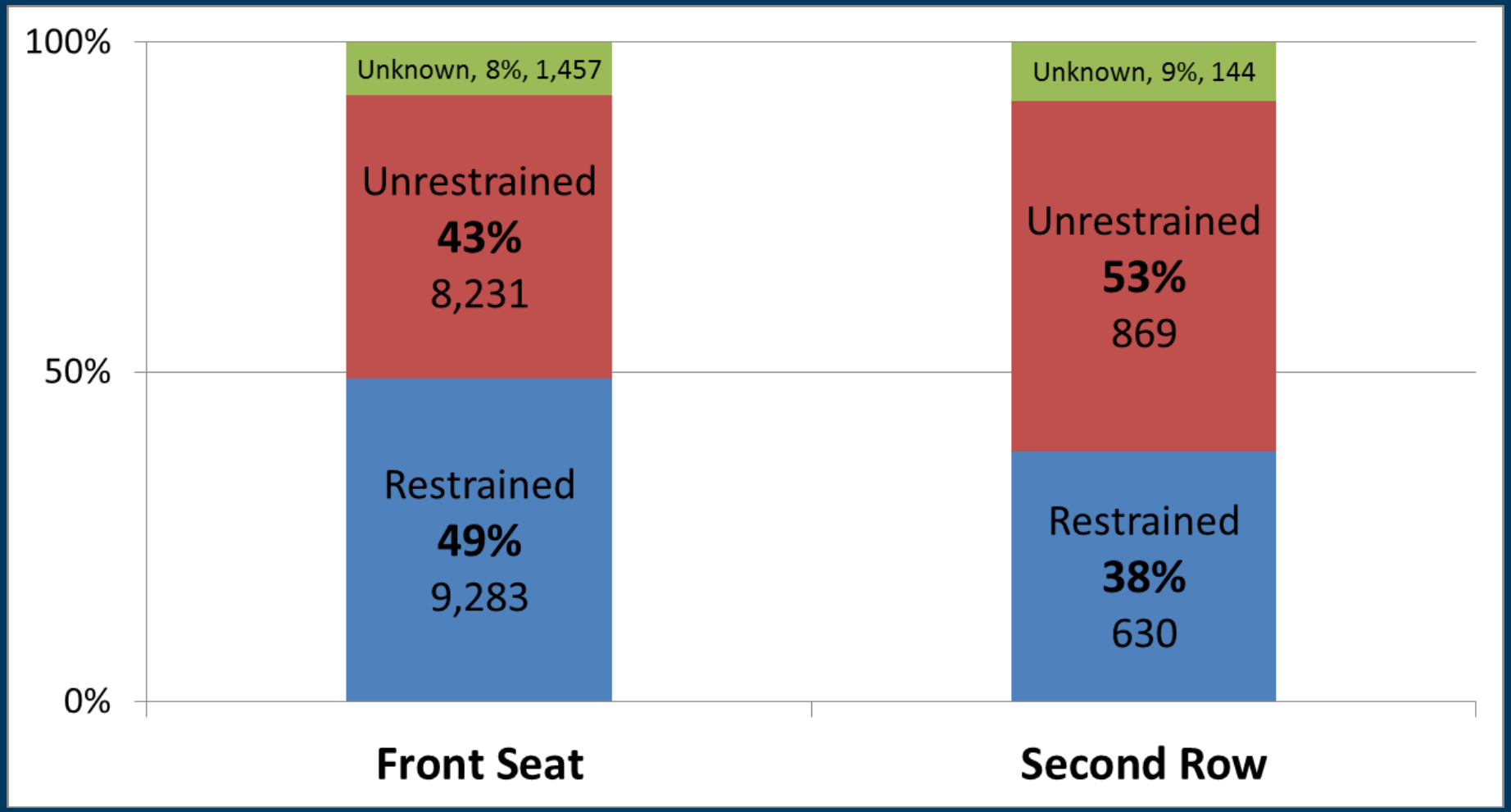
National Highway Traffic Safety Administration

