Evaluating the Use of Child Restraint Systems and Resulting Injury and Fatalities using Demographic and Social Characteristics of Driver's Home Zip Code

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Abstract

Motor vehicle crashes are the leading cause of death among young children. Use of child restraint systems, such as car seats, significantly reduces the risk of injury and fatality. Previous research showed that adults with low income and low education were less likely to use child restraint systems. Therefore their children were more likely to suffer injuries during accidents. Using GES (Geographic Estimates Systems) NASS (National Automotive Sampling System) and demographic data from the American Community Survey, this study determined that there is an association between variables related to socioeconomic deprivation and the use of restraint systems. Specifically, controlling for other factors in multiple logistic regression, it was found that the odds of restraint nonuse were higher for areas with highest deprivation (OR=1.15; OR 95% CI=1.10 − 1.21). Adjusted odds of injury were approximately 4 times higher for children traveling with drivers from zip codes with a high deprivation index when restraint system was not used (OR=4.24; OR 95% CI=2.31 − 7.77).

Key Words: child restraint system, logistic regression, complex survey design, American Community Survey, GES NASS

1. Introduction

Motor vehicle crashes are identified as the leading cause of death among young children. Correct use of child restraint systems such as car seats was shown to reduce the risk of fatality by 71% for infants and 54% for toddlers ages 1 to 4 in passenger vehicles (NHTSA, 2014). There is evidence documenting the nonuse or improper use of child restraint systems by some populations. NHTSA 2013 national survey on the use of booster seats shows that Hispanic and African-American children are less likely to be restrained when traveling in motor vehicles (Pickrell and Choi, 2014 and Rangel et al, 2008). Boyd and Dellinger (2008) confirmed that populations such as males, younger adults, adults with low educational attainment, and intoxicated drivers are less likely to use child restraint systems. Winston et al (2006) showed that individuals with low income, low education, and minorities are less likely to properly use child restraint systems and therefore are more likely to suffer during motor vehicle accidents.

Previous research was based on the child restraint system use surveys, insurance, and medical data. This study will examine child restraint system use applying the national survey of automotive accidents (NASS GES) data. This study will examine whether the use of restraint systems and increased child injuries and fatalities can be explained by social and demographic factors associated with driver's home zip code. According to the U.S. Census Bureau (2016), black and Hispanic adults had lower income compare to whites. Census data also reveal a relationship between income and education - factors considered as proxy for economic disadvantage. This study speculated that adults living in areas with a high concentration of minority populations, individuals with low education, or individuals in poverty will have an increased risk of restraint nonuse or injury among children. Demographic factors include race/ethnicity composition of the zip code (percent white, black,

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Hispanic), education (percent of adults without a high school diploma and percent of adults with a bachelor's degree or higher education), percent of individuals living below poverty level, and socioeconomic deprivation index.

2. Methods and Data Sources

Data from the National Automotive Sampling System (NASS) General Estimates System (GES) for the years 2010-2014 were used in the study. The data are a nationally representative sample of crashes reported to the police and are collected using a complex survey design sampling methodology. Five years of data were combined to increase the sample of crashes involving children.

The GES NASS data for years 2010 through 2014 were recoded according to the GES analytical manual (NHTS 2015). This study was restricted to the analysis of records from the person file describing child passengers ages 0 to 3. Cases were restricted to non-special use vehicles excluding taxis, school, military, police, ambulance, fire, emergency services, and other special use transport defined by NASS GES. Vehicles involved included automobiles, utility vehicles, vans, and trucks. All variable were converted to the 2014 definitions. The total number of records included in the study was 5,697 unweighted records representing 685,215 weighted population counts.

This study considered two outcomes of interest: the use of child restraint systems and the injury of children. The use of child restraint systems is defined by the police report and indicates whether a child restraint system was used at all and used properly. For this study, cases where child restraint systems considered appropriate for children under age 3 and marked as used properly were considered. The use of child restraint systems was coded as a binary variable. Injury was coded using police-reported injuries translating the classification into a binary variable: all cases where injury was reported as no apparent injury, possible injury, and suspected minor injury were coded as not injured; cases with suspected serious injury, fatal injury, injured, severity unknown were coded as injured.

GES NASS data are reported at the person, vehicle, and accident levels. Data on all child passengers were reported at the person level with supplementary variables added to the person file from the vehicle and accident files. Person-level predictors describing child's characteristics were child's age, proper use of restraint (defined as use of child car seat for children 3 or younger positioned in the back seat), and child's gender. Person-level predictors describing driver's and other passengers' characteristics included driver's age, driver's sex, driver's use of restraint, indicator of driver's alcohol impairment, and use of restraint by other passengers. Vehicle characteristics included the age of vehicle translated into five year increments. Accident level variables included whether the accident occurred on the highway or a state road.

