Child Restraint Use and Driver Screening in Fatal Crashes Involving Drugs and Alcohol

Yanlan Huang, MS,^a Chang Liu, MPH,^b Joyce C. Pressley, PhD, MPH^{b,c}

abstract

BACKGROUND: There are reports that the incidence of alcohol-involved crashes has remained stable among fatally injured drivers while drug involvement has increased in recent years.

METHODS: Data from the Fatality Analysis Reporting System (FARS) from 2010 to 2013 were used to examine drug and alcohol status of drivers ($N = 10\,864$) of 4-wheeled passenger vehicles involved in a fatal crash while transporting a passenger aged 0 to 14 years ($N = 17\,179$). Mixed effect multivariable logistic regression used SAS GLIMMIX to control for clustering. Odds ratios are reported with 95% confidence intervals (CIs).

RESULTS: Only 28.9% of drivers were screened for both alcohol and drugs, and 56.7% were not tested for either. The total proportion of unrestrained child passengers increased nearly linearly by age. Findings ranged as high as 70% for 13- to 14-year-olds with drivers positive for drugs and alcohol. In multivariable adjusted models, inappropriate child seating with drivers who tested positive was as follows: alcohol, 1.30 (95% CI, 0.92–1.82); drugs, 1.54 (95% CI, 1.24–1.92); and for both drugs and alcohol, 1.88 (95% CI, 1.38–2.55). More than one-fourth were unrestrained with drivers positive for cannabis (27.7%). Overall mortality was approximately triple for unrestrained versus restrained (33.5% vs 11.5%; $P < .0001$) and was higher in front-seated than rear-seated passengers (40.7% vs 31.5%; $P < .0001$).

CONCLUSIONS: Passengers were less likely to be appropriately seated and to be restrained when transported by a driver positive for drugs and alcohol, but this finding varied according to passenger age and drug/alcohol category.

Departments of ^aBiostatistics, ^bEpidemiology, and ^cHealth Policy and Management, Center for Injury Epidemiology and Prevention, Mailman School of Public Health, Columbia University, New York, New York

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Address correspondence to Joyce C. Pressley, PhD, MPH, Departments of Epidemiology and Health Policy and Management, Center for Injury Epidemiology and Prevention, Mailman School of Public Health, Columbia University, 722 West 168th St, Suite 812G, New York, NY 10032. E-mail: jp376@cumc.columbia.edu

WHAT'S KNOWN ON THIS SUBJECT: Drivers suspected of being alcohol-impaired are less likely to properly seat and restrain child occupants riding in their vehicle.

WHAT THIS STUDY ADDS: Incidence of alcohol and drug screening, mortality, appropriate seating position, and restraint use in young occupants transported by drivers who are unimpaired, or positive for drugs only, alcohol only, and various drug and alcohol combinations are reported.

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Motor vehicle injuries are a leading cause of death for children aged 0 to 14 years.¹ Seating of children in rear seats with appropriate restraints has been shown to be highly effective in reducing child injury and death in motor vehicle crashes.^{2–4} Despite recommendations that children be rear-seated, 15% of child motor vehicle occupant deaths in 2013 occurred in child passengers riding in a front seat.⁵ One-fifth (20%) of children involved in fatal crashes in 2011 were reported to be unrestrained, with 41% of the fatally injured children being unrestrained.⁶ The increased risks to infants and children being driven by alcohol-impaired drivers have been reported, with inappropriate child restraint and higher alcohol-related driving being associated with a higher incidence of child passenger injury and inappropriate child passenger restraint.^{7–10} Although considerable evidence exists that enforcement is targeting drinking drivers, the prevalence of alcohol involvement has remained stable among fatally injured drivers while the prevalence of drug involvement in fatal motor vehicle crashes has increased significantly in recent years.¹¹ Although not specific to drivers of pediatric passengers, it is reported that drivers positive for both alcohol and cannabis exhibit riskier driving behaviors than drivers positive for either alcohol or cannabis alone.^{12–14} Drivers who tested positive for alcohol or drugs reportedly drive at higher speeds and are more frequently unbelted.¹⁵ An earlier study (2005–2008) found that drivers suspected of alcohol or drug use transported a higher percentage of unrestrained front seat child passengers compared with drivers not suspected of alcohol or drug use.¹⁶ Drug regulations have changed since the time frame of this earlier study. In particular, since that time, legalization of marijuana for medicinal and recreational use

has occurred, with considerable variation that could have serious implications for the strength of enforcement, oversight, and monitoring of child safety.

