Lowered Legal Blood Alcohol Limits for Young Drivers: Effects on Drinking, Driving, and Driving-After-Drinking Behaviors in 30 States

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A B S T R A C T

Objectives. This study evaluated the effects on drinking and driving of lowered allowable blood alcohol concentration (BAC) limits for drivers younger than 21 years in 30 US states between 1984 and 1998.

Methods. Outcome measures were based on self-reports from a cross-sectional sample of more than 5000 high school seniors in 30 states surveyed before and after BAC limits were implemented in their states.

Results. Frequency of driving after any drinking and driving after 5 or more drinks declined 19% and 23%, respectively. Lower BAC limits did not affect overall amount of drinking or total number of miles driven.

Conclusions. Significant beneficial effects of lowered youth BAC limits have appeared despite limited publicity and enforcement of the new laws. (*Am J Public Health.* 2001;91:801–804)

Rates of alcohol-related traffic crashes in the United States have declined significantly in the past 2 decades, both among the general adult driving population and among teenagers.[1,2] The literature on driving while intoxicated indicates that several policies have been effective in reducing alcohol-related crashes among the general driving population.[3] In addition to efforts aimed at controlling driving while intoxicated among all drivers, several initiatives have specifically targeted teenaged drivers—most notably, raising the legal drinking age to 21 years, which reduced teenaged crash deaths by 15% (see Wagenaar[4] for a review of more than 50 studies). The study reported here evaluated the effects of laws that reduced the allowable blood alcohol concentration (BAC) for teenaged drivers to low limits (0.00–0.05 g per 100 mL), in contrast to the higher 0.08 or 0.10 limits typical in US states for adult drivers.

Before 1983, no state had enacted a law setting a reduced BAC limit specifically for minors, even though BAC limits for the general driving public were well-established law in all 50 states and the District of Columbia. Between 1985 and 1992, a dozen states passed laws that lowered BAC limits for youths only. In 1991, the US Congress passed legislation that provided incentives for states to enact reduced BAC limits for youths (23 USCA §410). Four years later, Congress strengthened the federal law, providing that any state not enacting a youth BAC limit of 0.02 or less by October 1, 1998, would lose 5% of its federal highway funds for that year and lose 10% of its highway funds in each subsequent year until it enacted a 0.02 youth BAC level (23 USCA §161).

Three published studies have examined the effects of lowered BAC laws on teenaged driving after drinking and fatal car crash involvement.[5–7] The limited evidence to date indicates that lowered BAC limits for youths are effective in reducing driving after drinking and crash involvement among teenagers. Our first objective was to replicate these findings with a much larger sample of 30 states. Our second objective was to better understand the nature of the effects of this policy. For example, do lower youth BAC limits reduce teenaged drinking, thereby reducing drinking and driving and alcohol-related car crashes? Or does this policy affect driving after drinking without affecting the amount or pattern of teenaged drinking? Finally, because many teenagers ride as passengers with other teenaged drivers, we examined whether youth BAC limits affect the prevalence or frequency of riding with a driver who had been drinking.

Methods

Outcome data were from a large-scale series of annual surveys of high school seniors across the United States from the Monitoring the Future project, conducted by the Institute for Social Research at the University of Michigan, Ann Arbor. Adequate samples of teenagers surveyed before and after lowered BAC limits were implemented were available in 30 states that changed their BAC laws between 1984 and 1998. States included in the study, ages covered by the new laws, effective dates, and legal citations are provided in Table 1. The Monitoring the Future surveys involve nationally representative surveys of each US high school senior class, beginning in 1975. The Monitoring the Future survey design and results have been described in detail elsewhere.[8,9] We summarize here measures used for this study of youth BAC laws, design of this policy evaluation, and sampling and statistical analysis considerations.

Measures

Two items measured the core outcome of interest for the current study, driving after drinking: *"During the last 2 weeks, how many times (if any) have you driven a car, truck, or motorcycle after drinking alcohol?"* and *". . . after having 5 or more drinks in a row?"* Parallel items assessed riding with a driver who had

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been drinking: *"During the last 2 weeks, how many times (if any) have you been a passenger in a car when the driver had been drinking?"* and *". . . when you think the driver had 5 or more drinks?"* Questionnaire response alternatives and coded values used in analyses were as follows: none (0), once (1), twice (2), 3–5 times (coded 4), 6–9 times (coded 7.5), and 10 or more times (coded 10).

