

New York Study of Booster Seat Effects on Injury Reduction Compared to Safety Belts in Children Aged 4-8 in Motor Vehicle Crashes

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Child Occupant Injuries

- ▶ Motor vehicle crashes are the leading cause of death for children 4-8 years-old in the United States and are the second leading cause of death for children in this age group in New York State. (WISQARS™ 1999-2007)
- ▶ In New York State, annually on average 125 child motor vehicle occupants in this age group were hospitalized and 3,162 were treated in hospital emergency departments due to motor vehicle crashes.
- ▶ Riding unrestrained and improper restraint use contribute to motor vehicle injuries sustained by children in this age group.

Booster Seats

- ▶ The National Highway Traffic Safety Administration (NHTSA) recommends the use of belt-positioning booster seats when children are 4 years of age and 40 pounds and no longer fit their forward-facing child safety seat but are still too young (under 8 years old) and too short (below 4'9") to properly fit into the seat belt alone.

Risk Reduction Benefits of Booster Seats

- ▶ Booster seats reduced injury risk for children 4-7 years by 59% compared to seat belts alone. (2003)
- ▶ Child restraints reduced fatality risk for children 2-6 years by 28% compared to seat belts alone. (2006)
- ▶ Children 4-7 years in states with booster seat laws were 39% more likely to be reported as appropriately restrained as compared to states without such laws. (2007)

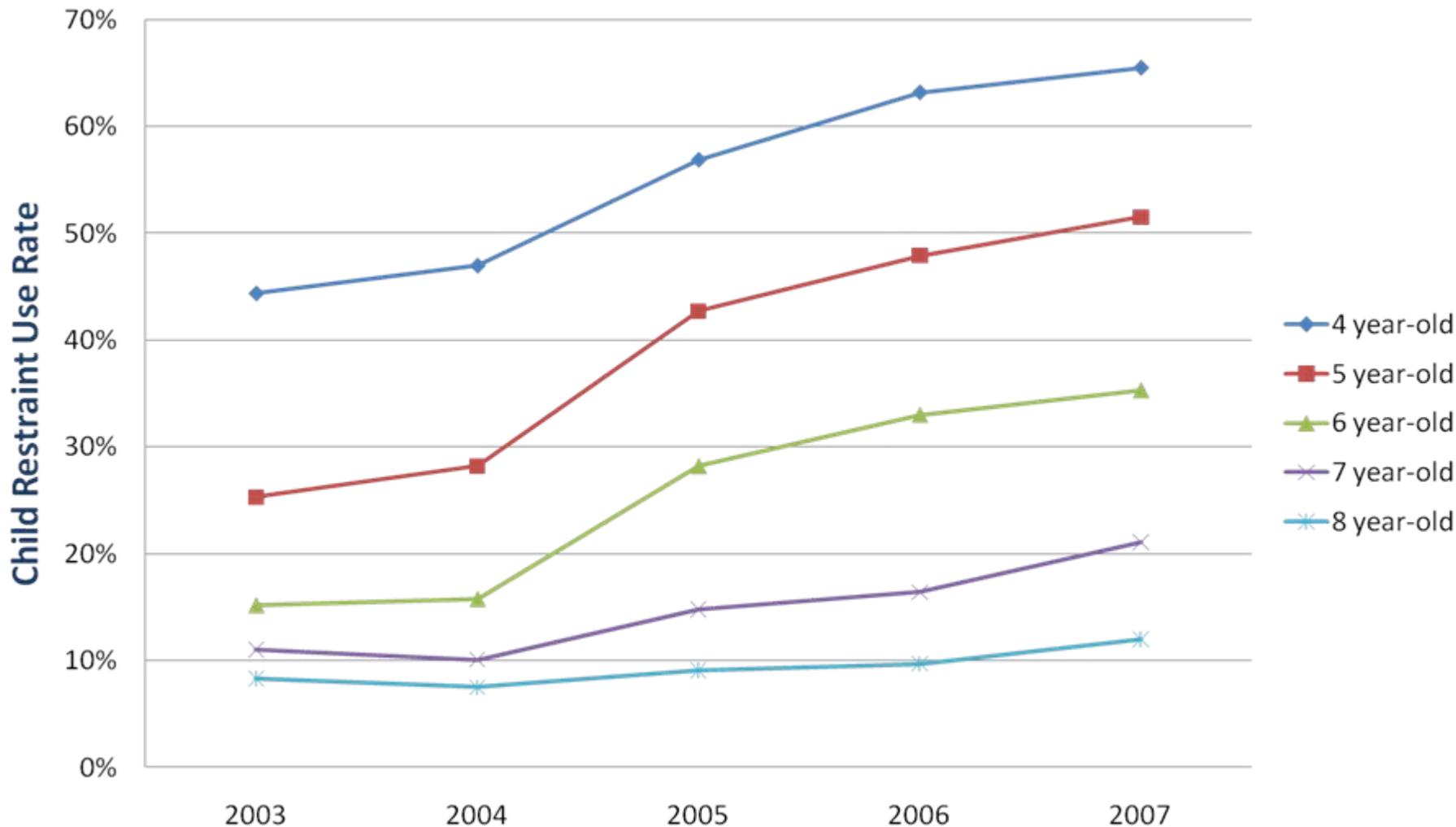
Source: Children's Hospital of Philadelphia, Partners for Child Passenger Safety