Area deprivation index developed by researchers at the Health Innovation Program at the University of Wisconsin-Madison School of Medicine & Public Health includes measures of education, employment, income, home value, rent, labor force status, poverty, single-parent households, households without a vehicle, households without a phone, households without complete plumbing, and crowded households. The index was developed using 2010 block groups and summarized at the zip code tabulation area level. The area deprivation index represents a measure of socioeconomic deprivation experienced by neighborhoods. The index was translated into quartiles to avoid linearity assumption between deprivation and outcomes of interest. The highest quartile corresponds to the most deprived zip codes.

Data from the American Community Survey 5 year sample were used to describe social and demographic factors not included in the neighborhood deprivation index. The Amer-

ican Community Survey 2010-2014 data summarized at the zip code level were downloaded from the U.S. Census Bureau American FactFinder. Variables downloaded from the American Community Survey represent aspects of socioeconomic conditions that were determined as highly important by previous researchers. Based on the literature review, several broad socioeconomic domains associated with economic disadvantage and neighborhood deprivation were selected: education, race/ethnic composition, and poverty. Demographic variables were translated into quartiles based on the population percentages within zip codes estimated on the census data before variables were merged with the NASS GES data.

All data management and statistical analysis was performed using R version 3.2.4 (2016-03-10) – "Very Secure Dishes". Survey package developed in R by Lumley (2014) was used for the analysis. The NASS GES data include variables identifying sampling units, stratas, and weights. Replicate weights were developed for each year of the survey data accounting for the complex survey design using jackknife delete n method. Then, all years were merged into one data set to increase sample size. As the outcomes of interest were binary variables, multiple logistic regression adjusted for survey sampling frame was chosen as an appropriate method.

3. Results

3.1 Analysis of Restraint System Usage

3.1.1 Univariate Analysis of Restraint System Usage

Table 1 presents univariate analysis of restraint use when child, driver, and vehicle characteristics were considered. Adjusted for population weights and the sampling frame, it was found that 18% of children involved in accidents were not in proper restraint. Among notable factors impacting odds of restraint nonuse, odds of not being in proper restraint were more than double for 3 year old children compared to infants (OR=2.23; 95% CI=$2.14 - 2.23$). Odds of restraint nonuse were lowest when children traveled with 25-34 year old drivers and highest when children traveled with 35-44 year old drivers compared to 25-34 year old drivers (OR=1.42; OR 95% CI=$1.37 - 1.47$). Odds of restraint nonuse were 79% higher for children traveling in cars when other passengers did not wear seat belts (OR=1.79; OR 95% CI=$1.72 - 1.86$). Odds of restraint nonuse increased as vehicle age increased (OR=1.27; OR 95% CI=$1.21 - 1.33$ - for 15 year old vehicles compared to vehicles under 5 years old).

Odds of restraint nonuse were nearly identical for children traveling with men compared to women drivers (OR=0.95; or 95% CI=$0.92 - 0.99$). There was no discernible difference for odds of restraint nonuse for driver's use of restraint (OR=0.95; or 95% CI=$0.92 - 0.99$) and driver's impairment by alcohol (OR=1.06; OR 95% CI=$0.85 - 1.32$).

Table 2 presents odds of restraint nonuse and misuse examined for demographic variables derived from driver's zip code. In comparison to areas with low concentration of population (Q1), odds of restraint nonuse were higher for areas with high concentration (Q4) of black adults (OR=1.18; OR 95% CI=$1.10 - 1.25$); for areas with high concentration of Hispanics (OR=1.43; OR 95% CI=$1.34 - 1.53$); and lower for areas with high concentration of whites (OR=0.48; OR 95% CI=$0.45 - 0.50$).

The odds of restraint nonuse were higher for areas with high concentration of adults without a high school diploma (OR=1.55; OR 95% CI=$1.48 - 1.62$) and lower for areas with high concentration of adults with bachelor's degree or higher education (OR=0.67; OR 95% CI=$0.64 - 0.70$). The odds of restraint nonuse were higher for areas with high concentration of adults living 100% below poverty level (OR=1.28; OR 95% CI=$1.22 -$

1.35). In comparison to the area with low deprivation index, odds of restraint nonuse were higher for areas with highest deprivation, (OR=1.15; OR 95% CI=1.10 − 1.21).