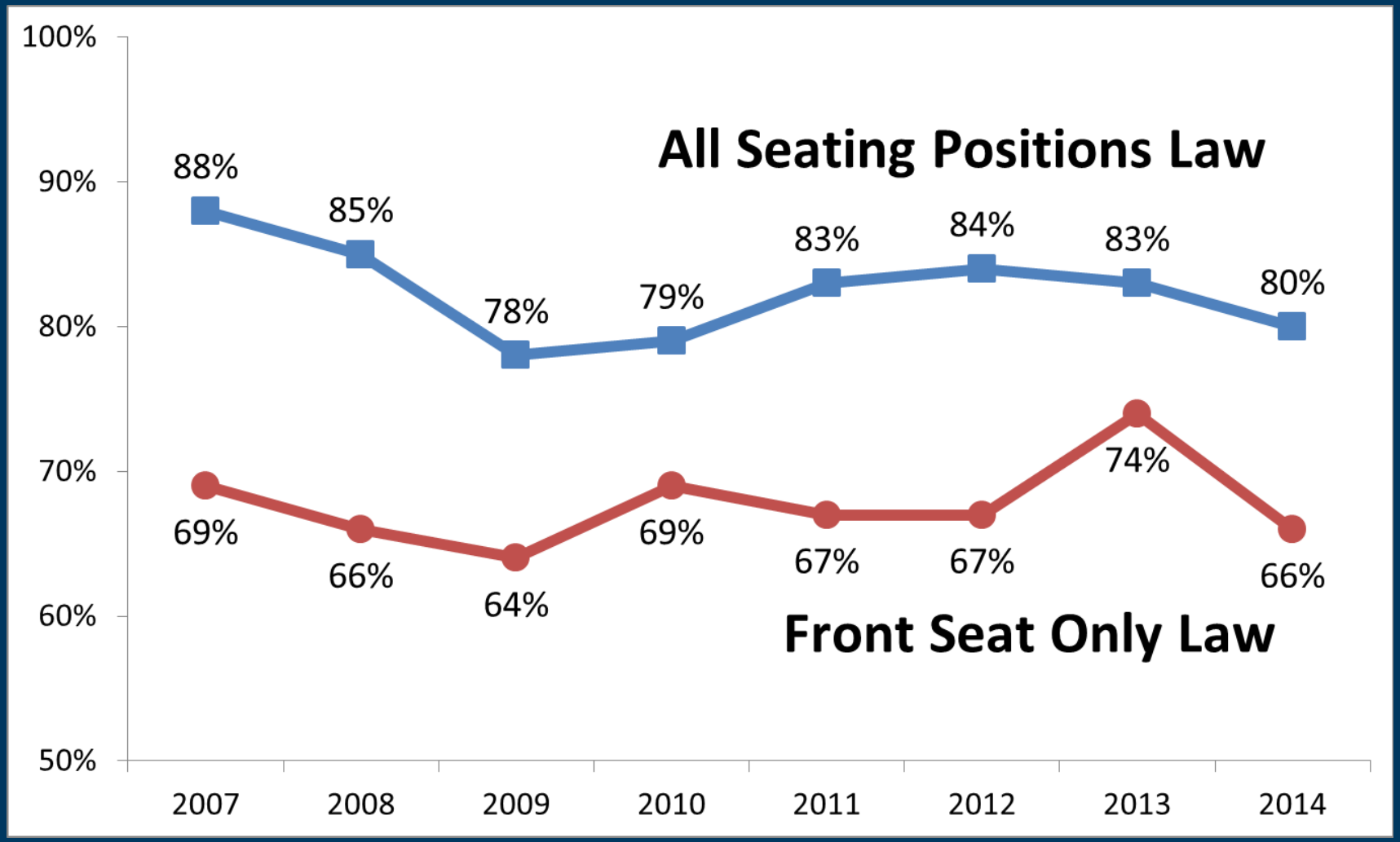
TRB Webinar
Improving Rear Seat Passenger Safety: Challenges and Strategies
– Introduction