NYS Child Occupant Restraint Law

- ▶ Children under age 4 must be restrained in federally approved child safety seats. (1984)
- ▶ Children ages 4 - 6 must be properly secured in an appropriate child restraint system, one for which your child meets the weight and height recommendations of the child restraint manufacturer. (2005)
 - ▶ Analysis of the effects of this law by our bureau found children aged 4-6 years experienced a statistically significant 18% reduction in traffic injury rate after implementation. The reduction in injury rate among 4-6 year-olds was mainly due to the 72% increase in child restraint usage rate after the law was implemented. (*Pediatrics*, In Press)
- ▶ As of November 24, 2009, the law was expanded to include all children until their 8th birthday.

Child Restraint Usage Rate

Children Ages 4-8, Involved in MV Crashes
New York State, 2003-2007



Accident Information System (AIS)

- AIS
 - ▶ Police Accident Reports (\approx 200,000 per year)
 - Ticketing Information
 - ▶ Motorists' Reports (\approx 70,000 per year)
 - ▶ From the New York State Department of Motor Vehicles (NYS DMV)
- What happens before and during a crash

Pre-Hospital Care Report (PCR) Data

▶ PCR

- NYS DOH Bureau of Emergency Medical Services (EMS)
- What happens (immediately) following a crash

Injury Surveillance System

Statewide Planning And Research Cooperative System (SPARCS)

- ▶ **Hospital Discharge Data**

 - (≈ 15,000 motor vehicle related per year)

- ▶ **Outpatient Emergency Department Visits (ED)**

 - (≈ 140,000 motor vehicle related per year)

→ Includes data not reportable to DMV

- **Medical and Financial Outcomes**

Injury Surveillance System

- **NY Crash Outcome Data Evaluation System (CODES)**
 - ▶ Linked database
 - ▶ Matches individual records from Accident Information System (AIS) data to Pre-Hospital Care Report (PCR) data
 - ▶ Matches individual records from Accident Information System (AIS) data to Hospital Discharge and Emergency Department data

Multiple Imputation for Missing Values

▶ IVEware

▶ Imputation and Variance Estimation Software

- IVEware is a set of C and FORTRAN routines that can be launched from SAS or run independently using data from many sources.
- IVEware performs single or multiple imputations of missing values using the Sequential Regression Imputation Method.
- IVEware can be downloaded free from:

<http://v.s.v.s.www.isr.umich.edu/v.s.src/v.s.smp/v.s.ive/v.s.>

Multiple Imputation for Missing Values

- ▶ The variables without missing values:
 - Age
 - Airbag deployed
 - Vehicle towed
 - Crash year
 - Hospital length of stay (los)
 - Hospital charges
 - Level of care (Hospitalization, ED Visit)
 - Maximum Abbreviated Injury Score (MAIS)