3.1.2 Multivariate Analysis of Restraint Systems Usage

A multiple logistic regression model adjusted for complex survey design methods was fitted to evaluate the odds of restraint nonuse/misuse when demographic variables were considered. Table 3 shows the odds ratios estimated with relevant child, driver, vehicle characteristics, and selected demographic variables. Estimated odds ratios were close in each of the models considered. Direction of the coefficients for demographic variables describing socioeconomic status was as expected - a higher concentration of black adults, Hispanics, adults with lower education, adults living 100% below poverty level, and adults in neighborhoods with a higher deprivation index were associated with higher odds of restraint nonuse. Direction of coefficients for concentration of white adults and adults with bachelor's degree or higher education was reversed.

Table 4 shows estimated odds of injury in the multiple logistic regression model when neighborhood deprivation index was considered. This model was chosen because deprivation index offers a composite measure of socioeconomic characteristics. Baseline category for this model is an accident involving a boy less than 1 years old, traveling in a car less than 5 years old with a 25-34 year old driver from a zip code with a low deprivation index when the child was the only passenger. Controlling for other variables, odds of restraint nonuse or misuse increase as neighborhood deprivation index increases. Specifically, odds of restraint nonuse were higher for each quartile of the deprivation index: compared to the area with lowest deprivation, odds of restraint nonuse increased by 5% in second quartile (OR=1.05; OR 95% CI=1.00 − 1.09), by 12% in third quartile (OR=1.11; OR 95% CI=1.07 − 1.17), and by 40% in fourth (highest deprivation) quartile (OR=1.40; OR 95% CI=1.34 − 1.48). Figure 1 shows odds ratios of restraint nonuse/misuse for this model.

3.2 Analysis of Injury Outcome

3.2.1 Univariate Analysis of Injury Outcome

Table 5 presents univariate analysis of injury when child, driver, and vehicle characteristics were considered. Among notable factors explaining odds of injury, odds were nearly 5 times higher when drivers did not use restraint (OR=4.69; OR 95% CI=4.07 − 5.41) and 3 times higher when the driver was impaired by alcohol or drugs (OR=2.81; OR 95% CI=2.05 − 3.85). When child characteristics were considered, odds of injury were 44% higher if no child restraint system was used (OR=1.44; OR 95% CI=1.32 − 1.58). Odds of injury were twice as high for 2 year old children (OR=2.01; OR 95% CI=1.86 − 2.18) and 27% higher for 3 years old children (OR=1.27; OR 95% CI=1.15 − 1.41) compared to infants. Odds were 34% higher when girls are compared to boys (OR=1.34; OR 95% CI=1.24 − 1.45).

When drivers' and other passengers' characteristics were considered, odds of injury were 52% lower for children traveling with drivers 35-44 (OR=0.48; OR 95% CI=0.43 − 0.55) to children traveling to drivers 25-34 years old. Odds were 9% higher when the driver was a woman (OR=1.09; OR 95% CI=1.01 − 1.17). Odds of injury were 23% higher (OR=1.23; OR 95% CI=1.11 − 1.36) if the trip involved other passengers wearing restraint and 37% higher (OR=1.37; OR 95% CI=1.18 − 1.59) if passengers other than children did not wear seat belts.

When vehicle and accident characteristics were considered, odds of injury increased with vehicle's age and were twice as high for vehicles 15 years old or higher compared

vehicles under 5 years old (OR=2.28; OR 95% CI=2.01 − 2.59). Odds of injury were 69% higher if an accident occurred on a highway (OR=1.69; OR 95% CI=1.40 − 1.68).

When demographic variables were considered, it was found the odds of injury were 75% higher for children traveling with drivers from zip codes with high deprivation index compared to zip codes with the lowest deprivation index (OR=1.75; OR 95% CI=1.57 − 1.95). Other demographic variables considered (race, ethnicity, education, poverty) did not reveal the expected association between socioeconomic deprivation and injury. Results for these variables are displayed in table 6.

3.2.2 Multivariate Analysis of Injury Outcome

The injury outcome was studied using multiple logistic regression model adjusted for complex survey design methods. Table 7 shows the odds rations estimated with relevant child, driver, and vehicle characteristics, and selected demographic variables.

Estimated odds ratios for variables not associated with demographic characteristics derived from driver's zip code were close in each of the models considered. Similar to the univariate analysis, direction of the coefficients for demographic variables describing socioeconomic status varied and did not uniformly confirm a speculation that a higher socioeconomic deprivation is associated with higher odds of injury. These variables might be associated with injury through a mechanism that is too complex to estimate with models fitted.

