of the four pairs of states monitoring nighttime fatal crashes involving teenage drivers in the age groups targeted by the law. Study states set different ages for the BAC law: New Mexico and North Carolina, younger than age 18; Wisconsin, younger than age 19; and Maine, younger than age 20. As a group, the states that lowered their BAC levels for youth had significantly greater post-law reductions in nighttime fatal crashes among adolescents relative to adults (34% teens vs. 7% adults) than the comparison states (26% teens vs. 9% adults).

In a follow-up study, Hingson et al. (1994) compared 12 states (North Carolina, Wisconsin, Oregon, Arizona, Maine, Maryland, Ohio, Vermont, New Mexico, California, Rhode Island, and Georgia) that lowered illegal BACs for youth before 1991 with 12 comparison states (Virginia, Minnesota, Washington, Utah, Massachusetts, Pennsylvania, Indiana, New Hampshire, Colorado, Texas, Connecticut, and Alabama). During the post-law period, the proportion of fatal crashes that involved single vehicles at night declined 16% among young drivers targeted by those laws, while it rose 1% among drivers the same age in comparison states where BAC limits were not changed. Adult crashes declined

only 5% and 6% in the two groups during the post-law period. The study found that significant declines in the proportion of nighttime single-vehicle crashes among young drivers occurred only in states that lowered the underage BAC limit to .02 or lower. In other states that reduced the young driver BAC limit to .04, .05, or .06, there was no significant difference from states that did not lower the limit at all. (Note: All states have subsequently lowered their limits to .02 or lower.) The decline was only noticed for states that dropped the BAC level to .00 or .02, true zero tolerance laws rather than the mixed-message laws for youth.

Zwerling and Jones (1999) conducted a systematic review of zero tolerance laws and their effect on alcohol-related injuries and fatalities. Six studies met their strict selection criteria. All six studies showed reductions in injuries and fatalities associated with the implementation of zero tolerance laws: in three studies, the reductions were statistically significant. The greatest reduction (22%) was reported in one study for single-vehicle nighttime fatal crashes involving underage drivers in those states adopting zero tolerance laws. Despite some methodological difficulties cited by the authors, the six studies presented "accumulating evidence in support of the effectiveness of these laws." The total evidence is strengthened even more because similar results were found in different countries (Australia and the United States) using different methods and different outcome measures.

Voas, Tippetts, and Fell (2003) used data on all drivers younger than 21 involved in fatal crashes in the United States from 1982 through 1997. Quarterly ratios of BAC-positive to BAC-negative drivers in each of the 50 states were analyzed in a pooled cross-sectional time series approach. After accounting for differences among the 50 states in various background factors, changes in economic and demographic factors within states over time, and the effects of other related laws, results indicated a significant 24.4% reduction in alcohol-positive drivers younger than 21 who were involved in fatal crashes associated with the zero tolerance laws. The policy in the United States of making it illegal for underage drivers to have any alcohol in their systems appears to have been effective in reducing the proportion of fatal crashes involving youthful drinking drivers.

In the *Scope* of the TIRF report (p. 5), the authors state:

"This review excludes studies of the impact of lower BAC limits for young or new drivers, commercial drivers....Such studies have limited relevance to the present issue. Therefore, in the interests of clarity and focus, it was decided to restrict the review to studies that have examined the impact of lowering the BAC limit for the general population of drivers."

We strongly disagree with this contention. Lowering the limits for drivers younger than 21 in the United States is directly relevant to the issue of lowering the limit to .05 BAC in Canada. Before the adoption of zero tolerance laws, young drivers were under the same BAC limit standards as adults. Adopting zero tolerance laws is the same as lowering the BAC limit from .10 (or .08) to .02 for drivers younger than 21. Young drivers perceive this change the same way that adults perceive lowering the limit to .08 BAC - that the state is getting tougher on impaired driving. The fact that lowering the BAC limits for youth had an even greater effect on them than lowering the limits for adults should not be lost in the discussion. Besides, if Canada does lower the illegal per se limit to .05 BAC, that will affect young Canadian drivers, just as zero tolerance laws affect young U.S. drivers.

Table 4 summarizes the research on lowering the BAC limit for youth. Notable is the fact that TIRF excluded these relevant studies from their critical review.