The objectives of the present study were to describe the association of drug-related, alcohol-related, and the combination of drug/alcohol-related risky seating and child restraint behaviors in drivers of infant, child, and adolescent passengers aged 0 to 14 years. In particular, among those involved in a fatal motor vehicle crash, we examined the following: (1) the incidence of drug and alcohol screening of drivers involved in fatal crashes while driving young passengers and its relation to passenger mortality; and (2) the association between the driver's drug/alcohol use and child passenger seating position and restraint use in a subpopulation analysis of drivers screened for both alcohol and drugs.

METHODS

Data Source

Data from the Fatality Analysis Reporting System (FARS) from the National Highway Traffic Safety Administration (NHTSA) from 2010 to 2013 were used in this study.¹⁷ FARS is a census of all crashes on US public roads in which at least 1 person died within 30 days. FARS contains person-, vehicle-, and crash-level variables, including driver and passenger characteristics, drug and alcohol information, restraint use, seating position, severity of injury, traffic violations charged, vehicle body type, model year, crash time, impact point, rollover, ejection, and speed-related crashes. Restricting our analysis to a more recent time period by using the latest available FARS data allowed us to capture the latest circumstances under which children are being transported.

Study Population With Descriptive Information on Exclusions

Of the 22 680 children aged 0 to 14 years involved in a fatal collision between 2010 and 2013, a total of 19 240 (84.8%) were occupants in 4-wheeled passenger vehicles (passenger cars, vans, sport utility vehicles, or pickup trucks) with model years 1970 or later. Exclusions included emergency vehicles, large vans, and buses, as well as unknown seating position and unknown restraint status (Fig 1). The final study population included 17 179 child passengers riding in 4-wheeled passenger vehicles with 10 864 drivers who met the study inclusion criteria. More than one-half (56.7%) of drivers involved in a fatal collision while driving a child passenger were not screened for either drugs or alcohol (Supplemental Information). The 4885 child passengers whose driver ($n = 3141$) was screened for both alcohol and drugs were investigated in a subpopulation analysis.

Variable Classification

Person-level characteristics

Child Passenger Seating Position (Outcome Variable)

Seating position was categorized as front seat or rear seat. During the time frame of this study, NHTSA recommendations were that all children aged ≤ 12 years be seated in the rear. Passengers aged 0 to 12 years sitting in the front seat were categorized as inappropriately seated.

Child Restraint (Outcome Variable)

Child restraint status was examined across child age categories as follows: (1) a dichotomous variable (restrained versus unrestrained); and (2) a 3-category variable of restrained in an infant or child restraint, restrained seat belt only, or unrestrained. Child restraint status was examined for appropriate child restraint used (forward facing, rear

FIGURE 1
Population flow diagram of the study population of the child passengers, FARS 2010 to 2013. MV, motor vehicles.

facing, or booster seat) and child restraint not used (Supplemental Information).

Child Passenger Age and Sex

Child passenger age was examined both as a continuous variable and categorized into age groups 0 to 1, 2 to 4, 5 to 8, 9 to 12, and 13 to 14 years. Sex was categorized as male, female, or unknown.

Child injury severity was categorized as not injured, injured (including possible injury, injured, and unknown severity), died within 30 days of crash, or unknown.

Driver Age and Sex

Driver age was examined both as a continuous variable and collapsed into age groups 15 to 19, 20 to 44, 45 to 64, and >65 years. Sex was categorized as male, female, or unknown.

Driver Restraint

Driver restraint status was categorized as restrained (shoulder belt only, lap belt only, lap and shoulder belt, or restraint used/type unknown), unrestrained, or unknown.

Driver Alcohol, Drug Use, and Drug Type

The driver was considered to have alcohol present if police reported (documented the presence of) alcohol or the driver had a blood alcohol concentration (BAC) ≥ 0.01 . Of the 717 drivers categorized as having a positive BAC, 75.3% of drivers had a BAC ≥ 0.08 , with an additional 7.7% between 0.05 and 0.08. In a dichotomous variable, the driver was considered positive for drugs if police reported drug involvement or the driver tested positive for drugs. Drug type was dichotomized as any cannabis or other drug types.