Mary T. Byrd, MA
Social Science Researcher
Office of Behavioral Safety Research
National Highway Traffic Safety Administration

Fatality Distribution for Front Seat and Second Row Passenger Vehicle Occupants in 2014 by Restraint Use (FARS)



Observed Rear Seat Belt Use by State Seat Belt Law (NOPUS)



Related NHTSA Activities

- Published research on advanced rear seat occupant restraints in March 2016
- December 2015 NCAP Upgrade Announcement
  - Proposed rear seat dummy for NCAP crash tests
- Developing NPRM to amend FMVSS No. 208 to require seat belt reminders for front and rear seating positions
- New research to evaluate the effect of an all seating positions seat belt law

Mary T. Byrd, MA

mary.byrd@dot.gov

NHTSA.gov

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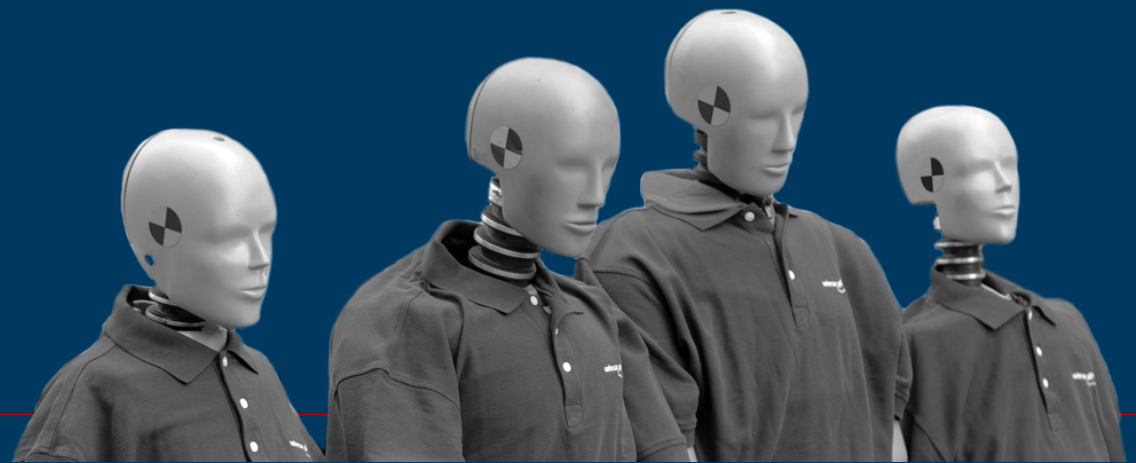

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New Car Assessment Program; Request for comments, 80 Federal Register 241 (16 December 2015), pp. 78522 – 78591. Retrieved from https://www.gpo.gov/fdsys/pkg/FR-2015-12-16/pdf/2015-31323.pdf

Rear Seat Safety: Variation in protection by occupant, crash and vehicle characteristics