Use of alcohol during the last 30 days was measured with a question that had a standard, closed-ended format with 7 response alternatives: 0 occasions (0), 1–2 occasions (coded 1.5), 3–5 (coded 4), 6–9 (coded 7.5), 10–19 (coded 14.5), 20–39 (coded 29.5), and 40 or more occasions (coded 40). An additional question about heavy use of alcohol asked respondents how many times in the last 2 weeks they had 5 or more drinks in a row; response alternatives (and coded values) were the same as for the driving-after-drinking questions.

We measured number of miles driven by the following item: *"During an average week, how much do you usually drive a car, truck, or motorcycle?"* Response alternatives and coded values used in analyses were as follows: not at all (0), 1–10 miles (5.5), 11–50 miles (30.5), 51–100 miles (75.5), 101–200 miles (150), and more than 200 miles (200).

TABLE 1—States With Blood Alcohol Concentration (BAC) Law Change Included in Analyses

State	Age	BAC Limit	Effective Date	Legal Citation
Arizona	<21	0.00	12/31/84	1984 Ariz Sess Laws 67, §7
Arkansas	<21	0.02	6/30/93	1993 Ark Acts 863, §3
California	<18	0.05	1/1/87	1986 Cal Stat 1105, §1
Colorado	<21	0.02	7/1/97	1997 Colo Sess Laws 256, §12, §13
Florida	<21	0.02	1/1/97	1996 Fla Laws 272
Georgia	<18	0.06	7/1/91	1991 Ga Laws 589, §8
Idaho	<21	0.02	7/26/94	1994 Idaho Sess Laws 422, §1
Illinois	<21	0.00	1/1/95	1995 Ill Laws 88-588, §5
Indiana	<21	0.02	1/1/97	1996 Ind Acts 96, §5
Iowa	<21	0.02	7/1/95	1995 Iowa Acts 48, §7
Kansas	<21	0.02	7/1/97	1996 Kan Sess Laws 216, §1
Kentucky	<21	0.02	10/1/96	1996 Ky Acts 198, §10
Maryland	<21	0.02	7/1/88	1988 Md Laws 254
Massachusetts	<21	0.02	6/25/94	1994 Mass Acts 25
Michigan	<21	0.02	11/1/94	1994 Mich Pub Acts 211
Minnesota	<21	0.00	6/1/93	1993 Minn Laws 347
Mississippi	<21	0.08	7/1/95	1995 Miss Laws 540, §1
Nebraska	<21	0.02	1/1/94	1993 Neb Laws 564, §2
New Jersey	<21	0.01	12/17/92	1992 NJ Laws 189
New York	<21	0.02	11/1/96	1996 NY Laws 196, §11
Ohio	<18	0.02	7/25/90	1990 Ohio Laws 143, §131
Oklahoma	<18	0.02	7/1/95	1994 Okla Sess Laws 387, §10
Oregon	<18	0.00	10/3/89	1989 Ore Laws 715, §7
Pennsylvania	<21	0.00	9/12/95	1994 Pa Laws 143, §1
Rhode Island	<18	0.02	7/3/95	1995 RI Pub Laws 164
Tennessee	<21, ≥16	0.02	7/1/93	1993 Tenn Pub Acts 491
Texas	<21	0.07	9/1/93	1993 Tex Gen Laws 790
Virginia	<21	0.02	7/1/94	1994 Va Acts 359
Washington	<21	0.02	7/1/94	1994 Wash Laws 275, §10
Wisconsin	<18	0.00	7/1/84	1983 Wis Laws 74

Sampling Design and Analyses

A 3-stage national probability sample results in self-completed questionnaire administrations in about 135 high schools across the United States (approximately 112 public and 23 private) and yields about 17 000 respondents per year. The response rate for students in the schools used in the present analyses was 85%, with absentees accounting for nearly all of the nonrespondents. Average response rates during the 3-year baseline before each policy change were identical to average response rates during the 3-year postlaw period.

The Monitoring the Future sampling procedures do not result in a rigorously representative sample within each state in the study. The samples are drawn so as to be nationally representative, including all geographic regions, levels of population density, types of schools, and so on; more precisely, the design is such that the samples are representative of each of the 4 major geographic regions (Northeast, North Central, West, and South). The sample in any single state is not assuredly statistically representative of that state, but as one aggregates across states, one approaches a representative sample for the aggregate set of states. Thus, for example, data aggregated across the 30 states with a changed BAC law fairly accurately represent all high school seniors who live in states with a changed BAC law. In the aggregate, this should be a more than adequate sample from which to draw inferences about the effects of lowered youth BAC law changes. The available data do not, however, permit accurate assessment of potential *differential* effectiveness of the legal changes across individual states.

