Alcohol and Motor Vehicle–Related Deaths of Children as Passengers, Pedestrians, and Bicyclists

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PUBLIC CONCERN OVER ALCOHOL-related motor vehicle mortality and morbidity reached a high point in the early 1980s, when nearly 60% of motor vehicle fatalities were associated with alcohol use by at least 1 person involved in the crash. Interventions in response to this concern included raising the minimum drinking age in all states, enactment of per se illegal blood alcohol–content laws, and administrative license suspension. A marked decline in alcohol-related fatalities has been associated with these policies, with the percentage of drivers using alcohol involved in fatal crashes decreasing from 47.9% in 1991 to 41.0% in 1996. Although the focus of policies has been to address the high risk of alcohol-related mortality for drivers, children as passengers, pedestrians, and bicyclists are also at risk of death in alcohol-related crashes. Previous analysis of North Carolina crash data indicated that between 1979 and 1982, alcohol use was associated with 15.4% of the motor vehicle–related deaths of children. The purpose of the present study was to examine, on the national level, the association between alcohol use by drivers and mortality of children who were passengers, pedestrians, and bicyclists for the years 1991 through 1996.

METHODS

Data for this analysis come from the Fatality Analysis Reporting System (FARS). During 1991-1996, 19,673 children and adolescents younger than 16 years were killed in motor vehicle–related crashes. For the present analysis, we excluded 1132 crashes involving more than 2 vehicles, 1460 crashes involving unusual circumstances such as off-roadway locations or nonmotorized conveyances other than bicycles, 313 vehicles other than cars and light trucks, 92 cases with missing driver information, and 456 children listed as passengers, pedestrians, and bicyclists for the years 1991 through 1996.

Context
The overall percentage of motor vehicle deaths associated with alcohol consumption declined between 1991 and 1996, but the risk of death due to alcohol-related crashes for children warrants analysis.

Objective
To examine the association between alcohol use by drivers and mortality of children who were passengers, pedestrians, and bicyclists.

Design and Setting

Subjects
A total of 16,676 children younger than 16 years who were passengers, pedestrians, or bicyclists and whose death was due to a motor vehicle crash.

Main Outcome Measure
Alcohol use by drivers involved in crashes in which children died, assessed by age and sex of the child and driver and type of crash.

Results
A total of 3310 deaths (19.9%) involved alcohol-related crashes. The percentage declined from 21.6% in 1991 to 17.8% in 1996. Considering only crashes in which the alcohol-use status of the child’s driver was relevant, the decline was less marked, from 18.8% in 1991 to 15.1% in 1995, with an increase to 16.4% in 1996. Among crashes involving alcohol, the child’s own driver had been drinking in 66.3% of cases, varying from 58.0% to 70.7% over time. Drivers younger than the legal drinking age of 21 years who had been drinking alcohol accounted for 30.3% of alcohol-related passenger deaths among children.

Conclusion
While the overall percentage of alcohol-related motor vehicle deaths for children declined between 1991 and 1996, experiences for passengers, pedestrians, and bicyclists differ. Selected characteristics of children and drivers that elevate the risk of an alcohol-related motor vehicle death point to the need for further policy and clinical interventions.

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as drivers rather than passengers. Any passengers riding with the 456 underage drivers were included. The final analysis sample of children younger than 16 years who died as passengers, pedestrians, or bicyclists in crashes involving cars or light trucks represented 84.8% (16,676/19,673) of the initial population.

There are 4 potential indicators of alcohol involvement in FARS, each with strengths and weaknesses. The first is the actual measurement of a driver’s blood alcohol concentration (BAC). Although this is quantifiable and objective, there was no BAC measurement for 60.2% of drivers in our analysis sample. Fatally injured drivers are usually tested, but measurements are obtained for relatively few surviving drivers. The second is to use imputed alcohol involvement based on an algorithm developed by the National Highway Traffic Safety Administration that estimates alcohol involvement based on characteristics of the crash and the driver(s) involved. This measure has the advantage of being available for all crashes, but most cases involve imputation. The third indicator is to use the investigating police officer’s assessment of whether a driver had been drinking alcohol. Unfortunately, this information also is sometimes missing; for various reasons, officers sometimes do not believe they have sufficient information to make a judgment. The fourth method is to include only those cases in which the officer is definitive in his or her assessment that alcohol was or was not involved.

We rejected the first and second indicators because of missing values and assessed the validity of the third and fourth by examining their positive and negative predictive values. For the purpose of this analysis, we report the values for the child’s driver. For the third indicator, the positive and negative predictive values are 85.8% and 91.1% (k = 0.73), respectively. For indicator 4, the positive and negative predictive values are 85.8% and 96.6% (k = 0.84).