Driver Previous Moving Violations

The following previous moving violations (history of speeding, driving while intoxicated, and other moving violations occurring within 3 years of the crash date) were analyzed as dichotomous variables.

Crash-level Characteristics

Rollover and Ejection

Rollover was analyzed as a dichotomous variable. Ejection from the vehicle was categorized as not ejected or ejected (partially or totally).

Excessive Speed

Excessive speed was analyzed by using a dichotomous variable. A vehicle was categorized as speeding if the driver was charged with a speeding violation or if the travel speed of the vehicle was reported to be above the posted speed limit. Due to large quantities of missing data, actual miles per hour traveled were not available for analysis.

A social weekend was defined as 6:00 PM Friday to 6:00 PM Sunday.¹⁸ Weekend versus weekday was analyzed as a dichotomous variable.

Day/Night

A dichotomous variable was used to distinguish daytime (6:00 AM to

5:59 PM) and nighttime (6:00 PM to 5:59 AM).

Statistical Analysis

The χ^2 test was used in bivariable analyses of the associations between the driver's drug/alcohol screening status and potential covariates. Significance was defined as a P value $<.05$. Because there could be multiple child passengers in the same vehicle, the SAS GLIMMIX procedure with random effects was used to generate odds ratios (ORs) with 95% confidence intervals (CIs) using multilevel models to control for violation of the assumption of independence. The grouping variable is a derived variable that created a unique vehicle-specific number that facilitated controlling for clustering of children being driven by the same driver. Unadjusted and adjusted ORs with 95% CIs for child restraint use and child seating position were produced by using univariable and multivariable multilevel logistic regressions. Except for age and sex, variables that were not significant predictors of the outcome were not included in the final model. Subpopulation analysis was performed on 4885 child passengers whose driver ($n = 3141$) was screened for both alcohol and drugs. All analyses were conducted by using SAS version 9.4 (SAS Institute, Inc, Cary, NC).

RESULTS

There were 17 179 children aged 0 to 14 years being driven by 10 864 drivers of 4-wheeled passenger vehicles involved in fatal motor vehicle crashes during the study time frame (Table 1). Approximately one-third (33.5%) of unrestrained passengers died compared with 11.5% of restrained passengers ($P < .0001$). Among restrained passengers, there were 317 (12.4%) deaths in the front-seated passengers and 1321 (11.3%) deaths in

rear-seated passengers ($P = .1164$). Among the unrestrained passengers, mortality was higher in front-seated than in rear-seated subjects (40.7% vs 31.5%; $P < .0001$) (Fig 2). The unadjusted mortality disparity (as reflected by mortality in the proportion unrestrained/mortality in the proportion restrained) was higher for the front seat (3.28) than for the rear seat (2.79).

Among children aged 0 to 12 years who died, 377 (14.5%) were seated in the front. Of these 377 front-seated children, 43.2% were unrestrained. Among the 190 (7.3%) deaths of front-seated teenagers, 87 (45.8%) were unrestrained. Older children and children in pickup trucks (which may not have rear seats) were more likely to be front-seated.

Proportion of Drivers Receiving Drug and Alcohol Screening

To assess the incidence of drug and alcohol screening in drivers, driver characteristics were examined for the 10 864 drivers who met the study inclusion criteria. Of these, 4705 (43.4%) drivers were screened for either drugs or alcohol or both, and 6159 (56.7%) drivers were not screened for either drugs or alcohol. Only 3141 (28.9%) drivers were assessed for both drugs and alcohol. Among drivers screened for both, 1756 (55.9%) drivers were negative for both drugs and alcohol, 800 (25.5%) drivers were positive for drugs only, 263 (8.4%) drivers were positive for alcohol only, and 322 (10.6%) drivers were positive for both drugs and alcohol.