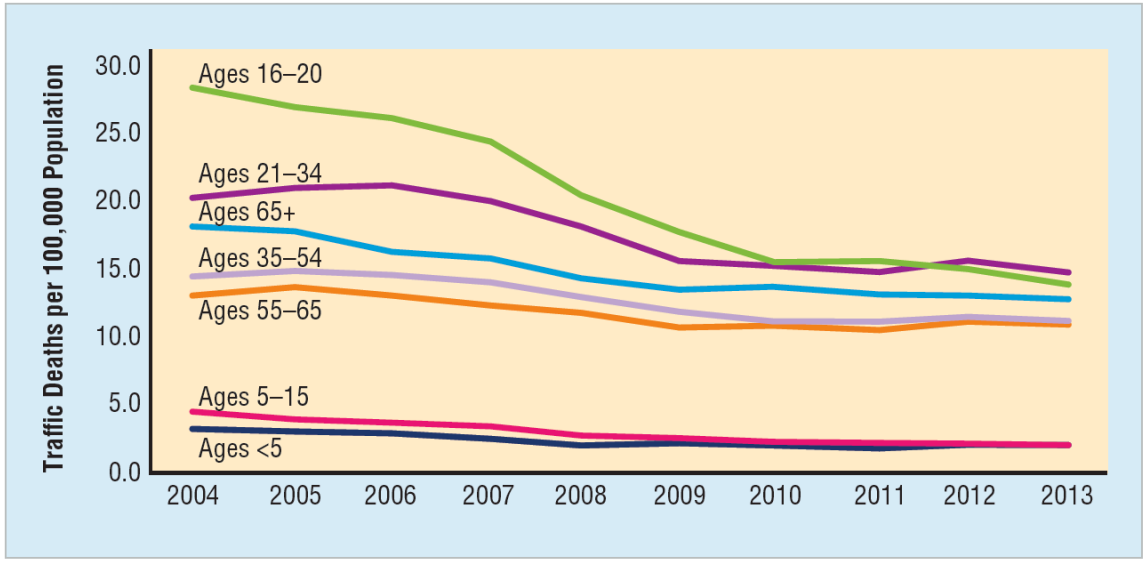
Dennis Durbin, MD, MSCE

Professor of Pediatrics
Perelman School of Medicine
University of Pennsylvania

Chief Clinical Research Officer
The Children's Hospital of Philadelphia
Research Institute

ADVANCES IN HIGHWAY SAFETY

Motor Vehicle Traffic Fatality Rates by Age Group, 2004–2013

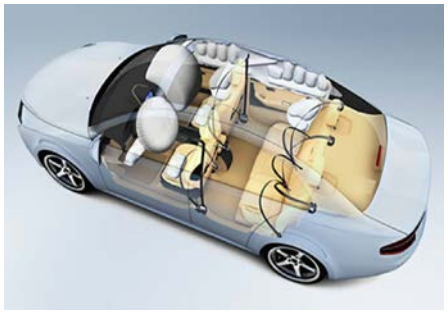


Source: Fatality Analysis Reporting System (FARS) 2004–2012 Final File, 2013 Annual Report File (ARF). Population—Bureau of the Census.

