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Child Passengers Injured in Motor Vehicle Crashes

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Abstract

Introduction—During 2010, 171,000 children aged 0-14 were injured in motor vehicle crashes. Despite the severity of the problem, research has been limited, and most of what we know about these children emanates from fatal crash databases. **Method**—Using information from the General Estimates System, this effort examines the occurrence of non-fatal crashes among children aged 0-14 over the last decade. **Results**—We found about 1% of the non-injured children in the file had been driven by a driver who was positive for alcohol. This percentage climbed to about 2% among children who had suffered injuries. Compared with the proportion of alcohol-positive drivers at the time of the crash, the proportion of drivers who sped or failed to obey a traffic signal were significantly higher. **Practical Applications**—The finding that drinking and driving with children did not decrease over time questions the adequacy of the extant child endangerment laws.

Keywords

Child endangerment; non-fatal crashes; alcohol; speeding; traffic signs

Introduction

Overall, motor vehicle crashes (MVCs) are the leading cause of death for children aged 4 and aged 11-14 (NHTSA, 2012a). During 2010, about 1,000 U.S. children younger than 15 were killed in MVCs (NHTSA, 2012a; Kelley-Baker & Romano, 2014), and that same year, another 171,000 children aged 0-14 were injured in MVCs (NHTSA, 2012a). Despite the severity of the problem, research on child endangerment on our roads remains limited and most of what we know about these children emanates from fatal crash databases. In 2000, Margolis and colleagues (2000) used the Fatality Analysis Reporting System (FARS) dataset (1991-1996) to report that 3,310 children had died in those years in an alcohol-related MVC. Around the same time, Quinlan and colleagues (2000) also used the FARS data (1985-1996) to report that of the 5,555 child passenger deaths they examined, 64% occurred while the child was riding with a drinking driver. Consistent with their previous results, most recently

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Quinlan et al. (2014) found that 65% of children who died in alcohol-related MVCs between 2001 and 2010 were transported by a drinking driver. These rates were also consistent with those recently estimated by Kelley-Baker and Romano (2014), suggesting the rate of children involved in alcohol-related fatalities has persisted over the last 20 years.

Very little has been examined using non-fatal crash statistics. Starnes (2005) used the 1998-2002 General Estimates System (GES), a national sample of police-reported motor vehicle crashes, to evaluate the role that improper restraint and seat position play in causing non-fatal injuries among children younger than 16 years old. As expected, the author reported that restraint use reduced the severity of the injury—with the severity of the injury also depending on the type of vehicle, being lower on SUVs, vans, or pickups than in passenger cars. Hana (2010) used the 1999-2008 GES database to examine the body regions affected by non-fatal severe (incapacitating) injuries among children younger than 8 years old that were involved in motor vehicle traffic crashes. The author reported that head injuries were the most common among severe injuries and that improper use of safety belts contributed largely to those severe injuries. Although useful and informative, current studies based on non-fatal crashes have not provided information about the factors that contribute to endangering children in non-fatal crashes. The goal of this manuscript is to begin that examination. More specifically, we aim to add to the extant literature by providing an estimation of the number of children aged 0-14 involved in non-fatal crashes in the U.S. as they were driven by drivers aged 21 or older, report the prevalence of the severity of their injuries, look at their evolution over the last decade, and examine some key factors hypothesized to contribute to the different severity levels (drivers' age, gender, as well as some drivers' driving behaviors such as drinking and driving, speeding, and failing to obey a traffic signal).

METHODS

Data Sources

Data used for this analysis came from the 2002-2011 General Estimates System (GES). Started in 1988 and maintained by the National Highway Traffic Safety Administration (NHTSA), the GES is a nationally representative sample of police-reported motor vehicle crashes. Not included in the GES are crashes that were not reported to the police. Police reports are sampled from 60 primary sampling units (PSUs) designed to represent the geography, roadway mileage, population, and traffic density of the U.S. About 50,000 police accident reports (PARs) are randomly selected each year. Trained data entry NHTSA personnel interpret the PARs, coding approximately 90 data elements into a common format and entering them into an electronic data file. No personal information is kept. After checking the electronic data for validity and consistency, the data file is created.

Inclusion criteria—For this effort, only passenger vehicles, minivans, pickups, and sports utility vehicles were kept in the file (i.e., buses were excluded). The age, gender, and injury severity (if injured) of both drivers and passengers were also kept in the database. Based on police reports, the GES also informs drivers' drinking, speeding and other traffic violations. With respect to drivers transporting children, we included in our analysis only those aged 21

years old and older driving at least one child under the age of 15 years old. This was to ensure that the child (as defined in this study as an individual 14 years of age or younger) was driven by someone old enough to be a parent or guardian (over 21 years of age). This ensured a minimum 7-year gap between driver and passenger, reducing the chances that the driver and passenger were peers.

Measures

For the current study, variables of interest included the following:

Time of the Day and Day of the Week—We examined the following time frames: 6 a.m. to 9:59 a.m., 10 a.m. to 4:59 p.m., 5 p.m. to 7:59 p.m., and 8 p.m. to 5:59 a.m. We also created a binary variable indicating if the crash took place on weekdays or over the weekend.