The effect of the deprivation index was evaluated while controlling for other child, driver, passenger, and vehicle characteristics. Table 8 shows estimated odds of injury in the multiple logistic regression model. Baseline category for this model is an accident on a state road involving a boy less than 1 years old, traveling in a car less than 5 years old with a 25-34 year old male driver from a zip code with a low deprivation index. The driver is specified to use a seat belt and the child was the only passenger in the baseline category.

The model introduces an interaction between the use of child restraint system and deprivation index. Figure 2 shows the odds ratio for variables included in the model. Conditional on children not in proper restraint, the odds of injury increase with increases in deprivation index quartiles. Specifically, the odds of injury were higher for each quartile of the deprivation index: compared to the area with lowest deprivation, odds of restraint nonuse increased by 256% in second quartile (OR=2.56; OR 95% CI=1.83 − 3.57), by 308% in third quartile (OR=3.08; OR 95% CI=2.40 − 3.95), and by 424% in fourth (highest deprivation) quartile (OR=4.24; OR 95% CI=2.31 − 7.77). Figure 3 displays a predicted probability plot for injury outcome plotting probability of injury for children in restrain vs. children without restraint across the deprivation index quartiles.

4. Conclusion

This study investigated the relationship between demographic factors and the use of restraint as well as injury systems using the GES NASS data. In absence of the sociodeomgraphic characteristics of drivers in the NASS GES data, this study derived sociodemographic data using the driver's zip code and estimated the odds of restraint misuse and the resulting injury among children while controlling for other factors associated with the motor vehicle crash.

Previous research pointed out links of restraint nonuse or misuse and socioeconomic factors such as race, ethnicity, and education using survey and insurance data. Findings presented in this analysis support the hypothesis that children riding with adults with disadvantaged socioeconomic background have increased odds of restraint nonuse and injury

and fatality. This link is most prominent when neighborhood deprivation index is considered and was consistent when proxies of socioeconomic deprivation such as race, ethnicity, education, and poverty were examined.

When the injury outcome was examined, controlling for other factors, the odds of injury were 4 times higher for children not wearing restraint and traveling with adults from an area with a high deprivation index. The link between demographic variables describing race, ethnicity, education, and poverty used as proxies for socioeconomic deprivation and injury is less consistent.

Drivers' zip codes were the source of the demographic information. Zip codes are areas large enough to introduce the possibility of aggregation errors and ecological fallacies, especially when single variables such as race, ethnicity, or education are considered. This analysis gave preference to using neighborhood deprivation index as the key variable denoting socioeconomic deprivation because it represents a composite measure accounting for contribution of several demographic characteristics within the zip code.

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Table 1: Odds and percentages for children traveling without restraint when GES NASS variables are considered.

	pct	OR	OR 95% CI	95% CI on odds
Child under 1 y.o.	14%	1.00		
Child age 1	14%	0.98	0.93-1.02	
Child age 2	18%	1.36	1.30-1.41	
Child age 3	27%	2.23	2.14-2.32	
Boy	18%	1.00		
Girl	18%	0.97	0.95-1.00	
Driver <25	18%	1.15	1.11-1.19	
Driver 25-34	16%	1.00		
Driver 35-44	22%	1.42	1.37-1.47	
Driver 45+	19%	1.19	1.12-1.27	
Male driver	19%	1.00		
Female driver	18%	0.95	0.92-0.99	
Driver used restraint	18%	1.00		
No driver restraint	17%	0.92	0.85-1.01	
Driver not impaired by drugs/alcohol	18%	1.00		
Driver impaired by drugs/alcohol	19%	1.06	0.85-1.32	
Only child passenger	16%	1.00		
All passengers wear belts	17%	1.06	1.02-1.11	
Not all passengers wear belts	26%	1.79	1.72-1.86	
Vehicle <5 y.o	17%	1.00		
Vehicle 5-9 y.o	17%	1.02	0.98-1.05	
Vehicle 10-14 y.o.	20%	1.23	1.18-1.27	
Vehlice 15+ y.o.	21%	1.27	1.21-1.33	

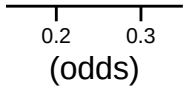

Table 2: Odds and percentages for children traveling without restraint when demographic variables are considered.