Table 4. Studies of the Effectiveness of Lowering the BAC Limit for Youth

STUDY	RESULTS	TIRF CRITICISM	COMMENTS
Blomberg(1992). "Lower BAC limits for youth: Evaluation of the Maryland .02 law."	A significant 11% decrease in police-reported alcohol crashes involving drivers less than 21 years of age associated with the .02 law. Decrease was 50% in six communities that highly publicized the law and the enforcement of it.	The TIRF review excludes studies of the impact of lower BAC limits for young or new drivers. These studies may provide examples of lowering BAC limits, but such laws are only applicable to a specific subset of drivers. Such studies have limited relevance to the issue.	We disagree with this exclusion. Lower limits for young drivers are related to the bigger issue of lowering limits in general and should be included in any objective, scientific analysis and review.
Hingson, Heeren, Howland, & Winter (1992). "Reduced BAC limits for young people (Impact on night fatal crashes)."	As a group, states that lowered BAC limits for youth had significantly greater postlaw reductions in nighttime fatal crashes among drivers less than 21 years of age relative to drivers older than 21 (34% for teens; 7% for adults) than the comparison states that did not lower the limit (26% for teens; 9% for adults).	Not referenced. Not discussed for reasons stated above.	Relevant to the issue of the effects of lowering BAC limits.
Hingson, Heeren, & Winter (1994). "Lower legal blood alcohol limits for young drivers."	Single-vehicle nighttime fatal crashes declined 16% in 12 states that lowered the limit for youth while it rose 1% in 12 comparison states that did not lower the limit for youth. Adult nighttime fatal crashes declined 5% and 6% respectively in the two groups.	Not referenced. Not discussed for reasons stated above.	Relevant to the issue of lowering BAC limits.
Zwerling& Jones (1999). "Evaluation of the effectiveness of low blood alcohol concentration laws for younger drivers."	Systematic review of the effects of zero tolerance laws indicate that all six studies showed significant reductions in injuries or fatalities associated with the implementation of lower BAC limits for youths less than 21.	Not discussed for reasons stated above.	More evidence that lower BAC limits are effective.
Voas, Tippetts, & Fell (2003). "Assessing the effectiveness of minimum legal drinking age and zero tolerance laws in the United States."	Lower limits for youth have resulted in an average 24.4% reduction in alcohol-positive drivers less than 21 years of age involved in fatal crashes since their implementation in the United States.	Not discussed.	More evidence of the effectiveness of lower BAC laws.

Public Support for Lower BAC Limits

Surveys in the United States indicate that most people believe they should not drive after two or three drinks (Royal, 2000). This is equivalent to a BAC of .05 for many people (National Highway Traffic Safety Administration, 1994). Considering this reported attitude, the public favors a BAC limit of .05. The countries that have already adopted .05 BAC as their limit do not report any public outcry that the limit is too strict.

The BAC Limits in Canada Section (p. 15) of the TIRF report states:

"In this context, it should be noted that for most drivers in Canada, changing the BAC in the Criminal Code would not reduce the threshold BAC at which sanctions first occur for drivers. Other than Quebec, all provinces currently have a BAC limit of 50 mg/dl (40 mg/dl in Saskatchewan). Changing the BAC limit in the Criminal Code would not strictly speaking lower the BAC limit but rather serve to lower the limit at which criminal sanctions are first imposed."

We would ask the following questions concerning that statement:

- What proportion of the drivers are aware that there is an administrative sanction at .05 BAC? The administrative license sanction laws in the U.S. are all set at the illegal (criminal) BAC limit (.08 or .10). This combination is very effective (as was acknowledged by TIRF). Why is the administrative limit different from the criminal limit in Canada?

- Has the separate .05 BAC threshold for administrative sanctions been evaluated for its effectiveness in Canada? We are not aware of any studies. Lowering the Criminal Code offense to .05 BAC in other countries has proven to be effective.

- Isn't that the whole point of lowering the limit to .05 BAC to make it a criminal offense at that level, which will deter drivers from drinking and driving in the first place?

Conclusion

When all of the international evidence on lowering BAC limits is assembled, reviewed, and summarized, we conclude that Canada should strongly consider lowering the illegal (criminal) BAC limit to .05.

Mann, Macdonald, Stoduto, Bondy, & Shaikh (1998) reviewed all of the available scientific evidence in assessing the potential impact of lowering the BAC limit to .05 in Canada. 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 very thoughtful and thorough review concluded that the potential impact of a .05 BAC in Canada could be a reduction in motor vehicle crash fatalities on the order of 6-18%. This translates to 185 to 555 lives saved each year in Canada if .05 BAC Criminal Code is adopted.

More recently, Chamberlain and Solomon (2002) conducted an extensive review of all of the issues surrounding a .05 BAC criminal code limit for Canada. The review summarized the effects of low doses of alcohol on driving behavior, the relative risk of a crash at various BAC levels, the experience in other countries with lowering BAC limits, and answered criticisms of adopting a .05 BAC limit in Canada. This comprehensive review of the issues presents a compelling case for a .05 criminal BAC limit in Canada.

In general, the literature reveals that lowering the BAC illegal limit reduces drinking driver fatal crashes - whether it is from .10 BAC to .08 BAC or from .08 BAC to .05 BAC for adults, or from some higher BAC level to .02 BAC (or lower) for youth. The general public does not think people should drive after two or three drinks. This translates to .05 BAC for most people. Laboratory research shows that most people are significantly impaired with regard to critical driving tasks at .05 BAC.

It is not readily apparent why the TIRF report came to the conclusion that it did about lowering the limit to .05 in Canada. The overwhelming evidence from the scientific community supports the conclusion that lowering BAC limits is effective in reducing alcohol-related traffic fatalities.

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