Multiple Imputation for Missing Values

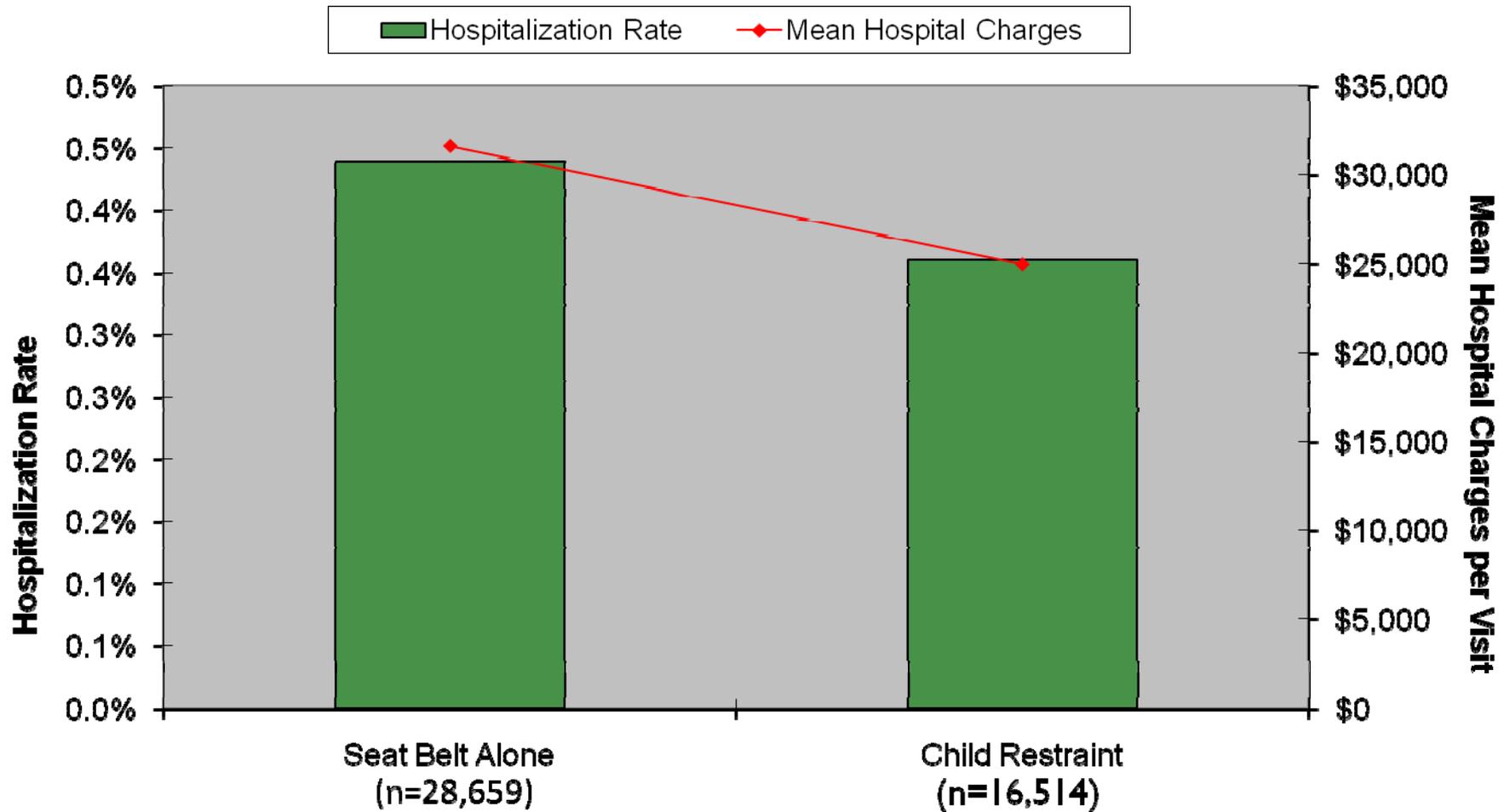
- ▶ Impute missing values for the following variables used in this study:

Variables	Percent of Missing
Child Safety Equipment (Child restraint v.s. Seat belt alone)	8.6%
Child Seating Position (Front seat v.s. Back seat)	6.0%
Vehicle Year (≥ 2000 v.s. < 2000)	11.3%
Child Gender (Male v.s. Female)	0.1%
Driver Safety Equipment (Restrained v.s. Unrestrained)	9.0%
Vehicle Type (Car, Light truck and Other)	0.1%

Hospitalization Rate and Mean Charges*

Children Aged 4-8, Involved in MV Crashes

Restraint Use, NYS 2005-2007



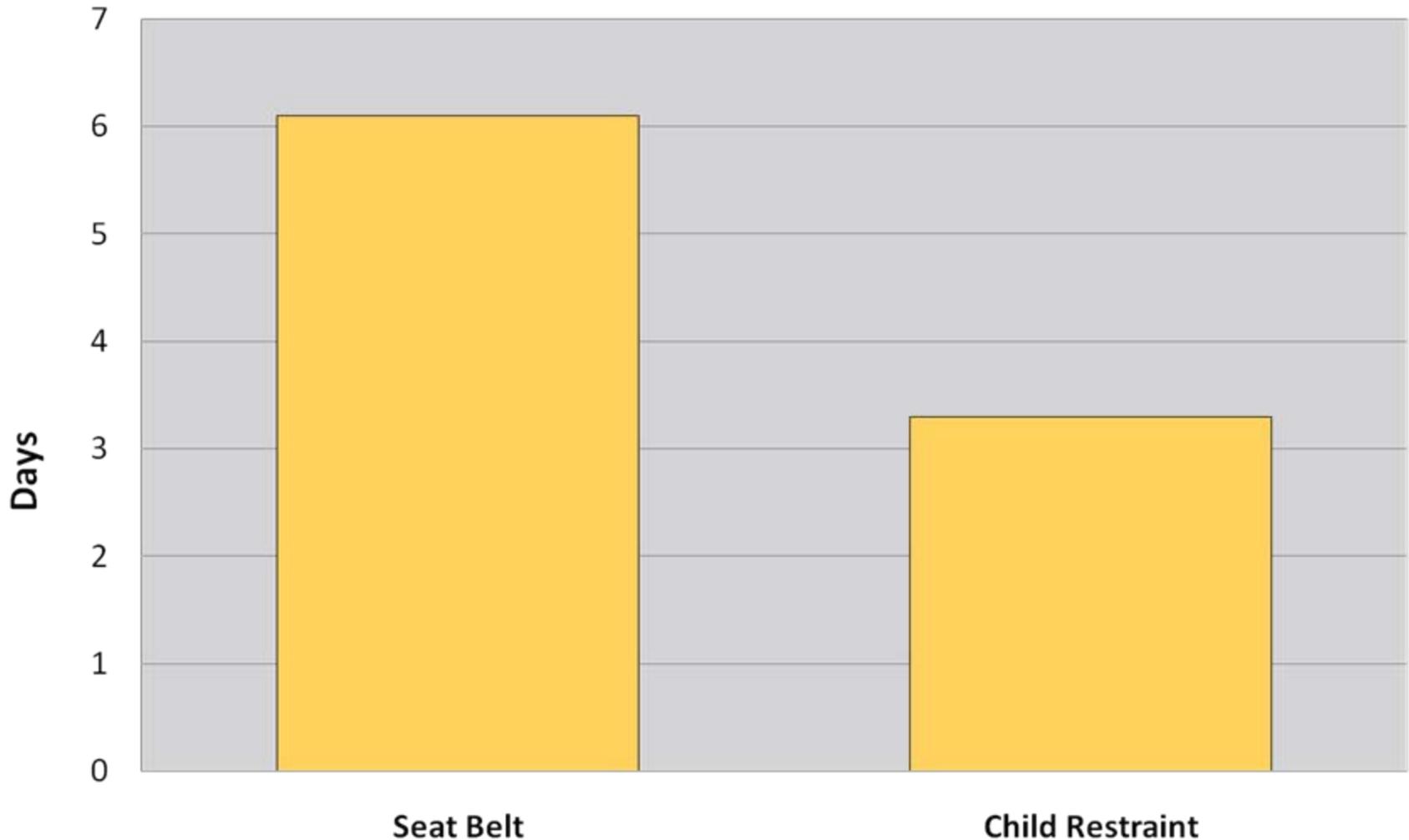
*Medical charges are in 2008 dollars adjusted for inflation using NHTSA's Consumer Price Index (CPI) method.