Driver

Speeding: To indicate if the driver was speeding at the time of the crash we looked at the traffic violation codes reported in the GES. The GES also provides a variable that summarily indicates if speeding was a factor in the crash (variable “speedrel”). Drivers who had been reported as speeding by the officer were included in this category.

Driver

“Fail to Obey.”: Police reports also inform if the driver ran a red light, failed to stop at a traffic signal, or failed to obey a yield signal. Drivers who committed any of these violations were included in the “fail to obey” category.

Driver

Alcohol: The GES file informed about the drivers’ alcohol involvement. Variable VEH_ALCH informs if the vehicle’s driver was drinking at the time of the crash (as reported by the officer). When this measure was absent, imputed values were estimated by NHTSA using sequential regression imputation (NHTSA, 2012). We used this information to create a 0-1 variable indicating alcohol was present in the crash.

Children

Restraint Use & Seat Position: The GES informs both about the seating position of the passengers and if they were wearing a seat belt at the time of the crash. Based on findings from Hana (2010), two seating positions were identified: first row, and second row or rearward. Also, a two-level variable was created indicating if the child was properly belted.

Children

Injury & Injury Severity: Information about the children’s injury severity in the GES is provided by classifying the injury as non-incapacitating, incapacitating, fatal, possible, or of “severity unknown.” Because they are under-sampled in the GES, we excluded fatally injured cases from this study (a detailed examination of the factors contributing to fatally injured children using the FARS was recently completed by this research team; see Kelley-

Baker & Romano, 2014). Because of the intrinsic uncertainty of the “possible injury” category, we adopted the conservative criterion of assuming that none of the “possible” injuries were so.

A further decision was made regarding those cases in which the injury was confirmed, but its severity was unknown. Injuries of unknown severity were excluded from analyses aimed to examine the factors that contribute to the severity of the injury. Thus, the variable indicating the severity of the injury was left with three levels: “no injury,” “non-incapacitating injury,” and “incapacitating injury.”

Driver & Children

Age: We separately examined the age of the drivers and that of children. Because crash risk for drivers under the age of 21 is highly exacerbated by the presence of other teenagers in the vehicle (e.g., Romano, Kelley-Baker, & Lacey, 2012), and to avoid confounding the risks associated with teens driving teens with that of adults driving children (the focus of this study), only drivers aged 21 and older transporting a child (passenger younger than 15 years old) were included in this study. To systematize the analyses, the following age categories were examined for drivers: 21-24, 25-29, 30-39, 40-49, 50-59, 60 and older. Regarding children’s age, we examined the possibility that drivers are more careful in their driving when transporting younger children—who may be seen as more vulnerable in the event of a crash—than when driving older children.

Driver & Children

Gender: We separately examined the gender of drivers and that of children. Because women are considered to be safer drivers than men (Li et al., 1998; McCartt and Northrup, 2004; Goldzweig et al., 2013), we hypothesize that female drivers will be more protective (take fewer driving risks) than their male counterparts. We also examined if such hypothesized gender-impact among drivers also takes place among children (i.e., if the gender of the child has any influence on the drivers’ driving behavior).

Analyses

We conducted descriptive, bivariate statistics to examine dual associations between the variables of interest. Comparisons across the different estimates were made by looking at point estimates and examining their 95% confidence intervals. We used STATA® to run the analyses, which were performed by taking the sampling design of the GES survey into account. We first looked at all crashes that satisfied the inclusion criteria and estimated the proportion of children that were injured, by age and gender. Also, we estimated the age and gender distribution of the drivers of injured children. We also estimated the prevalence of speeding, alcohol-related, and fail-to-obey crashes separately for non-injured and injured children. Next we ran logistic regressions to examine the factors that contribute to drivers’ drinking, speeding, and failure to obey a traffic signal. The factors examined were children’s age and gender; drivers’ age and gender; the day and time of the day; and the presence of alcohol (the latter was excluded from the alcohol-related models). We also ran a logistic model to examine how these factors affect the likelihood of having a child seated in the second row or rearward, and properly belted.

To examine the factors that shape the severity of the injury, we applied a Heckman selection model. The Heckman selection model was used to account for the fact that the severity of an injury can be measured only on children who were injured. Thus, our approach separately models and examines (i) the likelihood of an injury, and (ii) among those who are injured, the severity of the injury. Finally, we explored trends. To do so we estimated the annual prevalence of children's drivers who were drinking, speeding, or failed to obey a traffic law, and used 95% confidence intervals to make comparisons over time.

RESULTS

Table 1 shows the number and percentage of non-fatally injured children in the file and their drivers, by age and gender. In the U.S. between 2002 and 2011, 8,609,241 children younger than 15 years old were involved in a non-fatal crash when driven by a driver 21 years old or older. Of these, 19.1% (1,648,330) were injured. Annualized, these figures indicate a total of 164,833 non-fatally injured children. Table 1 shows that the percentage of injured children did not vary significantly by children's age, ranging from 17.4% among children less than a year old, and 21.6% among those 13 years old, but that difference was not statistically significant. No significant difference in the percentage of injured children by children's gender was detected either (19.0% among male children, 19.3% among female children).

