# Reducing Alcohol-impaired Driving: Maintaining Current Minimum Legal Drinking Age (MLDA) Laws

## Summary Evidence Tables

### Studies evaluating the effectiveness of raising the MLDA for decreasing crashes

| Author, Year<br>(Study Period)<br>Design suitability: design<br>Quality of execution<br>Evaluation Setting | Intervention/Comparison details | Results/Other information | Value used in summary | Follow-up period |
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| Hingson, 1983[1]<br>(4/1976 – 4/1981)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>Massachusetts | MLDA raised from 18 to 20 on 9/1/81.<br><br>Comparison to 18-19 year-old upstate New York drivers. | Single vehicle nighttime fatal crashes among 18-19 year olds decreased 15% (net change = -31%, $p < .05$)<br><br>Survey data indicate decrease in reported driving after drinking (net change = -22%, $p < .05$), and drinking in bars (net change = -57%, $p < .05$), but no significant decrease in general alcohol consumption. | Fatal Crashes: -31% | 24 months |
| Williams, 1983[2]<br>(1/1975 – 9/1980)<br><br>Greatest: Before/after with concurrent comparison<br><br>Good<br><br>IL, IA, ME, MA, MI, MN. MT, NH, TN | MLDA raised by varying amounts in different states; increases took effect between 1976 and 1980<br><br>Comparison of groups affected by the law change to older drivers under 22 years old, adjacent 'no change' states, and daytime crashes. | For single vehicle nighttime fatal crashes:<br>- net change for directly affected drivers relative to all comparison conditions was -25% ($p > .05$)<br>- net change for younger drivers not directly affected by the law change relative to older drivers was -3%<br><br>Net changes for nighttime fatal crashes (-23%, $p < .05$) and total fatal crashes (-14%, $p < .05$) were consistent with the reported effect. | Fatal Crashes: -25% | >= 9 months |
| Wagenaar, 1983[3]<br>(1972 –1979, monthly)<br><br>Greatest: Interrupted time series with concurrent comparison<br><br>Fair<br><br>Maine | MLDA raised from 18 to 20 on 10/77.<br><br>Comparison to drivers aged 20-21. | Single vehicle nighttime male injury/fatality crashes among 18-19 year–olds decreased 18% ($t = -1.4$, $p > .05$; net change = -33%)<br><br>Single vehicle nighttime male property damage crashes among 18-19 year–olds decreased 22% ($t = -3.5$, $p < .01$; net change = -18%)<br><br>Similar net changes result from comparisons to daytime crashes and PA drivers. | Injury Crashes: -33%<br><br>Other Crashes: -18% | 14 months |
| Smith, 1984[4]<br>(4/1976 – 4/1982)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>Massachusetts | MLDA raised from 18 to 19 on 4/16/79. Study evaluates impact on 16 and 17 year-old drivers.<br><br>Comparison to 16-17 year-old upstate New York drivers. | Single vehicle nighttime fatal crashes among 16-17 year olds increased 4% from mean of 25.7/year (net change = -22%, $p > .05$)<br><br>Survey data indicate decrease in reported driving after drinking (net change = -20%, $p < .05$), and drinking in bars (net change = -61%, $p < .05$), but smaller changes in general alcohol consumption (net change= -9%, $p > .05$). | Fatal Crashes: -22% | 36 months |