Although the Monitoring the Future study has been conducted annually since 1975, questions on driving and drinking were added in 1984, so analyses reported here are based on data from 1984 through 1998. The questions on driving and drinking are included in only 1 of 6 questionnaire forms (distributed in a random sequence within the classroom), so responses to these questions are based on a random one sixth of the total sample of high school seniors. Baseline data for analyses reported here consist of students surveyed in the 3 years before the lowered BAC policy went into effect in their specific state of residence, and postlaw data consist of students surveyed in the 3 years after the lowered BAC policy took effect in their state. In summary, we used samples of high school students before and after BAC limits were lowered for young drivers from each state experiencing such a policy change from 1984 to 1997; then we aggregated the state-specific samples to obtain a single overall best estimate of the effects of such policies on self-reported drinking, driving, riding with a driver who had been drinking, and driving after drinking.

Sample sizes at baseline and follow-up varied slightly because small numbers of cases had missing data on select items; for all variables, the sample size was at least 5000 cases at baseline and 5000 cases at follow-up. Thus, we used a pre–post design with repeated but separate cross-sectional probability samples of high school seniors (not a cohort design).

The sampling design was clustered, so students were not directly selected at random from the population of all students; instead, schools served as the primary sampling unit, and students were nested within schools. As a result, standard errors were larger than those that would result from a simple random sample of the same size.[10] The design effect, estimated with software written by Raghunathan et al.,[11] was 1.7, and all significance tests reported here have been adjusted to account for this design effect. Analyses were based on the general linear model with SAS PROC GLM.[12] We also controlled for broad national ("secular") trends in each outcome examined to ensure that estimated policy effects were not attributable to behavioral changes caused by other factors occurring both in states that low-

TABLE 2—Comparison of Mean Drinking and Driving or Riding After Drinking, Before and After Blood Alcohol Concentration (BAC) Law Changes in 30 States: High School Seniors, 1984–1998

	No. of Students		Mean		SD		
	Before	After	Before	After	Before	After	Effect Size[a]
Means as "quasi-continuous" counts							
Drinking, past 30 days	5086	5301	3.862	4.006	7.212	7.307	2.0 (NS)
Drinking ≥5 drinks	5062	5282	1.069	1.054	2.138	2.017	–0.7 (NS)
Drive after drinking alcohol	5309	5537	0.513	0.416	1.511	1.258	–6.4**
Drive after drinking ≥5 drinks	5239	5475	0.333	0.256	1.353	1.096	–5.7*
Ride with drinking driver	5275	5503	0.732	0.680	1.759	1.627	–3.0 (NS)
Ride with driver, ≥5 drinks	5234	5468	0.429	0.371	1.402	1.259	–4.1 (NS)
Drive and ride, driver drinking	5275	5503	1.237	1.096	2.841	2.464	–5.0*
Drive and ride, driver drinking ≥5 drinks	5197	5434	0.759	0.627	2.433	2.036	–5.4*
Miles driven per week	5266	5472	73.83	77.79	68.94	68.25	5.7*
Means adjusted for secular trends							
Drinking, past 30 days	5086	5301	–0.040	0.111	7.192	7.286	2.1 (NS)
Drinking ≥5 drinks	5062	5282	0.046	0.012	2.134	2.015	–1.6 (NS)
Drive after drinking alcohol	5309	5537	0.051	–0.034	1.509	1.257	–5.6*
Drive after drinking ≥5 drinks	5239	5475	0.032	–0.048	1.354	1.097	–5.9**
Ride with drinking driver	5275	5503	0.013	–0.018	1.755	1.627	–1.8 (NS)
Ride with driver, ≥5 drinks	5234	5468	0.022	–0.037	1.403	1.260	–4.2 (NS)
Drive and ride, driver drinking	5275	5503	0.063	–0.047	2.835	2.462	–3.9 (NS)
Drive and ride, driver drinking ≥5 drinks	5197	5434	0.056	–0.080	2.434	2.038	–5.6*
Miles driven per week	5266	5472	2.19	2.21	68.97	68.05	0.0 (NS)

Note. NS = not significant.
[a]Expressed as percentage of baseline SD.
*$P < .05$; **$P < .01$.

ered their youth BAC level and in states that did not.