Factors Associated With Drug and Alcohol Screening of the Driver

In unadjusted analyses, factors associated with alcohol or drug screening of drivers are shown in Table 2. In multivariable models, independent predictors of increased drug and alcohol screening for

drivers included driver age (drivers aged 20–44 years compared with drivers aged 15–19 years), driver restraint status (unrestrained), driver injury severity (died), previous moving violations, severity of child passenger injury (more severely injured or died), child passenger inappropriate seated/unrestrained, crash time (nighttime), crash characteristics (vehicle rollover), and speed (excess).

In both unadjusted and multivariable models, a driver's driving history (ie, violations in the last 3 years) of driving while intoxicated or of speeding was significantly predictive of being screened (Table 2). Compared with drivers not injured, drivers who died were more likely to be screened for drug/alcohol as were injured drivers in unadjusted models. When adjusted for other covariates, drivers who died continued to have higher rates of drug or alcohol screening while drivers injured was no longer a significant predictor. In unadjusted models, male drivers had higher odds of being screened compared with female drivers but not in adjusted models.

Child passenger injury severity was associated with drug/alcohol screening of drivers in both the unadjusted and adjusted models. Drivers of injured passengers were more likely to be screened, as were drivers of inappropriately seated or unrestrained child passengers (Table 2). Child age and sex were not independently associated with driver drug/alcohol screening.

Crash characteristics of night, rollover, and excess speed were associated with the driver undergoing drug/alcohol screening in both the unadjusted and adjusted models. Drivers who crashed at night, experienced vehicle rollover, or had a speed-related crash were more likely to be screened (Table 2).

TABLE 1 Drug and Alcohol Screening in Drivers Involved in Fatal Crashes While Driving Children Aged 0 to 14 Years, FARS 2010 to 2013

Variables	Driver Screened for Either Drug or Alcohol	Driver Not Screened for Either Drug or Alcohol	Total	<i>P</i>
Total	4705 (43.3)	6159 (56.7)	10 864	
Driver characteristics (<i>n</i> = 10 864)				
Driver age, y				<.0001
15–19	480 (10.2)	435 (7.1)	915 (8.4)	
20–44	3181 (67.6)	4302 (69.9)	7483 (68.9)	
45–64	832 (17.7)	1164 (18.9)	1996 (18.4)	
≥65	210 (4.5)	215 (3.5)	425 (3.9)	
Unknown ^a	2 (0.0)	43 (0.6)	45 (0.4)	
Driver sex				.0007
Male	2249 (47.8)	2726 (44.3)	4975 (45.8)	
Female	2456 (52.2)	3396 (55.1)	5852 (53.9)	
Unknown ^a	0	37 (0.6)	37 (0.3)	
Driver belt status				<.0001
Restrained	3241 (68.9)	5359 (87.0)	8600 (79.2)	
Unrestrained	1316 (28.0)	598 (9.7)	1914 (17.6)	
Unknown ^a	148 (3.1)	202 (3.3)	350 (3.2)	
Injury severity				<.0001
Died	2252 (47.9)	1019 (16.5)	3271 (30.1)	
Injured	1572 (33.4)	3039 (49.3)	4611 (42.4)	
Not injured	845 (18.0)	2048 (33.3)	2893 (26.6)	
Unknown ^a	36 (0.7)	53 (0.9)	89 (0.8)	
Previous violation				
Speeding				.0027
Yes	828 (17.6)	947 (15.4)	1775 (16.3)	
No	3798 (80.7)	5080 (82.5)	8878 (81.7)	
Unknown ^a	79 (1.7)	132 (2.1)	211 (1.9)	
Alcohol				<.0001
Yes	98 (2.1)	38 (0.6)	136 (1.3)	
No	4528 (96.2)	5989 (97.2)	10 517 (96.8)	
Unknown ^a	79 (1.7)	132 (2.1)	211 (1.9)	
Other moving violation				<.0001
Yes	751 (16.0)	801 (13.0)	1552 (14.3)	
No	3875 (82.3)	5226 (84.9)	9101 (83.8)	
Unknown ^a	79 (1.7)	132 (2.1)	211 (1.9)	
Passenger characteristics (<i>n</i> = 17 179)				
Passenger age, y				.0001
0–1	452 (6.1)	564 (5.7)	1016 (5.9)	
2–4	2159 (29.4)	3006 (30.6)	5165 (30.1)	
5–8	1846 (25.1)	2473 (25.2)	4319 (25.1)	
9–12	1735 (23.6)	2464 (25.1)	4199 (24.4)	
13–14	1159 (15.8)	1321 (13.4)	2480 (14.4)	
Passenger sex				.6306
Female	3581 (48.7)	4820 (49.0)	8401 (48.9)	
Male	3765 (51.2)	4993 (50.8)	8758 (51.0)	
Unknown ^a	5 (0.1)	15 (0.2)	20 (0.1)	
Injury severity				<.0001
Died	1405 (19.1)	1197 (12.2)	2602 (15.2)	
Injured	4359 (59.3)	4630 (47.1)	8989 (52.3)	
Not injured	1540 (21.0)	3939 (40.1)	5479 (31.9)	
Unknown ^a	47 (0.6)	62 (0.6)	109 (0.6)	
Restraint use				<.0001
Child restraint	2476 (33.7)	3684 (37.5)	6160 (35.9)	
Belt only	3171 (43.1)	4843 (49.3)	8014 (46.6)	
None	1643 (22.4)	1240 (12.6)	2883 (16.8)	
Type unknown ^a	61 (0.8)	61 (0.6)	122 (0.7)	
Front versus rear NHTSA-recommended seating ^b				<.0001
Compliant	6330 (86.1)	8731 (88.8)	15 061 (87.7)	
Noncompliant	1021 (13.9)	1097 (11.2)	2118 (12.3)	
Pickup truck				<.0001
Compliant	313 (29.4)	328 (22.4)	641 (25.3)	
Noncompliant	751 (70.6)	1139 (77.6)	1890 (74.7)	