| Author, Year (Study Period) Design suitability: design Quality of execution Evaluation Setting | Intervention/Comparison details | Results/Other information | Value used in summary | Follow-up period |
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| Hoskin, 1986[5] (1975-1982)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>FL, GA IL IA ME MI MT NE NH TN | MLDA raised by varying amounts in different states; increases took effect between 1977 and 1980<br><br>Comparison to drivers 25-29 years old. | Single vehicle nighttime fatalities/1000 drivers decreased by 15% (net change = -28%, p < .01, 1-tailed) | Fatal Crashes: -28% | >= 24 months |
| Males, 1986[6] (1975 – 1983)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>FL, GA IL, IA, ME, MA, MI, MN, MT, NE, NH, RI, TN | MLDA raised by varying amounts in different states; increases took effect between 1977 and 1981<br><br>Comparison to 21-24 year-old drivers and matched states. | Median ratio of single vehicle nighttime fatal crash involvement for affected vs. 21-24 year-old drivers:<br>- for drivers affected by MLDA change decreased by 23% (net change adjusted for comparison states = -14%)<br>- for drivers <=17 decreased by 15% (net change = +9%)<br><br>Author argues that MLDA increase causes an increase in fatalities among older drivers that are 'new' drinkers; for this group, the median change in single vehicle nighttime crashes was –4% (net change = +14%). | Fatal Crashes: -14% | >= 24 months |
| Wagenaar, 1986a[7] (1976 –1984, monthly)<br><br>Greatest: Interrupted time series with concurrent comparison<br><br>Fair<br><br>Michigan | MLDA raised from 18 to 21 on 12/78.<br><br>Comparison to drivers over 21 years old. | Single vehicle nighttime injury crash rates among 18 – 20 year-olds were unchanged (net change = -16%, p < .05)<br><br>Had been drinking injury crash rates among 18 – 20 year-olds decreased 6% (net change = -19%, p < .05)<br><br>Effect sizes presented are comparable to similar studies evaluating the impact of Michigan's increased MLDA over various time periods (e.g., Wagenaar, 1981a, Wagenaar, 1981b, Wagenaar, 1987) | Injury Crashes: -16% | 72 months |
| Wagenaar, 1986b[8] (1978 –1984, monthly)<br><br>Greatest: Interrupted time series with concurrent comparison<br><br>Good<br><br>Texas | MLDA raised from 18 to 19 on 9/1/81.<br><br>Comparison to drivers aged 19-20. | Single vehicle nighttime serious injury crash rates among:<br>- 18 year –olds decreased 11% (p < .05, one-tailed; net change = -6%)<br>- 16-17 year-olds decreased 8% (p < .05, one-tailed; net change = -3%)<br><br>Authors found that the estimated decrease in crashes was unchanged when an economic indicator was included in the model. | Injury Crashes: -6% | 39 months |

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| Lillis, 1987[9] (12/4/81 – 12/3/83)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>New York state | MLDA raised from 18 to 19 on 12/4/82. Intervention occurred in context of general anti-DUI campaign begun 11/81.<br><br>Comparison to 19 and 20 year old age groups. | Had-been-drinking injury crashes/10,000 licensed drivers:<br>- decreased 21% among 18 year-olds (baseline n = 732, net change = -15%)<br>- decreased 24% among 17 year-olds (baseline n = 393, net change = -17%)<br><br>Self-reported purchase of beer decreased from 51.6% (n=213) to 32.6% (n=212) in the target group (relative change of -37%, net change = -24%, p<.001).<br><br>Self-reported 47% decrease in drinking and driving (net change = -30%, p < .05) | Injury Crashes: -15% | 12 months |
| Decker 1988[10] (1980-1986)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>Tennessee | MLDA raised from 19 to 21 on 8/1/84; includes grandfather clause<br><br>Comparison to 21-24 year old drivers | Single vehicle nighttime fatalities per hundred million vehicle miles:<br><br>- decreased by 38% for 19-20 year old drivers (net change = -41%)<br><br>- decreased by 15% for 15-18 year old drivers (net change = -18%) | Fatal Crashes: -41% | 28 months |
| Womble, 1989[11] (1975 – 1986);<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>FL, GA, IL, IA, ME, MA, MI, MN, MT, NE, NH, NJ, TN | MLDA raised by varying amounts in different states; increases took effect between 1976 and 1980<br><br>Comparison to drivers aged 18-23 who were unaffected by the changed MLDA. | Net decrease in fatal crash rates for affected drivers relative to unaffected drivers was 12% (95% CI: -16%, -8%);<br><br>Study replicates Arnold, 1985, which covers a period from 1975 – 1983 and also found a 12% decrease. | Fatal Crashes: -12% | >= 72 months |
| Legge, 1990[12] (1975 – 1987, monthly)<br><br>Moderate: Interrupted time series<br><br>Fair<br><br>New York state | MLDA raised from 18 to 19 on 12/1/82; and from 19-21 on 12/1/85. The impact of two other traffic safety interventions during the study period was also modeled. | Male single vehicle nighttime fatalities for drivers of all ages (interpolated from graph):<br>- increased 1% when MLDA raised from 18 to 19 (t = 0.12, p > .05, n.s.)<br>- increased 24% when MLDA raised from 19 to 21 (t = 1.89, p > .05, n..s.)<br><br>Daytime fatalities also increased by 8.62/month (t = 2.16, p not reported) following the 1985 MLDA increase, suggesting that the observed increase was not specific to alcohol-involved crashes. | Fatal Crashes: +13% | >= 25 months |