	pct	odds	OR	CI on odds
% black - Q1	18%	1.00		
% black - Q2	17%	0.98	0.91-1.05	
% black - Q3	17%	1.00	0.92-1.04	
% black - Q4	20%	1.18	1.10-1.25	
% Hispanic - Q1	15%	1.00		
% Hispanic - Q2	15%	1.00	0.94-1.06	
% Hispanic - Q3	16%	1.10	1.04-1.17	
% Hispanic - Q4	20%	1.43	1.34-1.53	
% white - Q1	23%	1.00		
% white - Q2	19%	0.73	0.70-0.77	
% white - Q3	15%	0.60	0.57-0.63	
% white - Q4	12%	0.48	0.45-0.50	
% <high school diploma - Q1	16%	1.00		
% <high school diploma - Q2	17%	1.14	1.09-1.19	
% <high school diploma - Q3	16%	1.04	1.00-1.08	
% <high school diploma - Q4	22%	1.55	1.48-1.62	
% bachelor's degree+ - Q1	23%	1.00		
% bachelor's degree+ - Q2	19%	0.80	0.76-0.84	
% bachelor's degree+ - Q3	17%	0.69	0.66-0.72	
% bachelor's degree+ - Q4	17%	0.67	0.64-0.70	
% 100% below poverty level - Q1	16%	1.00		
% 100% below poverty level - Q2	17%	1.08	1.03-1.14	
% 100% below poverty level - Q3	18%	1.12	1.07-1.19	
% 100% below poverty level - Q4	20%	1.28	1.22-1.35	
Deprivation index - Q1	17%	1.00		
Deprivation index - Q2	17%	0.79	0.75-0.82	
Deprivation index - Q3	19%	1.14	1.08-1.21	
Deprivation index - Q4	22%	1.15	1.10-1.21	
				0.2 0.3 (odds)

Table 3: Odds ratios estimated by multiple logistic regression when restraint system nonuse is considered as a response variable and demographic variables were varied. Asterisk indicates estimates not significant at the 0.05 level.

	black	white	Hisp.	$<$ HS	$<$ BD+	poverty	depr.
Intercept	0.09	0.13	0.07	0.08	0.13	0.09	0.09
Age of child (years)	1.34	1.34	1.34	1.35	1.35	1.35	1.34
Child is a girl	0.96	0.98	0.97	0.96	0.96	0.96	0.96
All passengers wear belts	1.07	*1.02	1.06	1.04	1.05	1.07	1.07
Not all passengers wear belts	1.75	*1.64	1.72	*1.68	1.70	1.74	1.75
Driver $<$ 25	1.20	1.17	1.19	1.18	1.17	1.19	1.18
Driver 35-44	1.35	1.39	1.37	1.39	1.39	1.37	1.38
Driver 45+	1.13	1.15	1.16	1.16	1.14	1.14	1.14
Vehicle age (5 yr. intervals)	1.07	1.08	1.09	1.07	1.07	1.07	1.07
Demographic variable - Q2	*0.95	0.80	*1.05	1.13	0.81	1.08	1.05
Demographic variable - Q3	0.94	0.58	1.12	*0.99	0.70	1.09	1.12
Demographic variable - Q4	1.11	0.49	1.46	1.49	0.69	1.25	1.40

Table 4: Results of multiple logistic regression model when restraint system nonuse is considered as a response variable and deprivation index was included in the model

	Estimate	Std. Error	t value	Pr($>$|t|)
(Intercept)	-2.4509	0.0317	-77.35	0.0000
Age of child (years)	0.2958	0.0070	42.00	0.0000
Child is a girl	-0.0364	0.0146	-2.50	0.0169
All passengers wear seat belts	0.0637	0.0215	2.97	0.0051
Not all passengers wear seat belts	0.5584	0.0211	26.51	0.0000
Driver $<$ 24	0.1619	0.0192	8.44	0.0000
Driver 35-44	0.3204	0.0176	18.18	0.0000
Driver 45+	0.1352	0.0304	4.45	0.0001
Vehicle age	0.0722	0.0082	8.86	0.0000
Deprivation index - Q2	0.0447	0.0219	2.04	0.0480
Deprivation index - Q3	0.1113	0.0243	4.58	0.0000
Deprivation index - Q4	0.3393	0.0253	13.43	0.0000