We have used the definitive police report as the indicator of alcohol involvement to avoid the use of data for which 60% of the values were imputed. The percentages of alcohol involvement obtained with this definitive report indicator were then applied to the 16,676 deaths in our sample to generate population-based rates of death associated with alcohol.

We assessed the relationship between the alcohol-use status of the driver and the following variables: age and sex of the child, age and sex of the driver, and type of crash (single vehicle, 2 vehicles, pedestrian, and bicyclist). The relative risk (RR) of alcohol exposure, given these characteristics, was calculated using Epi-Info, version 6 (Centers for Disease Control and Prevention [CDC], Atlanta, Ga). Rates were determined based on the mid-year population estimates from the US Census.

**RESULTS**

During the 6 years studied, 16,676 children younger than 16 years were killed in motor vehicle crashes involving cars, light trucks, and vans as passengers, pedestrians, or bicyclists. Overall, 3,310 deaths (19.9%) involved a driver who had been drinking alcohol. Of the alcohol-related deaths, 79.5% involved children

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**Table 1. Total and Percentage of Alcohol-Related Traffic Deaths of Children Younger Than 16 Years**

<table>
<thead>
<tr>
<th>Year</th>
<th>Deaths, No.</th>
<th>Alcohol-Related Deaths, No. (%)†</th>
<th>Alcohol-Related Deaths per 100,000 Population‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>2778</td>
<td>600 (21.6)</td>
<td>1.03</td>
</tr>
<tr>
<td>1992</td>
<td>2686</td>
<td>540 (20.1)</td>
<td>0.91</td>
</tr>
<tr>
<td>1993</td>
<td>2746</td>
<td>568 (20.7)</td>
<td>0.95</td>
</tr>
<tr>
<td>1994</td>
<td>2884</td>
<td>597 (20.7)</td>
<td>0.99</td>
</tr>
<tr>
<td>1995</td>
<td>2828</td>
<td>515 (18.2)</td>
<td>0.84</td>
</tr>
<tr>
<td>1996</td>
<td>2754</td>
<td>490 (17.8)</td>
<td>0.80</td>
</tr>
<tr>
<td>Total</td>
<td>16,676</td>
<td>3310 (19.9)</td>
<td></td>
</tr>
</tbody>
</table>

*Data from the National Highway Traffic Safety Administration, Fatality Analysis Reporting System: 1975-1997.†Calculated by applying the percentages derived from definitive police reports to the entire analysis sample (see “Methods” section).‡Based on the age-appropriate mid-year populations.

**Table 2. Alcohol-Related Traffic Deaths by Child’s Age and Sex for Passengers, Pedestrians, and Bicyclists**

<table>
<thead>
<tr>
<th>Child’s Age, y</th>
<th>Total, No.</th>
<th>Alcohol-Related, %†</th>
<th>Total, No.</th>
<th>Alcohol-Related, %†</th>
<th>Total, No.</th>
<th>Alcohol-Related, %†</th>
<th>Total, No.</th>
<th>Alcohol-Related, %†</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>1023</td>
<td>27.0</td>
<td>996</td>
<td>23.2</td>
<td>368</td>
<td>12.9</td>
<td>242</td>
<td>10.7</td>
</tr>
<tr>
<td>3-5</td>
<td>872</td>
<td>27.9</td>
<td>842</td>
<td>22.6</td>
<td>867</td>
<td>7.1</td>
<td>416</td>
<td>15.9</td>
</tr>
<tr>
<td>6-8</td>
<td>690</td>
<td>25.8</td>
<td>659</td>
<td>26.7</td>
<td>1005</td>
<td>6.2</td>
<td>412</td>
<td>6.7</td>
</tr>
<tr>
<td>9-11</td>
<td>616</td>
<td>26.4</td>
<td>568</td>
<td>22.1</td>
<td>867</td>
<td>8.1</td>
<td>376</td>
<td>9.7</td>
</tr>
<tr>
<td>12-13</td>
<td>602</td>
<td>22.9</td>
<td>541</td>
<td>26.3</td>
<td>649</td>
<td>11.1</td>
<td>250</td>
<td>12.9</td>
</tr>
<tr>
<td>14-15</td>
<td>1481</td>
<td>24.9</td>
<td>1375</td>
<td>28.3</td>
<td>662</td>
<td>18.3</td>
<td>279</td>
<td>21.2</td>
</tr>
<tr>
<td>Total‡</td>
<td>5,284</td>
<td>25.9</td>
<td>4,981</td>
<td>25.2</td>
<td>4,418</td>
<td>9.8</td>
<td>1,975</td>
<td>12.4</td>
</tr>
</tbody>
</table>