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| O'Malley, 1991[13]<br>(1973 – 1990)<br><br>Greatest: Interrupted time series with concurrent comparison<br><br>Fair<br><br>DE, FL, GA, IL, MD, MA, MI, NE, NJ, OH, OK, TN, TX | MLDA raised by varying amounts in different states; increases took effect between 1978 and 1986<br><br>Comparison to daytime fatal crashes. | Single vehicle nighttime fatal crash rates among drivers <21 decreased by 15% across all 13 states ($p < .05$; net change = -2%).<br><br>Self-reported alcohol consumption among high-school seniors in MLDA age 18 states converged from ~.14 standard deviations higher than in MLDA age 21 states to similar levels when MLDA became 21 nationwide. | Fatal Crashes: -2% | 36 months |
| Durant, 1993[14]<br>(1975-1987, monthly)<br><br>Moderate: Interrupted time series<br><br>Fair<br><br>Michigan | MLDA raised from 18 to 21 on 12/23/1978. Effects of drinking-driving reforms implemented 3/30/1983 and changes in unemployment rate were also modeled. | Crash-related fatalities involving drivers under 21 decreased an estimated 17% ($p < .05$).<br><br>Time series results suggest that the effect of the change in MLDA is stable over time ($\delta = .938$).<br><br>Several comparison time series were modeled, but insufficient data were provided to calculate net changes. | Fatal Crashes: -17% | 108 months |
| Figlio, 1995[15]<br>(1976-1993, monthly)<br><br>Greatest: Interrupted time series with concurrent comparison<br><br>Fair<br><br>Wisconsin | MLDA raised to 19 on 7/84; raised to 21 on 9/86<br><br>Comparison to all drivers > 21 years old. | Had-been-drinking crashes/1000 drivers:<br><br>- decreased 19% (.35/1000 drivers) for 18 year olds (net change = -17%)<br><br>- decreased 27 % (.6/1000 drivers) for 19-20 year olds (net change = -25%) | Other Crashes:-21% | >= 87 months |