TABLE 1 Continued

Variables	Driver Screened for Either Drug or Alcohol	Driver Not Screened for Either Drug or Alcohol	Total	P
Crash-level characteristics (n = 10 864)				
Day/night				.0003
Day	2829 (60.1)	3914 (63.6)	6743 (62.1)	
Night	1876 (39.9)	2245 (36.4)	4121 (37.9)	
Weekday/weekend				.8095
Weekday	2880 (61.2)	3756 (61.0)	6636 (61.1)	
Weekend	1825 (38.8)	2403 (39.0)	4228 (38.9)	
Rollover				<.0001
Yes	1418 (30.1)	970 (15.8)	2388 (22.0)	
No	3287 (69.9)	5189 (84.3)	8476 (78.0)	
Ejected				<.0001
Fully	399 (8.5)	298 (4.8)	697 (6.4)	
Partially	63 (1.3)	47 (0.8)	110 (1.0)	
Not ejected	4243 (90.2)	5814 (94.4)	10 057 (92.6)	
Excessive speed				<.0001
Yes	651 (13.8)	452 (7.3)	1103 (10.2)	
No	1278 (27.2)	2552 (41.4)	3830 (35.3)	
Unknown ^a	2776 (59.0)	3155 (51.2)	5931 (54.6)	

Data are presented as n (%). The P values are χ^2 tests.

^a Unknown categories were not used in the calculation of the χ^2 tests.

^b According to NHTSA, all children aged ≤ 12 years should ride in the back seat.

Child Passenger Seating Position According to Driver Drug/Alcohol Use

In a subpopulation analysis of 4885 child passengers aged 0 to 14 years in vehicles driven by the 3141 drivers who were screened for both drugs and alcohol, 86.4% were compliant with the NHTSA recommendation that all children aged ≤ 12 years be seated in the rear. Predictors of child passengers aged 0 to 12 years being seated in the front in adjusted models included child passenger age, driver sex, vehicle type (pickup trucks versus other vehicles), and driver alcohol/drug involvement (Table 3). Older child passengers were more likely to be front-seated for 5- to 8-year-olds (OR, 2.85 [95% CI, 1.98–4.11]) and 9- to 12-year-olds (OR, 7.30 [95% CI, 5.12–10.42]).

In multivariable adjusted models that controlled for vehicle type (pickup trucks), child passengers tended to be front-seated (OR, 1.30 [95% CI, 0.92–1.82]) if drivers screened positive for alcohol, were 54% more likely to be front-seated if the driver screened positive for drugs (95% CI, 1.24–1.92), and 88% (95% CI, 1.38–2.55) more likely to be front-seated

in vehicles of drivers who screened positive for both drugs and alcohol (Table 3).