Mean Length of Hospital Stay

Children Aged 4-8, Involved in Motor Vehicle Crashes

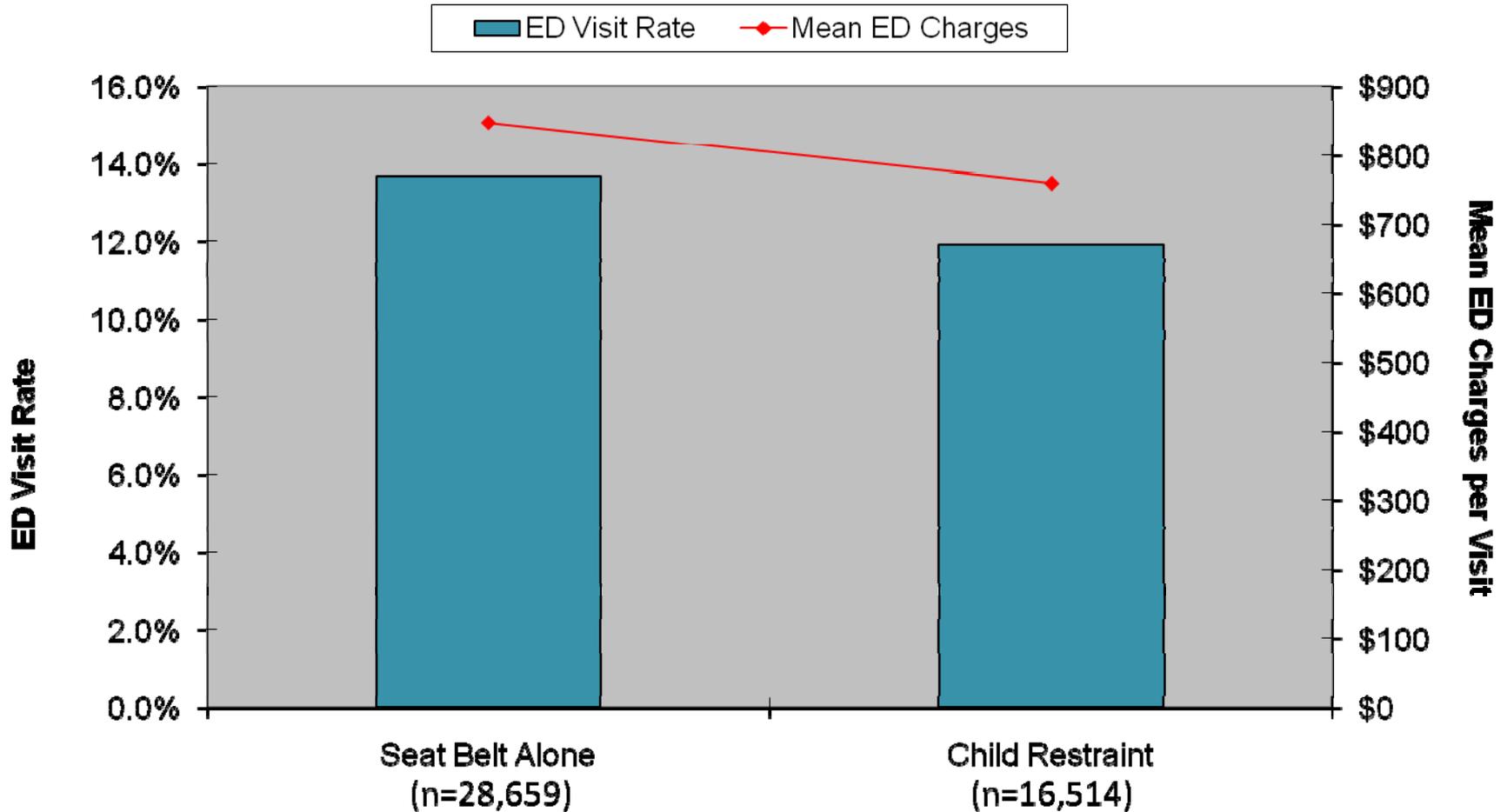
Restraint Usage, NYS 2005-2007



Emergency Department (ED) Visit Rate and Mean Charges*

Children Aged 4-8, Involved in MV Crashes

Restraint Use, NYS 2005-2007



*Medical charges are in 2008 dollars adjusted for inflation using NHTSA's Consumer Price Index (CPI) method.

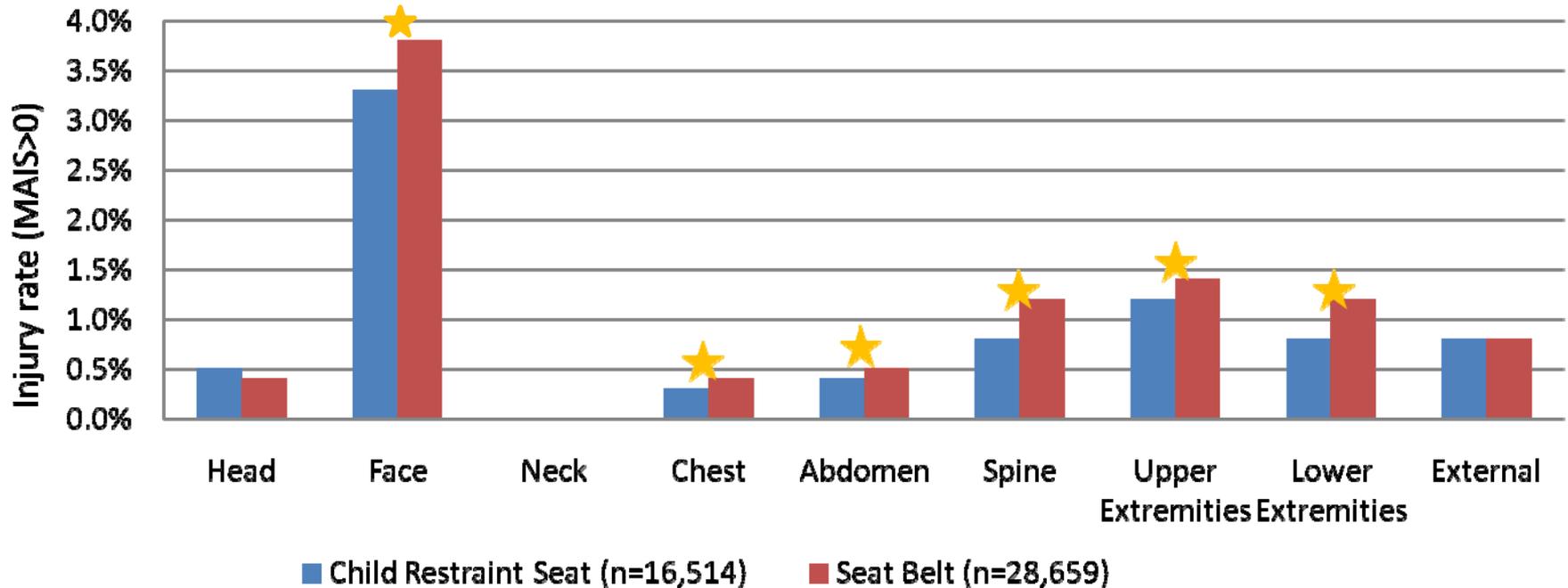


Maximum Abbreviated Injury Score (MAIS)

▶ **MAIS**

- ▶ Calculated using ICD-9-CM diagnosis codes from hospital treated patients by the NHTSA Program Resource Center at the University of Maryland for the NYS CODES Project
 - ▶ 0 = Not Injured → 6 = Maximum (Untreatable)
 - ▶ Overall score & score for each of 9 body regions

Distribution of Injuries by Body Region Children Aged 4 to 8 Years in Motor Vehicle Crashes New York State 2005-2007



★ Difference in injury rates between two restraint types is statistically significant.