**Regression analyses evaluating the effects of changes in the MLDA on crashes**

| Author, Year (Study Period) Design suitability: design Quality of execution Evaluation Setting | Intervention/Comparison details | Results/Other information | Value used in summary | Follow-up period |
|---|---|---|---|---|
| Cook, 1984[16] (1970 – 1977, yearly)<br><br>Greatest: Time series with concurrent comparison<br><br>Fair<br><br>48 contiguous states | MLDA decrease modeled along with state and time variables in a fixed effects ANCOVA.<br><br>Comparison to 21-24 year-old drivers and states that did not change MLDA. | Estimated impact of an increase in MLDA from 18 to 21 on fatality rates:<br>- a 9% decrease for 18-20 year-olds (95% CI: 2%, 16%)<br>- a 6% decrease for 16-17 year-olds (95% CI: -4%, 15%)<br>- no change in fatality rates for 21-24 year-olds<br><br>States that lowered drinking age had systematically lower initial fatality rates.<br><br>Authors obtained similar results to those reported using various estimation methods. | Fatal Crashes: -9% | Not reported |
| Du Mouchel 1987[17] (1975-1984, yearly)<br><br>Greatest: Time series with concurrent comparison<br><br>Good<br><br>48 contiguous states | MLDA raised in 26 states between 9/1976 and 8/1984;<br><br>Comparison to states that did not change MLDA. | Increased MLDA was associated with a 13% decrease in nighttime fatal crashes among affected age groups (95% CI: -18%, -8%)<br><br>Results of MLDA change were stable over time.<br><br>'Beginning drinker' status associated with 2% increase in crashes (95% CI: -4%, 8%) | Fatal Crashes: -13% | >= 5 months |
| Saffer, 1987a[18] (1975-1981, yearly)<br><br>Greatest: Time series with concurrent comparison<br><br>Fair<br><br>48 contiguous states | MLDA included as one of several independent variables in a logistic regression modeling a reciprocal causal effect between MLDA and fatality rates.<br><br>Comparison to 21-24 year old fatality rates and states that did not change MLDA.. | Estimated effects on fatality rate of increased MLDA from 18 to 21:<br><br>- 29% decrease among 18-20 year-olds (b=-.116, t=2.63; net change = -24%)<br><br>- 19% decrease among 15-17 year-olds (b=-.073, t=1.79; net change = -14%) | Fatal Crashes: -24% | Not reported |
| #22. Saffer, 1987b[19] (1975-1981, yearly)<br><br>Greatest: Time series with concurrent comparison<br><br>Fair<br><br>48 contiguous states | MLDA included as one of several independent variables in three logistic regression models. The results of the most comprehensive model are reported here.<br><br>Comparison to 21-24 year old fatality rates and states that did not change MLDA. | Estimated effects on fatality rate of increased MLDA from 18 to 21:<br><br>- 13% decrease among 18-20 year-olds (b=-.045, t=-5.12; net change relative to older drivers = -8%)<br><br>- 1% increase among 15-17 year-olds (b= .003, t=0.33; net change relative to older drivers = +6%) | Fatal Crashes: -13% | Not reported |
| Saffer, 1989[20] (1980-1985, yearly)<br><br>Greatest: Time series with concurrent comparison<br><br>Fair<br><br>48 contiguous states | MLDA included as one of several independent variables in a logistic regression.<br><br>Comparison to states that did not change MLDA. | Based on the authors' reported regression coefficient of –0.043 ($p < .05$), nighttime crash fatality rates for 15 – 24 year olds estimated to decrease 12% with an MLDA increase from 18 to 21 | Fatal Crashes: -12% | Not reported |