Table 1 also describes the age and gender of the drivers of injured children. Most (36.3%) of the drivers of these children were 30-39 years old, with the age distribution of these drivers varying with the age of the children they drove. About 22.9% of the youngest children (less than one year old) were driven by the youngest drivers in the file (aged 21-24). As children get older, the age of the drivers tends to increase. Most drivers of injured children were women (59.9%). These findings seem to reflect the age and gender of children and their main caretakers.

Next we looked at the distribution of drivers who had consumed alcohol, sped, failed to obey a traffic signal, as well as the distribution of children seated in the second to fourth row with proper restraint. Table 2 shows these distributions by children's age and gender, separately for non-injured and injured children. Overall, almost 1% of the non-injured children in the file had been driven by a driver who was reported as positive for alcohol. This percentage climbed to over 2% among children that had suffered injuries. Compared with the proportion of alcohol-positive drivers at the time of the crash (0.8% and 2.2% among drivers of non-injured and injured children, respectively), the proportion of drivers who sped or failed to obey a traffic signal were significantly higher, regardless of the children's injury (4.1% non-injured and 5.5% injured due to speeding, and 3.5% non-injured and 6.7% injured related to failure to obey). This finding, however, needs to be taken with caution, as it underscores a limitation of the database: by not informing about actual blood alcohol contents (BACs), only drivers showing clear signs of intoxication are reported as alcohol positive by the officer. Thus, the prevalence estimates for alcohol shown in Table 2 are likely to be fairly conservative and underestimate the number of alcohol-positive drivers driving with children.

As expected and broadly speaking, Table 2 also shows that the proportion of children with a restraint and seated in the second row or further varies with the children's age, becoming lower as the child gets older. For children of any age, the proportion of injured children with a restraint was significantly lower than that among those non-injured. This finding emphasizes the importance of proper seat belt use among children of any age. Regarding seat position, the picture is less clear. No injury-related difference associated with seat position was found for children younger than 2 years old; a finding that suggests that most of these young children do not travel in the front seat. For children aged 1 to 3 however, the proportion of injuries was significantly higher among children seated in the front row than in the second row or further back. For children older than 3 years old, no difference in the prevalence of injuries by seat position was found (with the exception of children aged 6 or 13, which we cannot explain), a finding that indicates that the seating of young children in vehicle's front row increases the chances of injury if a crash occurs. Finally, Table 2 shows that neither the age nor the gender of the child affects the prevalence of drinking, speeding, or failure to obey drivers, regardless of the children being injured or not.

The statistics presented in Tables 1 and 2 describe basic associations between children's and drivers' demographics and children's injuries. Next we examine the joint contribution of these factors to alcohol-related, speeding-related, and fail-to-obey-related crashes, as well as to the likelihood that the child was seated in the second-fourth row and restrained. Table 3 shows the outcome of five regression models estimating the contribution of the several factors of interest (children's age and gender, drivers' age and gender, alcohol, and day of the week and time of the day) to the likelihood that at the time of the crash the driver (i) was affected by alcohol, (ii) was speeding, (iii) failed to obey a traffic signal, (iv) the child was not seated in the first row, and (v) was wearing a restraint.

Table 3 shows that drivers are less likely to drink when driving with a young child (younger than 6 years old) than with an older child. They are also less likely to fail to obey a traffic signal when driving with a child younger than 7 years old or aged 10-14, than with a child aged 6-9. The age of the child, however, does not seem to affect the drivers' decision to speed. As expected, the likelihood of finding a child in the second-fourth row is significantly higher when the child is younger than 6 years old than aged 6-9. The likelihood of finding a child in the second-fourth row is even lower when the child is aged 10-14 than 6-9 years old. The likelihood of finding a child with a proper restraint is the highest for children aged 0-2, decreasing steadily for children aged 3-5, then children aged 6-9, and finally being the lowest after age 10 years.

The gender of the child appears to affect the likelihood the driver was drinking or failed to obey a traffic signal, being lower when the child was a female than when a male.

As expected the age of the driver was a significant explanatory factor in each of the five models. Broadly speaking, young drivers (in particular those aged 21-24) were more likely to have consumed alcohol, sped, or failed to obey a traffic signal than drivers aged 25-29, 30-39 (the reference group), or older. They also were less likely to have their child passenger sitting in the second-fourth row with a restraint. The exception occurs for drivers

aged 60 or older, who are found as likely to fail to obey a traffic signal as 21-24 year old drivers.

Also as expected and compared with their male counterparts, in general female drivers were found less likely to be drinking. Female drivers were also more likely to fail to obey a traffic signal than their male counterparts. No gender differences in speeding-related crashes were found. Gender was not an issue regarding children's seating position and if they were belted or not. Among the factors we examined, alcohol was the largest contributor to speeding. Alcohol was also the largest contributor to not having children sitting in the second-fourth row with a restraint. Alcohol was, however, not a significant contributor to drivers' failure to obey a traffic signal.