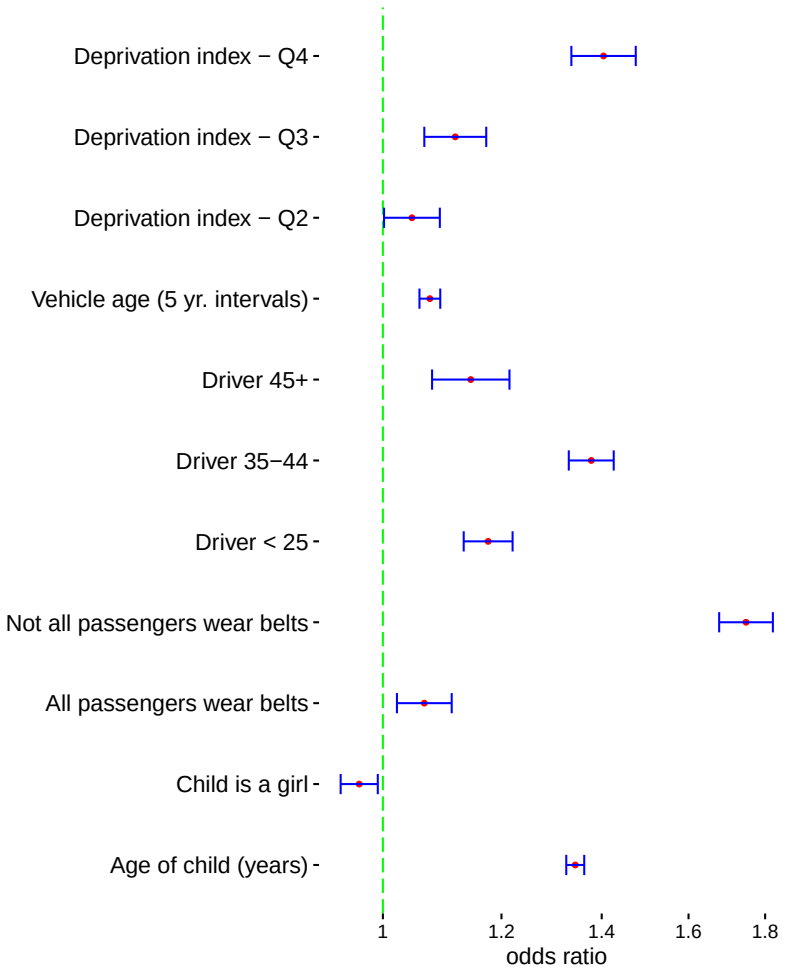

Figure 1: Odds ratio for variables included in the multiple logistic regression modeling restraint nonuse as a response variable.

Table 5: Odds and percentages for children injured when GES NASS variables are considered.

	pct	odds	OR	CI on odds
Child restraint used	0.80%	1.00		
No/improper restraint	1.20%	1.44	1.32-1.58	
Child under 1 y.o.	0.70%	1.00		
Child age 1	0.50%	0.69	0.64-0.75	
Child age 2	1.40%	2.01	1.86-2.18	
Child age 3	0.90%	1.27	1.15-1.41	
Boy	0.70%	1.00		
Girl	1.00%	1.34	1.24-1.45	
Driver <25	1.00%	0.99	0.9-1.1	
Driver 25-34	1.00%	1.00		
Driver 35-44	0.50%	0.48	0.43-0.55	
Driver 45+	0.80%	0.83	0.71-0.97	
Male driver	0.80%	1.00		
Female driver	0.90%	1.09	1.01-1.17	
Driver used restraint	0.80%	1.00		
No driver restraint	3.50%	4.69	4.07-5.41	
Driver not impaired by drugs/alcohol	0.90%	1.00	0.01-0.01	
Driver impaired by drugs/alcohol	2.40%	2.81	2.05-3.85	
Only child passenger	0.80%	1.00		
All passengers wear belts	0.90%	1.23	1.11-1.36	
Not all passengers wear belts	1.00%	1.37	1.18-1.59	
Vehicle <5 y.o	0.50%	1.00		
Vehicle 5-9 y.o	1.00%	1.85	1.67-2.05	
Vehicle 10-14 y.o.	1.10%	2.09	1.85-2.35	
Vehlice 15+ y.o.	1.20%	2.28	2.01-2.59	
Accident not on a highway	0.80%	1.00		
Accident on a highway	1.40%	1.69	1.40-2.05	

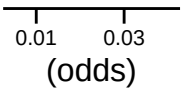

Table 6: Odds and percentages for children injured when demographic variables are considered.