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| Chaloupka, 1993[21] (1982-1988, yearly)<br><br>Greatest: Time series with concurrent comparison<br><br>Fair<br><br>48 contiguous states | MLDA included as one of several independent variables in a logistic regression model.<br><br>Comparison to states that did not change MLDA. | Nighttime crash fatality rate for 18 to 21 year-olds estimated to decrease 4.4% with uniform 21 MLDA and increase 12.1% with uniform 18 MLDA (relative change = -15%, $p < .01$) | Fatal Crashes: -15% | >24 months |
| Ruhm, 1996[22] (1982 – 1988, yearly)<br><br>Greatest: Time series with concurrent comparison<br><br>Fair<br><br>48 contiguous states | MLDA included as one of several independent variables in a fixed effects logistic regression.<br><br>Comparison to states that did not change MLDA. | Based on the authors' reported regression coefficient of –0.044 ($p < .05$), fatality rates for 18-20 year olds estimated to decrease 12% with an MLDA increase from 18 to 21<br><br>Multiple analyses highlight the sensitivity of regression parameter estimates to "reasonable changes in model specifications". | Fatal Crashes: -12% | >24 months |
| Voas 1999[23] **(**1982-1997, yearly)<br><br>Greatest: Time series with concurrent comparison<br><br>Fair<br><br>50 US states | MLDA increase modeled as proportion of the state's youth population affected by the law.<br><br>Comparison to states that did not change MLDA. | Raising MLDA to 21 associated with an estimated 19% decrease in ratio of drinking (estimated BAC >= 0.01 g/dl) to non-drinking drivers involved in fatal crashes. | Fatal Crashes: -19% | >132 months |
| Dee, 1999[24] (1977-1992, yearly)<br><br>Greatest: Time series with concurrent comparison<br><br>Fair<br><br>48 contiguous states | MLDA and beer tax modeled in a fixed effects logistic regression.<br><br>Comparison to states that did not change MLDA and to daytime fatality rates.<br>d | Based on a regression coefficient of –0.12 ($p < .05$), nighttime driver fatality rates for 18-20 year-olds estimated to decrease 7% more than daytime fatality rates ($b=-.05$, $p > .05$). | Fatal Crashes: -7% | >72 months |

**Studies evaluating the effects of lowering the MLDA on crashes**

| Author, Year (Study Period) Design suitability: design Quality of execution Evaluation Setting | Intervention/Comparison details | Results/Other information | Value used in summary | Follow-up period |
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| Naor, 1975[25] (1968 – 1973)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>Wisconsin | MLDA for wine and spirits lowered from 21 to 18 on 3/23/1972. MLDA for beer remained 18 throughout study period.<br><br>Comparison to non-alcohol-related crashes. | Proportion of driver fatalities with BAC >.05% decreased 5% following MLDA change ($p > .05$, net change = +2%) | Fatal Crashes: +2% | 21 months |
| Whitehead, 1975[26] (1/1968 – 6/1973)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>London, Ontario | MLDA lowered from 21 to 18 on 7/1971.<br><br>Comparison to daytime crashes. | Nighttime crashes involving male drivers:<br>- involving 16-17 year-olds increased 34% from a baseline of 127 (net change = +30%)<br>-involving 18 year-olds increased 58% from a baseline of 114 (net change = +19%)<br>-involving 19 year-olds increased 52% from a baseline of 138 (net change = +32%)<br>-involving 20 year-olds increased 31% from a baseline of 140 (net change = +14%)<br>-involving 24 year-olds increased 1% from a baseline of 110 (net change = -17%)<br><br>Study also reported large increases in overall crashes for affected age groups relative to older drivers. | Other Crashes: +22% | 22 months |
| Williams, 1975[27] (1968-1973; 3 years before/1 year after law change)<br><br>Greatest: Time series with concurrent comparison<br><br>Fair<br><br>MI, ON, WI<br>(IN, MN, IL) | MLDA lowered from 21 to 18 on 1/1/72, 7/28/71, and 3/23/72, respectively.<br><br>Comparison to adjacent states. | Nighttime fatal crashes among 18-20 year-olds:<br>- increased 17% in MI (net change = +6%)<br>- increased 43% in ON (net change = +4%)<br>- increased 11% in WI (net change = +14%)<br><br>Nighttime fatal crashes among 15-17 year-olds:<br>- increased 16% in MI (net change = +10%)<br>- increased 61% in ON (net change = +13%)<br>- increased 23% in WI (net change = +14%)<br><br>$F (3, 15) = 3.92$, $p < .05$ for aggregate change in fatalities.<br><br>Generalizability somewhat limited due to Wisconsin's change in MLDA involving only wine and spirits. | Fatal Crashes: +8% | 12 months |
| Ferreira, 1976[28] (1/1969 – 9/1973)<br><br>Greatest: Interrupted time series with concurrent comparison<br><br>Fair<br><br>Massachusetts | MLDA lowered from 21 to 18 on 3/1/1973.<br><br>Comparison to 21-23 age group. | Fatal crashes among 18-20 year-olds increased 39% from a baseline of 13.7/month ($p < .05$, net change = +38%) | Fatal Crashes: +38% | 7 months |

