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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 that 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 was 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.

1. 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 1000 U.S. children younger than 15 were killed in MVCs (Kelley-Baker & Romano, 2014; NHTSA, 2012a), 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, Foss, and Tolbert (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, Brewer, Sleet, and Dellinger (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 Quinlan, Shults, and Rudd (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).

2. Methods

2.1. Data sources

Data used for this analysis came from the 2002–2011 General Estimates System (GES). Started in 1988 and maintained by the National

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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.

2.1.1. 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.

2.2. Measures

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

2.2.1. Time of the day and day of the week

We examined the following time frames: 6 am to 9:59 am, 10 am to 4:59 pm, 5 pm to 7:59 pm, and 8 pm to 5:59 am. We also created a binary variable indicating if the crash took place on weekdays or over the weekend.

2.2.2. 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.

2.2.3. 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.

2.2.4. 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, 2012a, 2012b, 2012c). We used this information to create a 0–1 variable indicating alcohol was present in the crash.

2.2.5. 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.

2.2.6. 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."

2.2.7. 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.

2.2.8. Driver & children: gender

We separately examined the gender of drivers and that of children. Because women are considered to be safer drivers than men (Goldzweig et al., 2013; Li, Baker, Langlois, & Kelen, 1998; McCartt & Northrup, 2004), 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).

2.3. 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