Child Passenger Restraint Use According to Driver Drug/Alcohol Use

Child passenger age, driver age (continuous with quadratic term), driver belt status, and most driver alcohol/drug categories were associated with a child passenger being unrestrained in both unadjusted and adjusted analyses (Table 4). Child passengers driven by drivers positive for cannabis were less likely to be restrained compared with the other drug categories ($P = .0288$). Older children, children driven by younger drivers, and children driven by unbelted drivers tended to be unrestrained.

The proportions of child passengers who were unrestrained increased nearly linearly according to age beginning with 0- to 1-year-olds (9.7%), 2- to 4-year-olds (16.7%), 5- to 8-year-olds (23.7%), 9- to 12-year-olds (23.4%), and 13- to 14-year-olds (35.0%). This outcome varied significantly according to whether the driver was negative for both drugs and alcohol, positive

for drugs only, positive for alcohol only, or positive for both alcohol and drugs (Fig 3). Restraint type and seating position for children whose driver was not screened were more similar to children whose driver was negative for both drugs and alcohol.

Child Passenger Restraint According to Drug Category in Drivers Screening Positive for Drugs

Among the 1197 child passengers driven by drivers who were positive for drugs only, nearly one-fourth (23.6%) were unrestrained. Among children aged 0 to 1 year, 2 to 4 years, 5 to 8 years, 9 to 12 years, and 13 to 14 years driven by drivers positive for drugs, 11 (11.0%), 69 (19.3%), 73 (22.6%), 66 (25.5%), and 64 (40.8%) were unrestrained, respectively. The percentage of young passengers who were unrestrained according to drug category was highest in drivers taking depressants (29.9%) or cannabis only (27.7%) followed by stimulants only (24.4%), multiple drugs (24.2%), and narcotics only (21.0%). Drivers positive for other unspecified drugs transported the lowest proportion of unrestrained children (18.6%).

DISCUSSION

Our analysis demonstrates and quantifies one mechanism through which the impact of drugs, alcohol, or drugs and alcohol in combination adversely affect the safety of young passengers aged 0 to 14 years. Young passengers driven by drivers who screened positive for cannabis or drugs and alcohol were less likely to be seated in an appropriate seating position in the vehicle and were less likely to be restrained. Lowered restraint use was associated with higher mortality that tended to be approximately triple for unrestrained compared with restrained young passengers. Mortality for unrestrained front-seated passengers was higher than for rear-seated passengers, but both tended to approach or exceed 3 times that of restrained passengers.

Young passengers driven by drivers who screened positive for alcohol only tended to be inappropriately seated and those driven by drivers who screened positive for drugs only tended to be unrestrained. Our findings are consistent with and extend those of previous studies that showed the association between alcohol-related driving and inappropriate child passenger restraint in motor vehicle crashes.^{7,8,16,19–22} Our finding that child passengers were more likely to be front-seated if drivers screened positive for drugs, alcohol, and for both drugs and alcohol is consistent with an earlier study that concluded drivers suspected of alcohol or drug use had a higher percentage of child passengers riding in a front seat compared with drivers not suspected of alcohol or drug use.¹⁶ Particularly, the combination use of alcohol and drugs was associated with a lower restraint use compared with child passengers of drivers who were positive for either alcohol or drugs alone.

Our study further suggests that drug and alcohol screening is very low in

FIGURE 2

Percent mortality of child passengers involved in fatal crashes according to age group and seating position, FARS 2010 to 2013.

drivers involved in a fatal collision while transporting young passengers. Screening varied across child injury severity, appropriateness of child passenger transport, historical driving violations (driving intoxicated or speeding), and crash characteristics (rollover and nighttime crash). Our

findings regarding younger male drivers and nighttime crashes are consistent with other studies not specific to child passengers.^{11,23}

This study has limitations. The data set included only child occupants involved in a fatal crash. Because

TABLE 2 Unadjusted and Adjusted ORs (95% CIs) for Drug or Alcohol Screening of Drivers Involved in Fatal Crashes on US Roadways, FARS 2010 to 2013