Increased restraint use

Highway safety laws

Advanced restraint systems



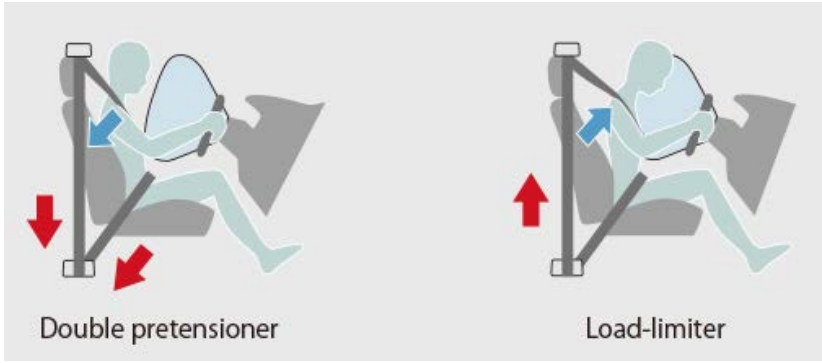
Vehicle Crashworthiness

ADVANCES IN HIGHWAY SAFETY

ADVANCES IN THE FRONT SEAT

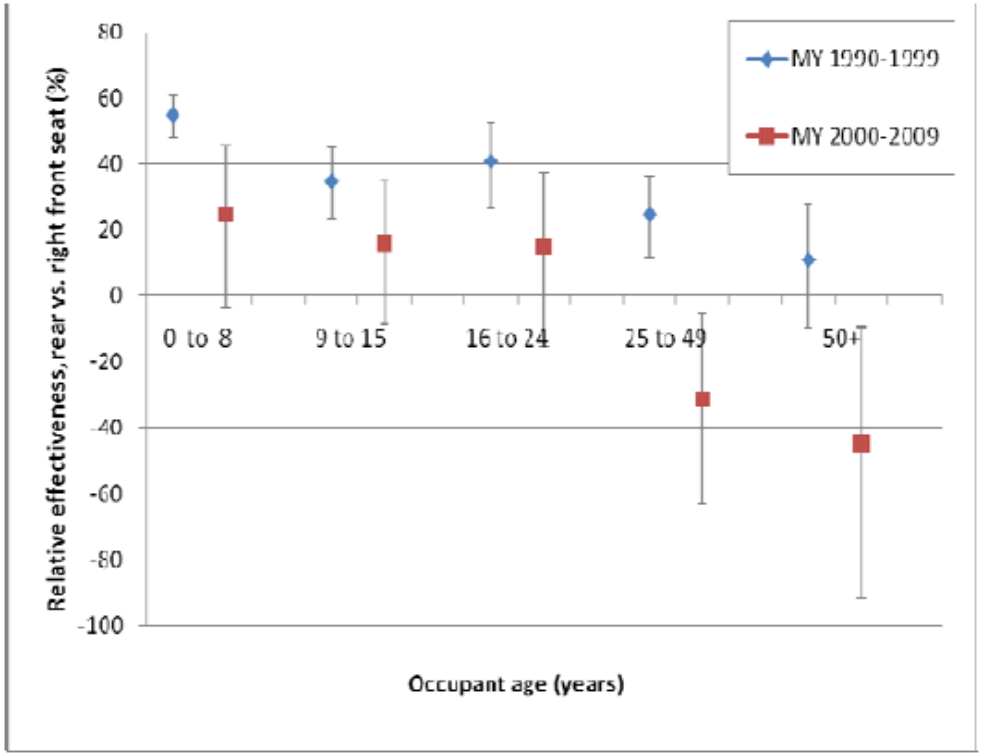
Airbag systems

Seat belt systems



Testing procedures

REAR VS. FRONT SEAT SAFETY
FARS, 1990-2009



Relative effectiveness of rear vs. right front seat for belted occupants

- Rear seat less protective relative to the front in newer model year vehicles
- Advances in safety technology have lagged in the rear.

Sahraei at al. *Proc AAAM*, 2010

OBJECTIVES

- Describe characteristics of occupants in front and rear rows of MY 2000 and newer vehicles involved in crashes
  - Rear row occupants with serious (AIS 3+) and fatal injuries
- Determine risk of AIS3+ injury for restrained rear row occupants by age group, impact direction and vehicle MY
- Determine the relative risk of fatal injury for restrained rear vs. front row occupants by age group, impact direction and vehicle MY