The occurrence of these risky-driving situations also varies with the day of the week and time of the day. Thus, while alcohol was found more likely to be present among drivers with children who crashed at nighttime (in particular from 8 p.m. to 5:59 a.m.) than at daytime (10 a.m. to 4:59 p.m.), the opposite occurs regarding speeding or failing to obey a traffic signal, which were most common at daytime, when most children are transported.

Next we examined the factors that contribute to children's injury and their severity (Table 4). Regarding the children's age, the likelihood that a child younger than 3 years old is found injured in a crash is significantly lower than that for older children, in particular among children aged 10-14. However, among the children who are injured, those younger than 3 years old (as well as those aged 3-5) are more likely to suffer a severe injury than older children (i.e., aged 6-9 or 10-14 years old). In other words, although drivers are less likely to be involved in a crash when driving with a very young child, for those involved in a crash the consequences are more severe for the youngest, most frail children. As expected, children sitting with a restraint are significantly less likely to be injured in a crash, and if injured, less likely to suffer a severe injury than unrestrained children unrestrained. Based on the main effects shown in Table 4, children's position seems to have no impact on the likelihood of the children being injured nor if injured, on the severity of the injury. However, because children's seat position varies with children's age, we also examined the interaction between seat position and children's age (not shown in Table 4). We found that for children aged 3-5, the likelihood of being injured in a crash is higher when seated in the front row than in the second-fourth rows. No significant interaction between injury and seat position was found for children of other ages. No significant interaction between seat position and injury severity was found either. In summary among children involved in a crash, children aged 3-5 years old are more likely to be found injured while seating in the front row than children of any other age. Regardless of seat position, the likelihood of injury when a crash occurs and the severity of the injury increase significantly when children (of any age) are not properly belted.

Although the gender of the children does not affect the severity of the injuries they receive, female children are less likely to be injured in a crash than male children. We speculate that this finding relates to the peculiar gender association between drivers and children shown in Table 1 and described above stating that most female children are driven by female drivers, which the literature consistently depicts as safer drivers than their male counterparts. In

Table 4, however, once adjusted by the other cofactors, the estimated contribution of gender to children's injury and severity was found statistically not significant. A similarly surprising limited statistical significance was found for the age of the driver. With the exception of drivers aged 50-59 (who were found less likely to have a child injured in a crash) and drivers aged 60 and over (who if crashed with a child and that child was injured, the likelihood that injury was severe was higher than for younger drivers of children), the age of the driver does not seem to affect the likelihood the child they were driving was injured, either severely or not. These findings suggest that factors other than drivers' age or gender contribute largely to the likelihood children are injured in a crash. Alcohol is one of those factors. Regardless of the drivers' age or gender, alcohol is the largest contributor to children's injury and to the severity of those injuries. Speeding and failure to obey a traffic signal are also significant contributors to the likelihood of children being injured in a crash, even after these factors were adjusted by the presence of alcohol. Once adjusted by the presence of alcohol, however, the contribution of speeding and/or failure to obey to injury severity is no longer significant.

The importance of alcohol to children's injuries is further shown by the remaining two factors in that model: day of the week and time of the day. Most non-fatal crashes in which at least one child is injured occur over a weekend and at nighttime (8 p.m. to 5:59 a.m.), times in which drinking and driving is most common (e.g., NHTSA, 2012c).

Figure 1 shows the evolution of the prevalence of the four types of behaviors over the last decade. As shown in Figure 1, the prevalence of alcohol among the drivers of children in the file did not change significantly between 2002 and 2011, remaining at about 1% over the entire period. The prevalence of drivers who failed to obey a traffic signal did not change either (it remained at about 4.3%). The prevalence of drivers who were speeding at the time of the crash, however, did increase over the last 10 years, from 1.8% in 2002 to 6.2% in 2011. Also of interest, the evolution of the prevalence of children who were sitting in the second-fourth row with a restraint varied depending on the children's age. Although such prevalence increased significantly over the last decade for children aged 0-9 (from 78.2% to 86.0%), it remained statistically unaltered for children aged 10-14 at about 51.0%.

DISCUSSION

As mentioned, research on children's involvement in motor vehicle crashes has been surprisingly sparse, with most research efforts focused on examining fatal crashes. These efforts show rates of motor vehicle fatalities among children have remained unchanged for over two decades (Kelley-Baker & Romano, 2014). The overall motivation for this effort was to extend the examination of children's involvement in motor vehicle crashes to those involved in non-fatal outcomes and begin to examine driver characteristics and behaviors related to those crashes. A first outcome of this effort is that it underscores the magnitude of the problem. While the estimated 1,000 children that die each year in a crash generated some concern (NHTSA, 2012a; Kelley-Baker & Romano, 2014), the almost 165,000 children that each year are involved in a non-fatal crash should elevate our concern, as the annual number of non-fatally injured children is about 137 times higher than that of fatally injured children. Further concern about the child endangerment problem arises when we consider the

psychological stress suffered by the over 690,000 children that although physically unharmed, each year experience the trauma of being involved in a crash.