	pct	odds	OR	CI on odds
% black - Q1	1.0%	1.00		
% black - Q2	0.5%	0.48	0.40-0.58	
% black - Q3	1.0%	0.97	0.88-1.07	
% black - Q4	1.0%	1.02	0.93-1.12	
% Hispanic - Q1	1.2%	1.00		
% Hispanic - Q2	1.4%	1.14	0.88-1.48	
% Hispanic - Q3	1.0%	0.79	0.62-1.02	
% Hispanic - Q4	0.6%	0.51	0.39-0.67	
% white - Q1	0.9%	1.00		
% white - Q2	0.8%	0.73	0.63-0.83	
% white - Q3	0.7%	0.71	0.62-0.81	
% white - Q4	1.0%	0.93	0.83-1.03	
% <high school diploma - Q1	0.9%	1.00		
% <high school diploma - Q2	0.9%	0.92	0.82-1.03	
% <high school diploma - Q3	0.8%	0.90	0.80-1.01	
% <high school diploma - Q4	0.8%	0.89	0.81-0.99	
% bachelor's degree+ - Q1	0.8%	1.00		
% bachelor's degree+ - Q2	0.4%	0.50	0.44-0.56	
% bachelor's degree+ - Q3	1.4%	1.90	1.65-2.18	
% bachelor's degree+ - Q4	0.8%	1.12	0.97-1.30	
% 100% below poverty level - Q1	1.2%	1.00		
% 100% below poverty level - Q2	0.3%	0.29	0.26-0.33	
% 100% below poverty level - Q3	0.8%	0.66	0.58-0.75	
% 100% below poverty level - Q4	1.1%	0.98	0.90-1.07	
Deprivation index - Q1	0.60%	1.00		
Deprivation index - Q2	0.90%	1.51	1.36-1.68	
Deprivation index - Q3	0.90%	1.55	1.38-1.75	
Deprivation index - Q4	1.00%	1.75	1.57-1.95	
				0.01 (odds)

Table 7: Odds estimated by multiple logistic regression when injury is considered as a response variable and demographic variables were varied. Asterisk indicates estimates not significant at the 0.05 level.

	black	white	Hisp.	$<$ HS	$<$ BD+	poverty	depr.
Intercept	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Accident on a highway	1.75	1.88	1.83	1.86	1.67	2.01	1.81
Child age 1	0.74	0.75	0.73	0.74	0.73	0.73	0.73
Child age 2	2.32	2.30	2.28	2.32	2.24	2.31	2.27
Child age 3	1.26	1.28	1.29	1.29	1.29	1.28	1.27
Child is a girl	1.35	1.33	1.35	1.34	1.38	1.34	1.34
No/improper restraint for child	0.71	1.62	6.66	1.78	1.19	2.02	0.53
Driver $<$ 25	0.91	*0.92	*0.92	*0.95	*0.96	*0.92	0.91
Driver 35-44	0.44	0.44	0.42	0.44	0.45	0.45	0.45
Driver 45+	0.77	0.80	0.78	0.79	0.81	0.80	0.81
Female driver	1.16	1.19	1.12	1.21	1.19	1.16	1.18
No driver restraint	5.05	5.00	4.85	5.05	5.00	5.21	4.78
All passengers wear belts	1.26	1.27	1.27	1.28	1.31	1.28	1.27
Not all passengers wear belts	1.36	1.37	1.41	1.36	1.37	1.32	1.34
Vehicle age (5 yr. intervals)	1.27	1.27	1.24	1.29	1.28	1.27	1.27
Dem. var. - Q2	0.41	*1.08	2.23	*0.90	0.64	0.35	*0.89
Dem. var. - Q3	0.79	*0.97	1.61	0.71	2.14	0.63	0.79
Dem. var. - Q4	0.76	1.47	*0.93	0.75	1.39	0.78	*0.83
Dem. var. - Q2 : No restraint	1.84	*0.84	0.19	0.47	0.72	0.10	2.56
Dem. var. - Q3 : No restraint	2.65	*1.06	0.15	*1.01	1.30	0.51	3.08
Dem. var. - Q4 : No restraint	2.03	0.45	0.22	0.73	1.36	0.78	4.24