METHODS

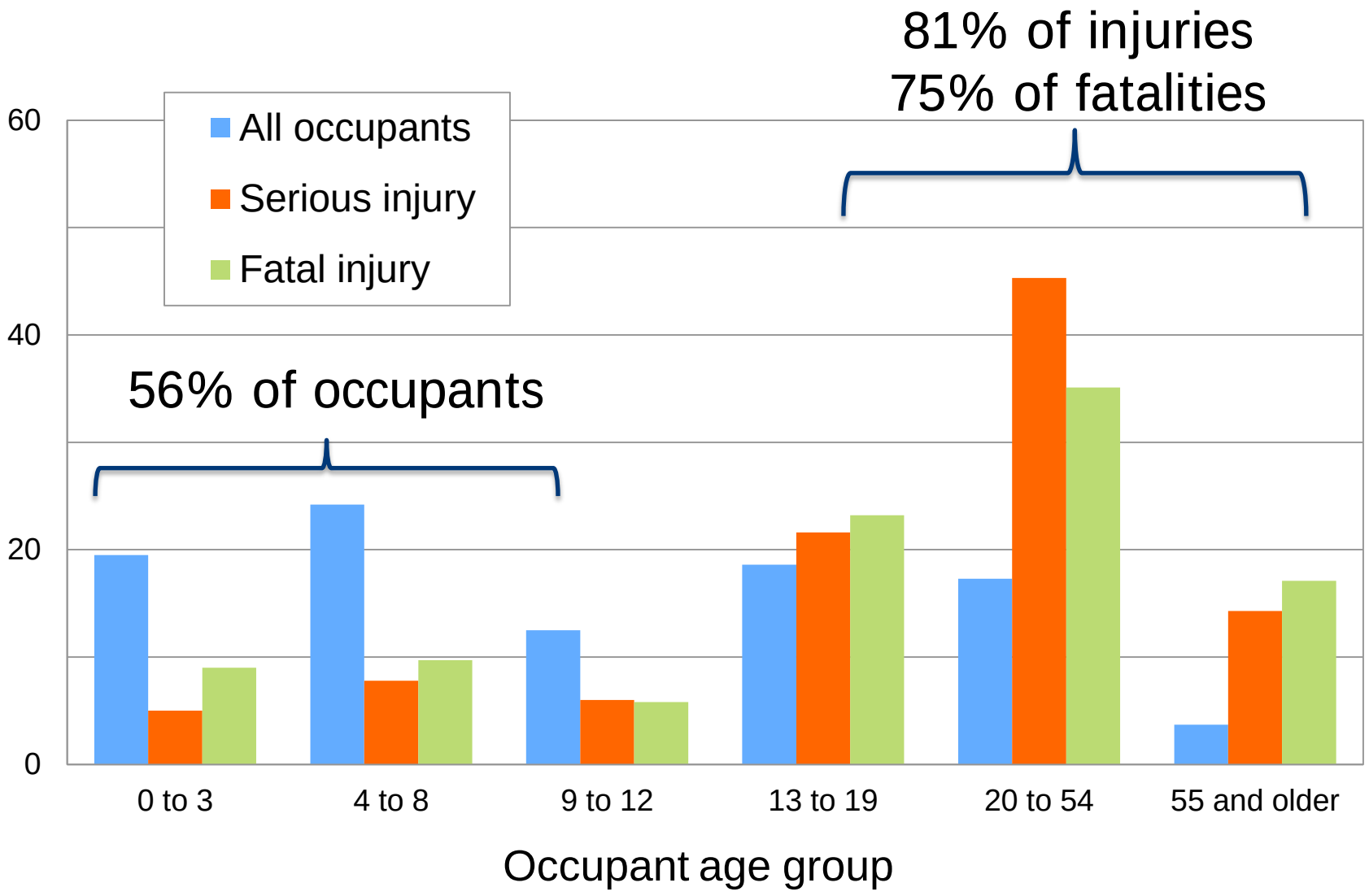
- Sources of Data
  - NASS-CDS, 2007-2012
  - FARS, 2007-2012
  - Passenger Vehicles restricted to MY 2000 and newer and ≤ 10 years old
- Combined FARS and NASS-CDS data
  - FARS cases substituted for all weighted fatality cases in NASS
- Serious injury:
  - AIS 3+