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| Brown, 1981[29] (1972 – 1974/1976 – 1979)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>Alabama | MLDA lowered from 21 to 19 on 7/22/1975.<br><br>Comparison to crashes not designated as had-been-drinking. | Among 18-20 year-olds, had-been-drinking crashes increased 250% from a baseline of 1232 (net change = +186%).<br><br>Proportion of had-been-drinking crashes involving 18-20 year-old drivers increased 39% from baseline of .12 (n = 1232, p < .05). | Other Crashes: +186% | 36 months |
| Smith, 1986[30] (1968 –1970)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>South Australia | MLDA lowered from 21 to 20 on 12/19/1968.<br><br>Comparison to 21-29 year-old drivers. | Crash related injuries for 17-20 year age group increased 140% from baseline of 1239 (net change = +1%, p > .05).<br><br>Net change for between-state comparison (Queensland) of +3% (p > .05) | Injury Crashes: +1% | 24 months |
| Smith, 1986[30] (1970 –1973)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>South Australia | MLDA lowered from 20 to 18 on 4/8/1971.<br><br>Comparison to 21-25 year-old drivers. | Crash related injuries for 17-20 year-old males increased 280% from baseline of 1225 (net change = +22%, p < .05).<br><br>Net change for between-state comparison (Queensland) of +21% (p < .05) | Injury Crashes: +22% | 32 months |
| Smith, 1986[30] (1/1968 – 6/1973)<br><br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>Western Australia | MLDA lowered from 21 to 18 on 7/1/1970.<br><br>Comparison to 21-29 year-old drivers. | Crash related injuries for 17-20 year-old males increased 30% from baseline of 1641 (net change = -2%, p > .05).<br><br>Net change for between-state comparison (Queensland) of -9% (p < .05)<br><br>Authors assert that there was widespread violation of drinking age laws in Western Australia prior to the MLDA change. | Injury Crashes: -2% | 36 months |
| Smith, 1986[30] (1971 –1976)<br>Greatest: Before/after with concurrent comparison<br><br>Fair<br><br>Queensland | MLDA lowered from 21 to 18 on 2/18/1974.<br><br>Comparison to 21-29 year-old drivers. | Crash related injuries for 17-20 year-old males increased 12% from baseline of 4102 (net change = +10%, p < .01).<br><br>Net change for between-state comparison (Western Australia) of +15% (p < .001) | Injury Crashes: +10% | 34 months |

1. Hingson R, Scotch N, Mangione T, et al. Impact of legislation raising the legal drinking age in Massachusetts from 18 to 20. Am J Public Health 1983;73:163-9.

2. Williams AF, Zador PL, Harris SS, Karpf RS. The effect of raising the legal minimum drinking age on involvement in fatal crashes. Journal of Legal Studies 1983;12:169-79.

3. Wagenaar AC. Raising the legal drinking age in Maine: impact on traffic accidents among young drivers. Int J Addict 1983;18:365-77.

4. Smith RA, Hingson RW, Morelock S, et al. Legislation raising the legal drinking age in Massachusetts from 18 to 20: effect on 16 and 17 year olds. J Stud Alcohol 1984;45:534-9.

5. Hoskin AF, Yalung Mathews D, Carraro BA. Effect of raising the legal minimum drinking age on fatal crashes in 10 states. Journal of Safety Research 1986;17:117-21.

6. Males M. Minimum purchase age for alcohol and young-driver fatal crashes: a long-term view. Journal of Legal Studies 1986;15:181-211.

7. Wagenaar AC. Preventing highway crashes by raising the legal minimum age for drinking: the Michigan experience 6 years later. Journal of Safety Research 1986;17:101-9.