Variable	Unadjusted, Driver Screened for Either Drugs or Alcohol	Adjusted, Driver Screened for Either Drugs or Alcohol
Driver characteristics		
Driver age, y		
15–19	Ref	Ref
20–44	0.65 (0.58–0.73)	0.82 (0.72– 0.93)
45–64	0.66 (0.58–0.76)	0.90 (0.78– 1.05)
≥65	0.86 (0.71–1.05)	1.11 (0.89– 1.38)
Driver sex		
Female	Ref	Ref
Male	1.11 (1.04–1.18)	1.06 (0.99– 1.14)
Driver belt status		
Belted	Ref	Ref
Unbelted	3.48 (3.20–3.79)	2.21 (2.01– 2.43)
Injury severity		
Not injured	Ref	Ref
Injured	1.59 (1.47–1.71)	0.98 (0.88– 1.08)
Died	4.68 (4.29–5.11)	2.60 (2.34– 2.90)
History, speeding		
No	Ref	
Yes	2.05 (1.85–2.27)	
History, driving while intoxicated		
No	Ref	Ref
Yes	3.11 (2.29–4.22)	2.04 (1.45–2.86)
History, other moving violation		
No	Ref	Ref
Yes	1.28 (1.17–1.39)	1.21 (1.10–1.33)
Passenger characteristics		
Passenger age, y		
0–1	Ref	
2–4	0.99 (0.89–1.09)	
5–8	1.01 (0.91–1.12)	
9–12	0.95 (0.86–1.06)	
13–14	1.19 (1.06–1.33)	
Passenger sex		
Female	Ref	
Male	1.02 (0.96–1.08)	
Passenger injury severity		
Not injured	Ref	Ref
Injured	2.41 (2.24–2.59)	1.64 (1.49–1.81)
Died	3.00 (2.73–3.31)	1.96 (1.74–2.21)
Restraint use		
Child restraint	Ref	
Belt only	0.97 (0.91–1.04)	
None	1.97 (1.80–2.16)	
Front versus rear NHTSA-recommended seating ¹		
Compliant	Ref	
Noncompliant	1.28 (1.17–1.41)	
Inappropriate seated/unrestrained		
No	Ref	Ref
Yes	1.72 (1.61–1.85)	1.10 (1.02–1.19)
Crash characteristics		
Day/night		
Day	Ref	Ref
Night	1.12 (1.06–1.20)	1.21 (1.12–1.29)
Weekday/weekend		
Weekday	Ref	
Weekend	0.98 (0.92–1.05)	
Rollover		
No	Ref	Ref
Yes	2.27 (2.11–2.43)	1.38 (1.27–1.50)
Ejected		
Fully	Ref	

TABLE 2 Continued

Variable	Unadjusted, Driver Screened for Either Drugs or Alcohol	Adjusted, Driver Screened for Either Drugs or Alcohol
Partially	1.13 (0.80–1.58)	
Not ejected	0.58 (0.52–0.66)	
Excessive speed		
No	Ref	Ref
Yes	2.05 (1.85–2.27)	1.54 (1.37–1.72)

TABLE 3 ORs (95% CIs) for Front-Seated Passengers Aged 0 to 12 Years Driven by Drivers Screened for Both Drugs and Alcohol Using Unadjusted and Adjusted Multilevel Logistic Regression for Children Involved in Fatal Crashes, FARS 2010 to 2013 (n = 4117)

Variable	Unadjusted	Multivariable Adjusted
Children age, y		
0–1	Ref	Ref
2–4	1.22 (0.82–1.80)	1.21 (0.82–1.81)
5–8	2.80 (1.96–4.01)	2.85 (1.98–4.11)
9–12	6.64 (4.70–9.39)	7.30 (5.12–10.42)
Driver sex		
Female	Ref	Ref
Male	1.05 (0.89–1.25)	0.73 (0.60–0.89)
Driver alcohol/drug involvement		
None	Ref	Ref
Drug only	1.37 (1.12–1.67)	1.54 (1.24–1.92)
Alcohol only	1.21 (0.88–1.66)	1.30 (0.92–1.82)
Both drug and alcohol	1.46 (1.10–1.94)	1.88 (1.38–2.55)
Pickup trucks versus other vehicles		
Other vehicles	Ref	Ref
Pickup trucks	3.64 (2.95–4.48)	4.22 (3.34–5.32)