Besides providing a better understanding of the magnitude of the child endangerment problem, the outcome of this analysis of non-fatal crashes tends to mimic those observed for fatal crashes. As reported for fatal crashes (Kelley-Baker & Romano, 2014), we found that the presence of a child does have a protective influence on driver's behavior. Nevertheless, although the presence of a child prompts drivers to drive more safely, such an influence has not been strong enough to preclude the endangerment of children by their drivers. Some drivers keep speeding, drinking, and failing to obey traffic signs when driving with children. Who are these drivers? Although a response to this question would require a more detailed focus than the one followed by this effort, it is clear that the demographics of children's drivers do not follow that for the whole population of drivers, with an overrepresentation of female drivers aged 30-39, which indicates the gender and age of children's main caregivers. What seems clear is that alcohol contributes to crash risk, either directly or through risky driving behaviors such as speeding or failing to obey a traffic signal. It also seems clear that these behaviors contribute to the severity of the children's injury: among non-fatal crashes, the proportion of drivers with children who drink and drive, speed, or fail to obey a traffic signal is lower among non-injury crashes (0.8%, 4.1% , and 3.5%, respectively) than among crashes resulting in a non-fatally injured child (2.2%, 5.5%, and 6.7%, respectively). The contribution of these factors to injury severity can be further demonstrated by comparing these findings with those reported by Kelley-Baker & Romano (2014) for fatal crashes: 14.1% and 18.5%, for alcohol-related (BAC .08) and speeding-related fatal crashes, respectively. Thus, our findings illustrate once more that drinking drivers not only put the children they drive in danger of injury, but also increase the severity of their injuries. Further, alcohol seems to be the largest contributor to children's endangerment. This was illustrated when we accounted for the joint effect of alcohol, speeding, and failure to obey a traffic signal, and alcohol remained the sole contributor to crash risk. In other words, once adjusted by the presence of alcohol, the contribution of speeding to injury severity and/or failure to obey was no longer significant.

Another interesting finding is that although drivers are less likely to drink when driving with a young child (younger than 6 years old) than with an older child, the age of the child does not seem to affect the drivers' decision to speed. Although a clear explanation for this finding lies beyond the scope of this work, we nevertheless speculate that such a different behavior could be related to the ways these two risky driving behaviors take place, with drinking and driving usually being associated with "poor planning" and speeding more often associated with impulsivity when driving (i.e., avoidance of drinking and driving often requires some planning before the driving starts, while speeding may occur as an unplanned driving behavior). In any case, future research should explore this possibility as it may suggest different prevention interventions for these two child endangering driving behaviors. For example, one intervention may focus on better planning (e.g., arranging for a designated driver or avoiding drinking), while another intervention may focus on drivers' remaining alert and avoiding distractions and impulsive behaviors when a child is present.

Regarding seat belt use, our study confirms once more the injury-protective relevance of having children properly placed and wearing a restraint (e.g., Voas et al., 2007). It also indicates that the failure to seat and restrain children properly varies with the children's age, increasing after children are 2 years old. Coupled with our previous findings, our study seems to indicate that drivers of very young children are somehow more cautious in their driving than drivers with older children (those reducing the likelihood that these young children are injured in the crash). However, the outcome of our Heckman selection model shows that although children aged 0-2 are less likely to be involved in a non-fatal crash, once these children are injured they tend to suffer more severe injuries, probably due to their extreme frailty.

When looking at trends we found that while the prevalence of *alcohol-positive drivers* and/or drivers who failed to obey a traffic signal remained constant over the 2002-2011 period, the prevalence of speeding among these drivers increased sharply over the same period (more than 3 times). Although explaining this finding also lies beyond the capabilities of the data in hand, we found interesting that these trends mimic other findings in the literature, which show a stable prevalence of alcohol use among crashed drivers (e.g., Voas et al., 2012) and an increase in speeding and risky-driving behaviors among women over the last decade (e.g., Romano & Kelley-Baker, 2008). We therefore speculate that our findings are caused by the stagnation in the levels of alcohol-related crashes in the country, and the surge in risky-driving behaviors among women, who as we found constitute the majority of the drivers in the file. Future research should also explore these speculations.

Our finding that for drivers with children, the risky driving behaviors we examined either remained stable or increased over the last decade should also call attention to the adequacy of current child endangerment laws and policies. A recent paper by this research team (Thomas et al., 2014) reported that of the 50 U.S. states, 41 have enacted a child endangerment law specific to abating the drinking and driving problem. Our finding that the drinking and driving with children problem did not decrease over time questions the adequacy of the extant child endangerment laws (a finding also reported for fatally injured children by Kelley-Baker & Romano, 2014, and Thomas et al., 2014). Further research on the adequacy of these laws, including not only the consequences they impose on those who violate the law as well as how much the U.S. driving population is aware of their existence, is clearly needed.