8. Wagenaar AC, Maybee R. Legal minimum drinking age in Texas: effects of an increase from 18 to 19. Journal of Safety Research 1986;17:165-78.

9. Lillis R, Williams T, Williford W. The impact of the 19-year-old drinking age in New York. Advances in Substance Abuse 1987;Suppl 1, Control Issues in Alcohol Abuse Prevention: Strategies for States and Communities:133-46.

10. Decker MD, Graitcer PL, Schaffner W. Reduction in motor vehicle fatalities associated with an increase in the minimum drinking age. JAMA 1988;260:3604-10.

11. Womble K. Impact of minimum drinking age laws on fatal crash involvements: An update of the NHTSA analysis. Journal of Traffic Safety Education 1989;37:4-5.

12. Legge J, Jr. Reforming highway safety in New York State: an evaluation of alternative policy interventions. Social Science Quarterly 1990;71:373-82.

13. O'Malley PM, Wagenaar AC. Effects of minimum drinking age laws on alcohol use, related behaviors and traffic crash involvement among American youth: 1976-1987. J Stud Alcohol 1991;52:478-91.

14. Durant R, Legge JS. Policy design, social regulation and theory building: lessons from the traffic safety policy arena. Political Research Quarterly 1993;46:641-56.

15. Figlio DN. Effect of drinking age laws and alcohol-related crashes: time-series evidence from Wisconsin. J Policy Anal Manage 1995;14:555-66.

16. Cook PJ, Tauchen G. The effect of minimum drinking age legislation on youthful auto fatalities. Journal of Legal Studies 1984;13:169-90.

17. DuMouchel W, Williams AF, Zador P. Raising the alcohol purchase age: its effects on fatal motor vehicle crashes in twenty-six states. Journal of Legal Studies 1987;16:249-66.

18. Saffer H, Grossman M. Drinking age laws and highway mortality rates: cause and effect. Economic Inquiry 1987;25:403-17.

19. Saffer H, Grossman M. Beer taxes, the legal drinking age, and youth motor vehicle fatalities. Journal of Legal Studies 1987;16:351-74.

20. Saffer H, Chaloupka F. Breath testing and highway fatality rates. Applied Economics 1989;21:901-12.

21. Chaloupka FJ, Saffer H, Grossman M. Alcohol control policies and motor vehicle fatalities. Journal of Legal Studies 1993;22:161-86.

22. Ruhm CJ. Alcohol policies and highway vehicle fatalities. J Health Econ 1996;15:435-54.

23. Voas RB, Tippetts AS, Fell J. The United States limits drinking by youth under age 21: does this reduce fatal crash involvements? 43rd Annual Proceedings Association for the Advancement of Automotive Medicine, September 20-21, 1999. Barcelona, Spain.

24. Dee TS. State alcohol policies, teen drinking and traffic fatalities. Journal of Public Economics 1999;72:289-315.

25. Naor EM, Nashold RD. Teenage driver fatalities following reduction in the legal drinking age. Journal of Safety Research 1975;7:74-9.

26. Whitehead PC, Craig J, Langford N, MacArthur C, Stanton B, Ferrence RG. Collision behavior of young drivers: impact of the change in the age of majority. J Stud Alcohol 1975;36:1208-23.

27. Williams AF, Rich RF, Zador PL. The legal minimum drinking age and fatal motor vehicle crashes. Journal of Legal Studies 1975;4:219-39.

28. Ferreira J, Sickerman A. The impact of Massachusetts reduced drinking age on auto accidents. Accid Anal Prev 1976;8:229-39.

29. Brown DB, Maghsoodloo SA. A study of alcohol involvement in young driver accidents with the lowering of the legal age of drinking in Alabama. Accid Anal Prev 1981;13:319-22.

30. Smith DI, Burvill PW. Effect on traffic safety of lowering the drinking age in three Australian states. Journal of Drug Issues 1986;16:183-98.