→ The overall injury rate (MAIS > 0) for all body regions is significantly lower in children in child restraint than those in seat belt alone (7.3% vs. 8.8%).

Logistic Regression Analysis

- Logistic Regression was performed using 2005-2007 NYS CODES linked data to evaluate the association between restraint type (child restraint v.s. seat belt alone) and the crash outcome in terms of medically diagnosed serious injury for child occupants aged 4-8 years involved in motor vehicle crashes.

Logistic Regression Model

- Dependent Variable: Injured

Dichotomized Injured as followed:

Fatality or Overall MAIS > 0 then Injured = Yes

Else Injured = No

Logistic Regression Model

- Independent Variables:
 - Child safety equipment (Child restraint v.s. Seat belt alone)
 - Child seating position (Front seat v.s. Back seat)
 - Vehicle year (≥ 2000 v.s. < 2000)
 - Child gender (Male v.s. Female)
 - Driver safety equipment (Restrained v.s. Unrestrained)
 - Airbag deployed (Yes v.s. No)
 - Vehicle type (Car, Light truck and Other)
 - Vehicle towed from scene (Yes v.s. No)
 - Crash year (2005, 2006 and 2007)
- PROC LOGISTIC and PROC MIANALYZE in SAS were used

Logistic Regression Results

- Unadjusted Odds Ratio (OR) and 95% Confidence Interval (CI) for injured v.s. not injured, comparing child motor vehicle occupants aged 4-8 years in child restraint system v.s. those in seat belt alone:

OR = 0.82 (95% CI: 0.73-0.92)

Multivariate Logistic Regression Results

Parameter	OR	95% CI	P-value
Child safety equipment (Child restraint v.s. Seat belt alone)	0.83	(0.74 - 0.94)	0.006
Child seating position (Front seat v.s. Back seat)	1.27	(1.11 - 1.45)	0.0006
Vehicle year \geq 2000 (Yes v.s. No)	0.87	(0.80 - 0.95)	0.002
Child gender (Female v.s. Male)	1.09	(1.00 - 1.18)	0.04
Driver safety equipment (Restrained v.s. Unrestrained)	0.60	(0.44 - 0.81)	0.001
Vehicle type (Light truck v.s. Car)	0.78	(0.72 - 0.85)	<.0001
Vehicle type (Other v.s. Car)	0.93	(0.77 - 1.12)	0.43
Airbag deployed (Yes v.s. No)	1.90	(1.41 - 2.55)	<.0001
Crash year (2006 v.s. 2005)	0.90	(0.83 - 0.98)	0.02
Crash year (2007 v.s. 2005)	0.78	(0.70 - 0.87)	<.0001
Vehicle towed from scene (Yes v.s. No)	3.57	(3.30 - 3.86)	<.0001

Conclusion --Logistic Regression

- Child restraint usage is associated with about 18% decrease in the medically diagnosed serious injuries (Fatality or MAIS > 0) for children aged 4-8 years involved in motor vehicle crashes, as compared with seat belt alone.
- Other variables such as vehicle type, vehicle year, crash severity (airbag deployed or vehicle towed), and driver restrained did not alter the effect of child restraint on injury outcome in the logistic regression model.

Other Conclusions

- ▶ Child restraint use rate among child occupants aged 4-8 years increased from 2003 to 2007 in New York State.
- ▶ Child restraint use rate experienced a larger increase among younger children 4-6 years, particularly after 2005 law.

Other Conclusions

- ▶ Children in child restraint had lower rate of hospitalization and ED visits, lower mean hospitalization and ED charges, and lower hospital length of stay, as compared to children in seat belt alone.
- Children in child restraint had lower medically diagnosed serious injury (MAIS >0) rates in 6 of all 9 body regions and overall MAIS, as compared to children in seat belt alone.

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