Because individual-level characteristics did not differ systematically between the before and after conditions, there was no need to control for individual-level factors. Nevertheless, to ensure that changes in individual-level factors did not account for any observed policy effects, we tested general linear models (SAS PROC GLM), incorporating individual-level variables known to be related to drinking and driving (e.g., gender, urbanicity, race/ethnicity).[13] In all cases, controlling for individual-level factors did not substantively change the results.

Results

Results showed clearly that the changed BAC laws were followed by statistically significant decreases in the amount of driving after drinking by high school seniors (Table 2). The mean frequency of driving after drinking any alcohol declined 19% after implementation of the new laws (i.e., from an average of 0.513 to 0.416 times in the past 2 weeks). The mean frequency of driving after drinking 5 or more drinks declined 23% (i.e., from an average of 0.333 to 0.256 times in the past 2 weeks). Expressed as a percentage of the baseline standard deviation, the estimated effects were –6.4 and –5.7, respectively (Table 2).

The youth BAC law changes had no significant effects on drinking behavior—the effects were specific to driving after drinking. We also found no significant declines in riding with a driver who had been drinking. There were significant declines in a combined measure of risky road travel—that is, the sum of the number of times a respondent drove after drinking or rode in a car with a driver who had been drinking. After adjustment for secular trends, only the measure of risky travel with a heavy drinking driver remained statistically significant.

Results also showed that there were no changes in total exposure to risk of car crash involvement as measured by number of miles driven after the lowered BAC limits were implemented. Specifically, the raw data indicated that the mean number of miles driven per week increased after the law changes, but that effect disappeared after adjustment for broader secular trends. Finally, we examined states separately in 2 groups—those with 0.00 to 0.02 BAC limits vs those with 0.04 to 0.08 limits. No substantial differences in effects of the law were found between the 2 groups (data not shown).

The results showing that the lowered youth BAC laws reduced self-reported driving after drinking, with no concomitant changes in overall drinking or number of miles driven, substantially increased the plausibility of interpreting observed relations in causal terms. Policy changes that lower BAC limits for youth specifically target teenaged driving after drinking and are not expected to affect overall drinking rates or total amount of driving among teenagers. The data were consistent with that expectation.

Discussion

Our results showing declines of 19% and 23% in self-reported driving after drinking and driving after heavy drinking, respectively, by teenagers are consistent with previous studies reporting 11% to 33% reductions in car crash injuries and fatalities following the lower youth BAC limits.[14] This is important because we studied a more representative sample of 30 states implementing this law, compared with previous studies that focused on small numbers of states that were early adopters of this policy innovation.

Opponents of lower BAC policies have argued that the laws target lower-risk moderate drinkers but have little effect on higher-risk drivers. Our results do not support this argument. We found slightly larger declines in driving after drinking 5 or more drinks (–23%) than in driving after any drinking (–19%).

Despite substantial benefits of these laws to date, evidence indicates that implementation to date of lower BAC limits for teenaged drivers in the United States has been less than optimal. A 1997 Gallup survey found that 36% of the driving-age public reported that they did not know whether their state had a different BAC level for drivers younger than 21 years, and only 18% of those who thought the legal

limit was different for minors knew the correct BAC level.[15] A 1983 survey of Maine teenaged drivers reported that only 50% were even aware that their state had a lower allowable BAC limit for youth.[7] It is well known that public awareness is a core prerequisite for the general deterrent effect of a law.[16] In fact, Blomberg[17] reported an experimental study of a public information campaign specifically designed to enhance the effects of Maryland's youth BAC law. Results showed that the addition of a public information campaign more than doubled the effect of Maryland's law.

It is important to keep in mind that this policy is a populationwide intervention significantly affecting one of the most important risky behaviors among teenagers. Even a modest effect size applied to the entire population results in substantial public health benefits. The policy, now in effect in all US states, is already resulting in significant reductions in driving after drinking among youth. Improved information and enforcement campaigns could substantially increase its beneficial effects. □

Contributors

A.C. Wagenaar designed the study and supervised collection of the legal data. P.M. O'Malley conducted statistical analyses. Both A.C. Wagenaar and P.M. O'Malley contributed to the writing and editing of the paper. C. LaFond collected legal data, interpreted statutes, and edited sections of the paper.

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