According to NHTSA, all children aged ≤12 years should ride in the back seat. Models are mixed effects using SAS GLIMMIX to control for clustering.

drivers who died were more likely to receive drug and alcohol screening, the results may or may not generalize to less severe crashes in which no one died. In addition, a large portion

of drivers were not screened for drugs or alcohol. These are described in as much detail as possible in the Supplemental Information. Misclassification is possible due

to limited testing for all drugs and some of the newer designer drugs for which there may not yet be tests. The effect of possibly missing drivers who are positive for drugs or alcohol could result in an underestimate of the true effect of drugs and alcohol on child safety. In addition, there is not enough information in the data to determine how much influence a particular drug exerted or whether and to what degree the driver may have been impaired. Some driver alcohol/drug data were from police reporting of alcohol/drug use (2 dichotomous variables in the data set), which lacked detail on drug type. The volume of missing data in the variable that indicated whether the screen was performed using blood or urine prevented us from investigating this factor. We do not have data for the variations in testing methods and thresholds across states. Our variable for being positive for drugs or alcohol does not control

TABLE 4 ORs (95% CIs) for Unrestrained Passengers Aged 0 to 14 Years Driven by Drivers Screened for Both Drugs and Alcohol Using Unadjusted and Adjusted Multilevel Logistic Regression for Children Involved in Fatal Crashes, FARS 2010 to 2013 (n = 4724)

Variable	Unadjusted, Unrestrained	Multivariable Adjusted, Unrestrained
Passenger age (years)		
0–1	Ref	Ref
2–4	2.11 (1.50–2.98)	2.45 (1.70–3.52)
5–8	2.90 (2.07–4.06)	3.94 (2.74–5.64)
9–12	2.95 (2.09–4.14)	4.35 (3.01–6.29)
13–14	5.10 (3.59–7.25)	6.83 (4.69–9.96)
Driver age ^a	0.98 (0.97–0.99)	0.98 (0.97–0.99)
Driver belt status		
Belted	Ref	Ref
Unbelted	6.06 (5.02–7.31)	5.78 (4.74–7.06)
Driver alcohol/drug involvement		
None	Ref	Ref
Drug only	1.50 (1.21–1.86)	1.25 (0.99–1.58)
Alcohol only	2.34 (1.72–3.19)	1.67 (1.20–2.32)
Both drug and alcohol	3.52 (2.66–4.67)	2.43 (1.79–3.30)

Models are mixed effects using SAS GLIMMIX to control for clustering.

^a Driver age in this model is a continuous variable with a quadratic term.

FIGURE 3
Percentage of unrestrained child passengers involved in fatal crashes according to age group and driver drug/alcohol involvement, any seating position, FARS 2010 to 2013.

for possible dose effects. The sample size of drivers with specified drug categories was small and did not allow for multivariable modeling of child seating position and restraint status according to specific drug categories. Although we had data on whether a child was restrained in a child or infant restraint, we did not have data on child weight and height, or on whether the restraint was properly installed or whether

the child was properly restrained in the seat. In our analysis, previous violations were dichotomous. Further study on the type and quantity of violation is warranted but beyond the scope of this article.

CONCLUSIONS

Of screened drivers involved in a fatal collision while transporting a child passenger, approximately

one-fourth were positive for drugs, alcohol, or both. In addition to their previously reported riskier driving patterns,¹⁴ such drivers contribute to child endangerment because their child passengers are less likely to be restrained or appropriately seated. More than one-fourth of child passengers transported by drivers who screened positive for cannabis were unrestrained. This finding is concerning, particularly with the growing legalization of cannabis for medical and recreational use. Pediatricians and pediatric injury prevention programs, particularly in states with relaxing or expanding cannabis drug laws, should support surveillance systems that are vigilant in their efforts to detect and intervene in the unsafe transport of child passengers.

ABBREVIATIONS

BAC: blood alcohol concentration
CI: confidence interval
FARS: Fatality Analysis Reporting System
NHTSA: National Highway Traffic Safety Administration
OR: odds ratio

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