METHODS

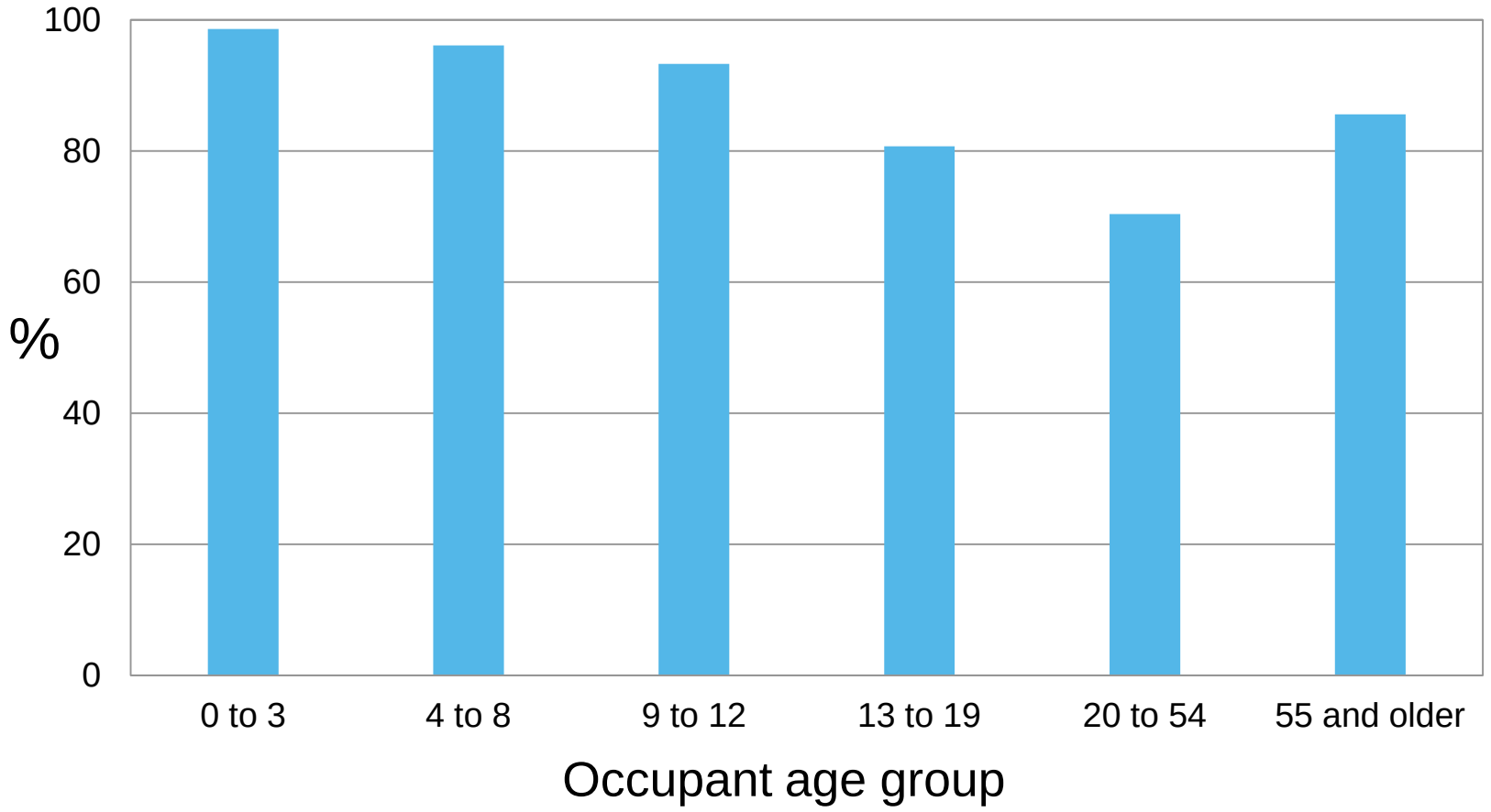
- Variable definitions
  - Occupant Age: 0-3; 4-8; 9-12; 13-19; 20-54; 55+
  - Restraint Status: restrained vs. not
  - Impact direction: front, rear, right side, left side, rollover, other/unknown
  - Rear row included 3rd row in 3-row vehicles
  - Vehicle MY: 2000-2002; 2003-2006; 2007-2013
- Statistical Analysis
  - Counts of deaths/injuries from FARS or NASS
  - Whole sample estimates of occupants from NASS
  - Logistic regression modeling to estimate RR
  - Analyses accounted for sampling and clustering of data