Despite its insights, this effort presents some limitations. Perhaps one of the most relevant is that it does not account for technological improvements in vehicle safety over time. It could be argued that if the child endangerment problem has not increased over these years, it was not because relevant laws or policies were enacted, but because of technical improvements in vehicle safety, from better and safer vehicle frames to the quality of booster seats and or safety belts. Nevertheless, while future research should also take such technical evolution into account, our findings showing a large and persistent child endangerment problem should call attention to this important and neglected problem.

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Biography

Eduardo Romano is a Senior Research Scientist at PIRE in Calverton, Maryland. His past work involved estimating the incidence and cost of national and state intentional and unintentional injuries, and the evaluation of Mexican policies aimed to deter binge drinking by young American visitors in Tijuana (Mexico). As a Principal Investigator (PI), he has participated in NIH-funded efforts to evaluate the involvement in crash-risk situations of women and different minority groups, as well in a NHTSA-funded project to study the involvement in traffic violations of recent immigrants to the United States. He is currently the PI in a NIH-funded project looking at estimating alcohol-related and drug-related relative risks and on an OJJDP project to study the impact of alcohol-related laws and policies on teens' impaired driving. Dr. Romano holds a Ph.D. in Agricultural and Applied Economics from the Virginia Polytechnic Institute and State University.

Tara Kelley-Baker, a Senior Research Scientist with PIRE, has developed and directed several research projects in the fields of drug and alcohol use/abuse prevention and traffic safety. Her recent projects and interests focus on women and youth and include research on drug use, binge drinking, underage drinking, and issues relevant to impaired driving. Currently, she serves as Co-Principal Investigator on 2013 National Roadside Survey and Drug Crash Risk Study. These major efforts establish the estimated incidence of alcohol- and drugged-impaired driving on our nation's roadways and determine the relative risk contribution of alcohol and drugs on crashes. She is also currently Principal Investigator on an NIAAA study examining child endangerment laws as they relate to aggressive and impaired driving. Recently, she served as Principal Investigator on an evaluation of a teen driving parental responsibility program, as well as a study investigating the feasibility of a teen alcohol interlock program. Her interest in this area includes prevention efforts aimed at reducing the large number of US citizens killed each year in drunk-driving crashes. These studies have contributed to the debate influencing legislative changes concerning drunk-driving laws in our nation.

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Highlights

- Estimation of the number and prevalence of children aged 0-14 involved in non-fatal crashes in the U.S.
- Information obtained from the General Estimates System (GES)
- About 1% of the non-injured children had been driven by a driver who was reported as positive for alcohol
- This percentage climbed to about 2% among children who had suffered injuries.
- The proportion of drivers with children who sped or failed to obey a traffic signal was higher than that positive for alcohol.

Figure 1.

Annual evolution of the percentage of (a) drivers who drink, sped, or failed to obey a traffic signal, while driving a child; and (b) children who were in the second (+) row wearing a restraint. An asterisk (*) denotes a significant trend.

Table 1

Number of children (non-Injured and non-fatally Injured) and percentage of non-fatally injured children (aged 0-14) by drivers' age and gender 2002-2011.

			Injured Children: Percent by Drivers' age and gender									
			Drivers' age group					Drivers' gender				
			21-24	25-29	30-39	40-49	50-59	60+	Male	Female		
	N (all)	Injured N (Inj)	% of N(all)	Children's Age (years)								

N denotes total number of children at each age. Total counts are provided separately for non-injured and non-fatally injured children. The percentage of non-fatally injured children (by drivers' age and gender) are based on N (injured). Only drivers aged 21 or over were included. All counts and percentages in this table are weighted to accommodate GES sampling design (towards the U.S. population).