*Data from the National Highway Traffic Safety Administration, Fatality Analysis Reporting System: 1975-1997.†Calculated by applying the percentages derived from definitive police reports to the entire analysis sample (see “Methods” section).‡Eighteen deaths were excluded from the analysis sample of 16,676 deaths because of missing data.
as passengers, and the remainder involved pedestrians or bicyclists struck by drivers who had been drinking alcohol. Among single-vehicle crashes, 26.3% (1148) of child deaths were associated with alcohol use. Among 2-vehicle crashes, alcohol consumption was noted for the child’s driver or for both drivers in 25.0% (1486) of the deaths. For these alcohol-related deaths of child passengers, 66.3% involved alcohol use by the child’s own driver.

Table 1 shows that the number of deaths per year ranged between 2686 and 2884, but the percentage of alcohol-related fatalities has declined from 21.6% to 17.8% (1.03/100000 to 0.80/100000 population). Considering the alcohol use status of only the child’s driver (excluding the deaths of pedestrians and bicyclists and the alcohol-use status of the other driver in 2-vehicle crashes), the percentage of alcohol-related deaths declined from 18.8% in 1991 to 15.1% in 1995 and increased to 16.4% in 1996. Using these alcohol use–related deaths as the denominator, the percentage of child passengers in which the child’s own driver was using alcohol showed a different pattern, declining from 67.9% in 1991 to 58.0% in 1994 and then rising to 70.7% in 1996. For children as pedestrians and bicyclists, the percentage of alcohol-related fatalities declined from 21.6% in 1991 to 17.3% in 1994 and climbing to 22.3% in 1996.

### Driver Characteristics

Overall, the drivers of children in these crashes were slightly more likely to be male (52.3%), but children aged 11 years and younger were more likely to be driven by females (Table 3). Among children aged 14 and 15 years, only 30.0% of the drivers were female. Alcohol use was associated with 23.3% of children’s deaths involving male drivers and 10.0% involving female drivers (RR, 2.33; 95% confidence interval [CI], 2.12-2.57).Alternatively, male drivers accounted for 70.0% of these alcohol-related deaths. The higher percentage of alcohol use by male drivers was consistent across children’s age cohorts.

The RR of alcohol involvement for drivers under the legal drinking age compared with those aged 21 years and older was slightly less than 1 (RR, 0.93; 95% CI, 0.85-1.02). Males younger than 21 years accounted for 38.8% of all deaths involving male drivers and 35.3% of the alcohol-related deaths. In contrast, females younger than 21 years accounted for only 24.9% of the deaths involving female drivers and 17.6% of the alcohol-related deaths. Taken together, drivers under the legal drinking age accounted for 30.3% of the alcohol-related children’s passenger deaths.

To distinguish crashes in which the drivers and child passengers could be considered social peers from those in which the driver was ostensibly a caretaking adult, we categorized deaths according to whether the driver was at least 6 years older than the child. For the 14- and 15-year-old victims, alcohol use was more common in the crashes involving drivers who were more than 6 years older than their passengers (28.9% vs 19.3%), but 62.6% of alcohol-related deaths for this group involved drivers close in age (<6 years difference), reflecting the greater exposure of teenagers to driving with social peers than with older adults. For 14- and 15-year-old girls involved in crashes with peer drivers, males accounted for 59.4% of the drivers, of whom 27.3% had been drinking alcohol. The RR of alcohol use by male drivers of these girls vs female drivers was 2.66 (95% CI, 1.85-3.84). For 14- and 15-year-old boys with age-peer drivers, 83.3% had male drivers, of which 20.4% had been drinking alcohol (RR, 2.48; 95% CI, 1.38-4.46). When riding with male drivers who were their age peers, girls were at greater risk of alcohol involvement than were boys (RR, 1.34; 95% CI, 1.08-1.66).