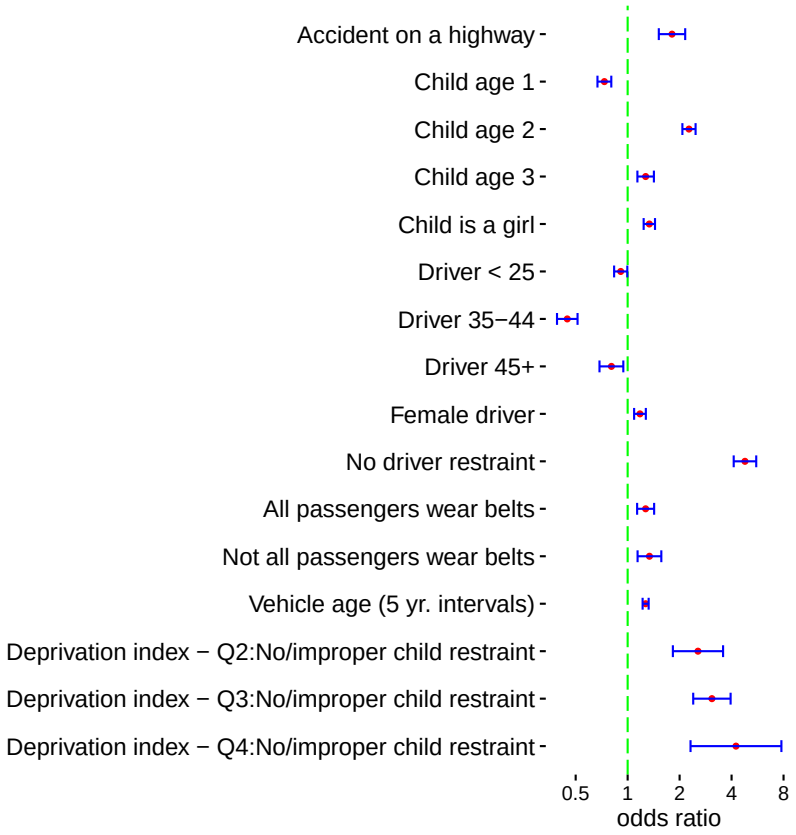

Figure 2: Odds ratio for variables included in the multiple logistic regression modeling injury as a response variable.

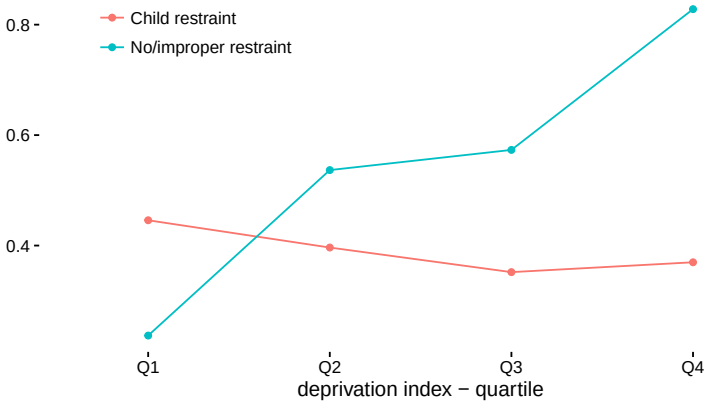

Figure 3: Predicted probability of injury for children using proper restraint vs. no restraint when deprivation quartile is varied and all other variables are kept constant.

Table 8: Results of multiple logistic regression model when injury is considered as a response variable and deprivation index was included in the model

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-5.8913	0.1543	-38.19	0.0000
Accident on a highway	0.5917	0.0897	6.59	0.0000
Child age 1	-0.3102	0.0471	-6.59	0.0000
Child age 2	0.8182	0.0448	18.25	0.0000
Child age 3	0.2402	0.0561	4.28	0.0002
Child is a girl	0.2893	0.0387	7.47	0.0000
No child restraint	-0.6338	0.1305	-4.86	0.0000
Driver age < 25	-0.0923	0.0449	-2.05	0.0487
Driver age 35-44	-0.8050	0.0699	-11.52	0.0000
Driver age 45+	-0.2165	0.0810	-2.67	0.0121
Female driver	0.1645	0.0399	4.13	0.0003
No driver restraint	1.5648	0.0766	20.42	0.0000
All passengers wear belts	0.2399	0.0579	4.14	0.0003
Not all passengers wear belts	0.2908	0.0808	3.60	0.0011
Vehicle age	0.2400	0.0205	11.70	0.0000
Deprivation index - Q2	-0.1179	0.1021	-1.15	0.2573
Deprivation index - Q3	-0.2375	0.0562	-4.23	0.0002
Deprivation index - Q4	-0.1879	0.1164	-1.61	0.1169
Deprivation index - Q2: No child restraint	0.9381	0.1708	5.49	0.0000
Deprivation index - Q3: No child restraint	1.1239	0.1272	8.83	0.0000
Deprivation index - Q4: No child restraint	1.4448	0.3092	4.67	0.0001