Table 2

CHILD: Non-Injured																
Child's Age (years)	N	Driver: Alcohol			Driver: Speeding			Driver: Fail to Obey			Child: "BACK SEAT"			Child: BELTED		
		%	95.0% LCI	95.0% UCI	%	1 LCI	95.0% UCI	%	95.0% LCI	95.0% UCI	%	95.0% LCI	95.0% UCI	%	95.0% LCI	95.0% UCI
<1	420,742	0.6%	0.4%	0.9%	4.9%	3.8%	6.3%	3.7%	2.7%	5.1%	89.1%	86.5%	91.2%	98.3%	97.6%	98.8%
1	554,293	0.8%	0.6%	1.1%	3.8%	2.9%	5.1%	3.3%	2.1%	5.1%	91.1%	89.5%	92.4%	98.7%	98.3%	99.1%
2	601,923	0.5%	0.4%	0.7%	4.4%	3.3%	5.9%	3.7%	2.7%	5.1%	92.3%	91.2%	93.3%	98.1%	97.5%	98.6%
3	557,523	0.6%	0.4%	0.8%	4.5%	3.4%	6.1%	4.3%	3.0%	6.2%	92.1%	90.6%	93.4%	98.1%	97.4%	98.6%
4	549,476	0.5%	0.3%	0.7%	4.0%	3.0%	5.3%	3.5%	2.5%	4.8%	88.0%	85.1%	90.4%	98.1%	97.4%	98.6%
5	475,879	1.1%	0.8%	1.4%	4.6%	3.5%	6.0%	3.3%	2.2%	4.8%	83.3%	79.6%	86.4%	97.3%	96.4%	98.0%
6	436,555	1.0%	0.7%	1.4%	5.0%	3.8%	6.5%	3.9%	2.8%	5.3%	84.3%	82.4%	86.1%	97.6%	96.8%	98.2%
7	423,925	1.0%	0.6%	1.8%	4.4%	3.4%	5.7%	4.4%	3.1%	6.1%	80.5%	77.9%	82.8%	98.2%	97.7%	98.5%
8	429,513	0.7%	0.4%	1.0%	3.9%	2.8%	5.5%	3.5%	2.5%	4.9%	75.6%	72.3%	78.6%	98.0%	97.4%	98.6%
9	467,889	1.1%	0.8%	1.6%	4.8%	3.4%	6.8%	3.7%	2.6%	5.2%	63.5%	54.5%	71.6%	97.7%	97.0%	98.2%
10	444,628	0.6%	0.4%	0.9%	3.4%	2.5%	4.8%	2.8%	1.8%	4.3%	64.1%	61.1%	67.1%	96.9%	95.9%	97.7%
11	409,181	0.5%	0.3%	0.8%	3.3%	2.4%	4.5%	3.1%	2.1%	4.3%	56.8%	51.5%	61.9%	97.1%	96.1%	97.9%
12	394,476	1.1%	0.8%	1.4%	4.0%	3.0%	5.2%	3.8%	2.4%	6.0%	51.1%	48.8%	53.4%	96.5%	95.5%	97.3%
13	368,795	0.7%	0.4%	1.3%	3.4%	2.5%	4.6%	2.9%	2.2%	4.0%	45.9%	43.3%	48.6%	97.0%	96.0%	97.8%
14	426,113	1.6%	1.2%	2.1%	3.0%	2.3%	4.1%	3.0%	2.2%	4.2%	44.1%	42.2%	46.1%	96.5%	95.6%	97.3%
Child's Gender																
CHILD: Injured																
Male	3,463,584	1.0%	0.8%	1.2%	4.1%	3.2%	5.3%	3.7%	2.7%	5.0%	75.3%	73.5%	76.9%	97.7%	97.4%	98.0%
Female	3,497,327	0.6%	0.5%	0.8%	4.2%	3.2%	5.4%	3.4%	2.4%	4.8%	75.2%	72.7%	77.5%	97.6%	97.2%	98.0%
All children	6,960,911	0.8%	0.7%	0.9%	4.1%	3.2%	5.3%	3.5%	2.6%	4.9%	75.2%	73.2%	77.2%	97.7%	97.3%	98.0%
Child's Age (years)	N	Driver: Alcohol			Driver: Speeding			Driver: Fail to Obey			Child: "BACK SEAT"			Child: BELTED		

LCI and UCI denote lower confidence interval and upper confidence interval, respectively.

Table 3

Outcome of regressions modeling the likelihood an adult driver with a 0-14 years old child would have consumed alcohol, sped, or failed to obey a traffic signal, as well as the likelihood the child is seated in the second (+) row wearing a restraint.

	Alcohol			Speeding			Fail to Obey			Child in Back Seat			Child Belted		
	OR	95%LCI	95%UCI	OR	95%LCI	95%UCI	OR	95%LCI	95%UCI	OR	95%LCI	95%UCI	OR	95%LCI	95%UCI
Children: Age															
0-2	0.78	0.63	0.98	0.99	0.85	1.15	0.88	0.80	0.97	3.28	2.91	3.69	1.93	1.67	2.23
3-5	0.82	0.68	0.98	0.98	0.87	1.09	0.85	0.77	0.94	2.28	2.14	2.43	1.11	1.00	1.24
10-14	0.99	0.83	1.17	0.88	0.77	1.00	0.83	0.76	0.91	0.40	0.35	0.46	0.73	0.65	0.82
<i>Ref: 6-9</i>															
Children: Gender															
Female	0.79	0.65	0.96	1.00	0.94	1.08	0.92	0.87	0.98	1.00	0.96	1.04	1.05	0.97	1.12
<i>Ref: Male</i>															
Driver: Age															
21-24	1.81	1.50	2.19	1.68	1.45	1.93	1.42	1.21	1.66	0.65	0.60	0.71	0.62	0.54	0.72
25-29	1.30	1.06	1.60	1.53	1.32	1.78	1.01	0.84	1.20	0.84	0.80	0.90	0.86	0.75	0.99
40-49	1.01	0.84	1.21	0.94	0.78	1.14	0.86	0.76	0.98	0.86	0.80	0.92	1.07	0.93	1.24
50-59	0.67	0.50	0.91	0.92	0.74	1.16	0.96	0.78	1.17	0.63	0.57	0.70	1.08	0.85	1.38
60+	0.41	0.29	0.58	0.60	0.46	0.77	1.78	1.46	2.17	0.53	0.47	0.59	0.96	0.78	1.18
<i>Ref: 30-39</i>															
Driver: Gender															
Female	0.52	0.43	0.63	1.03	0.94	1.13	1.41	1.22	1.63	1.07	0.99	1.16	1.05	0.92	1.21
<i>Ref: Male</i>															
Driver: Alcohol															
				2.12	1.65	2.73	0.81	0.56	1.18	0.45	0.34	0.60	0.19	0.14	0.26
Day of the Week															
Weekend	1.19	0.95	1.48	1.17	1.03	1.32	0.85	0.77	0.94	1.23	1.17	1.29	0.87	0.77	0.99
<i>Ref: Weekday</i>															
Time of the Day															