### Table 3. Alcohol-Related Traffic Deaths of Children by Driver’s Sex and Child’s Age*

<table>
<thead>
<tr>
<th>Child’s Age, y</th>
<th>Male Drivers</th>
<th>Female Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total, No.</td>
<td>Alcohol-Related, †</td>
</tr>
<tr>
<td>0-2</td>
<td>851</td>
<td>22.2</td>
</tr>
<tr>
<td>3-5</td>
<td>686</td>
<td>22.6</td>
</tr>
<tr>
<td>6-8</td>
<td>600</td>
<td>21.1</td>
</tr>
<tr>
<td>9-11</td>
<td>579</td>
<td>19.1</td>
</tr>
<tr>
<td>12-13</td>
<td>667</td>
<td>20.8</td>
</tr>
<tr>
<td>14-15</td>
<td>1998</td>
<td>26.7</td>
</tr>
<tr>
<td>Total</td>
<td>5381</td>
<td>23.3</td>
</tr>
</tbody>
</table>


†Calculated by applying the percentages derived from the definitive police reports to the entire analysis sample (see “Methods” section).

**COMMENT**

From 1991 through 1996, approximately 550 children per year died in alcohol-related motor vehicle crashes. To put this...
in perspective, it is estimated that annually 284 to 360 children younger than 18 years die from smoking-related illnesses and fires, and approximately 208 children younger than 15 years die as the result of unintentional firearm injuries.

Paralleling the national experience for alcohol-related motor vehicle deaths, the percentage of children’s alcohol-related deaths as passengers declined overall between 1991 and 1996, but patterns differed for younger and older children. The risk for younger children (<12 years) has declined somewhat, but there has been no consistent change for older children. The percentage of alcohol-related traffic deaths accounted for by the child’s own driver varied from 58.0% to 70.7%. In many cases, drivers were old enough to be considered the responsible caretaker rather than an adolescent peer who might be caught up in the social act of drinking. However, 30.3% of the alcohol-related child passenger deaths involved drivers younger than the legal drinking age of 21 years.

The major limitation of this study relates to the measure of alcohol involvement, as is nearly always the case in alcohol studies. In view of the absence of observable indicators of low BACs, police officers are highly unlikely to detect a BAC of less than 0.05% and hence to report that the driver was drinking alcohol, which argues in favor of our use of definitive police reports. Moreover, among fatally injured drivers for whom BAC values are available in FARS, only about 2% have positive BAC values that are less than 0.05%.

The overall alcohol involvement of 19.9% is lower than the 24% reported by the CDC for the period 1985-1996 for children younger than 15 years. One possible explanation for this disparity is that the algorithm that the National Highway Traffic Safety Administration uses to estimate alcohol involvement in crashes was not developed using the peculiar subset in which a child was a passenger but rather using all fatal crashes. A second possible explanation is that the CDC analysis included the late 1980s, before the marked recent decline in alcohol involvement in motor vehicle–related crashes.

There are several implications of these findings both for clinicians and policy makers. Although FARS data provide no information on the family relationships among persons involved in crashes, in view of a recent estimate that in a given year about 1 in every 6.6 children is exposed to family alcohol abuse or dependence, many crashes likely involved parents as drivers. Given recent evidence on the effectiveness of patient education on alcohol use, such counseling may be even more effective when offered about risks to parents’ own children. Clinicians could also educate parents to be especially attentive to the possibility of alcohol use by other drivers of their children. While 14- and 15-year-old victims were disproportionately riding with drivers close to their own age, the fact that there was evidence of alcohol use by 36.6% of the male drivers and 15.5% of the female drivers who were at least 6 years older than the child victim highlights the need to modify the behavior of these “responsible” adults.

For clinicians who work with adolescents the message is quite strong. Since a disproportionate share of the deaths was associated with drivers younger than 21 years, for whom alcohol use is per se illegal, it is important to help adolescents and young adults understand the risks that arise from this illegal behavior. Furthermore, effective strategies and techniques to avoid risky behaviors, such as riding with a driver who has been drinking, should be incorporated into health promotion programs for adolescents. Particularly noteworthy, however, is the risk to adolescent girls of an alcohol-related death (RR, 2.66) when male peers are driving compared with their female peers as drivers. It is important to underscore that the health message should be more extensive than “kids and alcohol don’t mix” because nearly 40% of the deaths of children aged 14 and 15 years involved drivers at least 6 years older than the children.

Given the disproportionate share of deaths in which the driver was under the legal drinking age, laws governing availability of alcohol to this age group should be more rigorously enforced. Since adolescents and young adults are more sensitive to price changes than are others, the tax structure on alcohol, especially beer, which is the beverage most commonly used by drinking drivers, could be altered to decrease its consumption among this younger group of drivers.

Despite impressive declines in alcohol-related motor vehicle deaths for adults during the past decade, the risk to children remains substantial, warranting additional attention and carefully targeted action.

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REFERENCES