	Alcohol			Speeding			Fail to Obey			Child in Back Seat			Child Belted		
	OR	95%LCI	95%UCI	OR	95%LCI	95%UCI	OR	95%LCI	95%UCI	OR	95%LCI	95%UCI	OR	95%LCI	95%UCI
06AM-09:59AM	1.00	0.71	1.42	1.04	0.87	1.23	1.23	1.10	1.37	0.89	0.82	0.97	0.87	0.75	1.02
05PM-07:59PM	2.25	1.84	2.74	0.82	0.71	0.95	1.13	1.01	1.26	1.02	0.97	1.07	1.00	0.88	1.14
08PM-05:59AM	6.68	5.47	8.16	0.80	0.66	0.98	0.71	0.58	0.86	1.08	0.99	1.17	0.65	0.56	0.76
<i>Ref: 10AM-04:59PM</i>															

Table 3 shows the outcome of four regression models estimating the contribution of the independent variables (leftmost column) to the likelihood that at the time of the crash the driver i) was affected by alcohol, ii) was speeding; iii) failed to obey a traffic signal; and that iv) the child was wearing a restraint and not seated in the first row. Second (+) row denotes a child sitting in the second, third or fourth row. OR, LCI and UCI denote odds ratio, lower confidence interval and upper confidence interval, respectively. Logistic regressions were applied to model the drivers' likelihood of drinking, speeding, and failing to obey a traffic signal (the three leftmost models in table 3). Multinomial logistic regression was applied to the fourth model, to accommodate the four levels of the dependent variable. Table 3 only reproduces the ORs and confidence intervals for the Second (+) row, restraint level. The reference level for this regression was "First row, no restraint."

Table 4

Factors contributing to the likelihood a child riding with an adult driver (i) is injured in a non-fatal crash and (ii) suffered a severe injury.

	Injury			Severity		
	Coeff	95%LCI	95%UCI	Coeff	95%LCI	95%UCI
<u>Children: Age</u>						
0-2	-0.05	-0.08	-0.02	0.03	0.01	0.04
3-5	-0.02	-0.05	0.01	0.02	0.00	0.04
10-14	0.04	0.01	0.07	0.00	-0.02	0.01
<i>Ref: 6-9</i>						
<u>Children: Gender</u>						
Female	-0.07	-0.12	-0.01	0.00	-0.01	0.01
<i>Ref: Male</i>						
<u>Children's Position & Restraint</u>						
Second(+) Row	-0.02	-0.09	0.05	0.01	-0.02	0.03
<i>Ref: Front Row</i>						
Restraint	-0.73	-0.81	-0.64	-0.07	-0.10	-0.04
<i>Ref: No Restraint</i>						
<u>Driver: Age</u>						
21-24	0.01	-0.01	0.03	0.01	-0.02	0.05
25-29	0.01	-0.04	0.07	-0.01	-0.03	0.01
40-49	0.02	-0.02	0.05	0.00	-0.02	0.02
50-59	-0.07	-0.09	-0.04	0.00	-0.04	0.04
60+	-0.03	-0.09	0.03	0.03	0.00	0.07
<i>Ref: 30-39</i>						
<u>Driver: Gender</u>						
Female	0.01	-0.03	0.04	0.00	-0.02	0.02
<i>Ref: Male</i>						
<u>Driver: Alcohol</u>	0.52	0.39	0.64	0.06	0.01	0.10
<u>Driver: Speeding</u>	0.23	0.11	0.36	-0.04	-0.08	0.01
<u>Driver: Fail to Obey</u>	0.39	0.32	0.45	-0.09	-0.17	-0.01
<u>Day of the Week</u>						
Weekend	0.04	0.01	0.07			
<i>Ref: Weekday</i>						
<u>Time of the Day</u>						
06AM-09:59AM	0.01	-0.03	0.05			
05PM-07:59PM	0.01	-0.03	0.04			
08PM-05:59AM	0.18	0.10	0.25			
<i>Ref: 10AM-04:59PM</i>						

Columns labeled “Injury” present the outcome of the equation modeling the likelihood a child was injured in a crash. Columns labeled “Severity” present the outcome of the equation modeling the likelihood an injured child suffered a severe injury. Second (+) row denotes a child sitting in the second, third or fourth row. LCI and UCI denote lower confidence interval and upper confidence interval, respectively.

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