Age Distribution in the Rear

Occupants and injuries

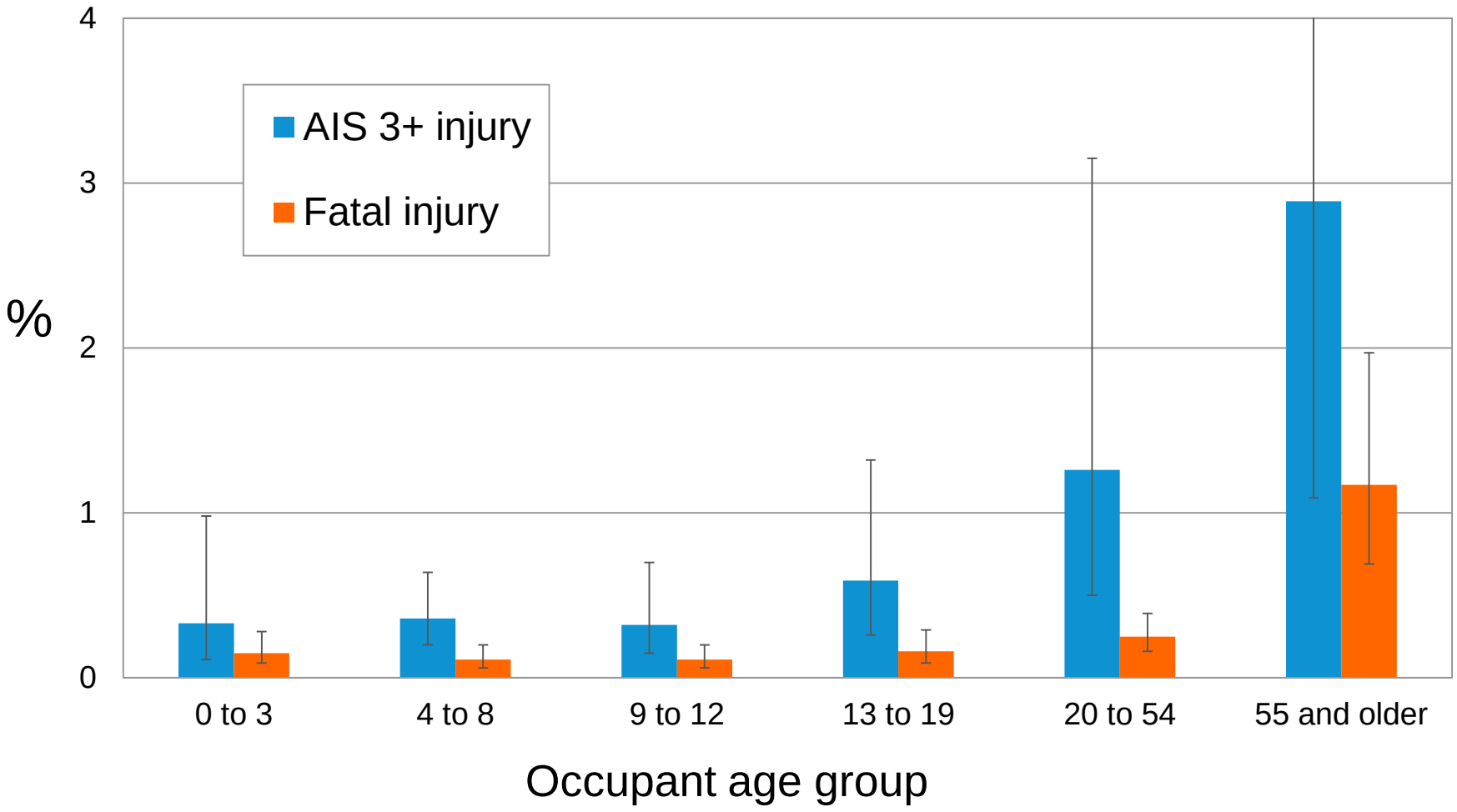


Rear Seat Restraint Use By Age

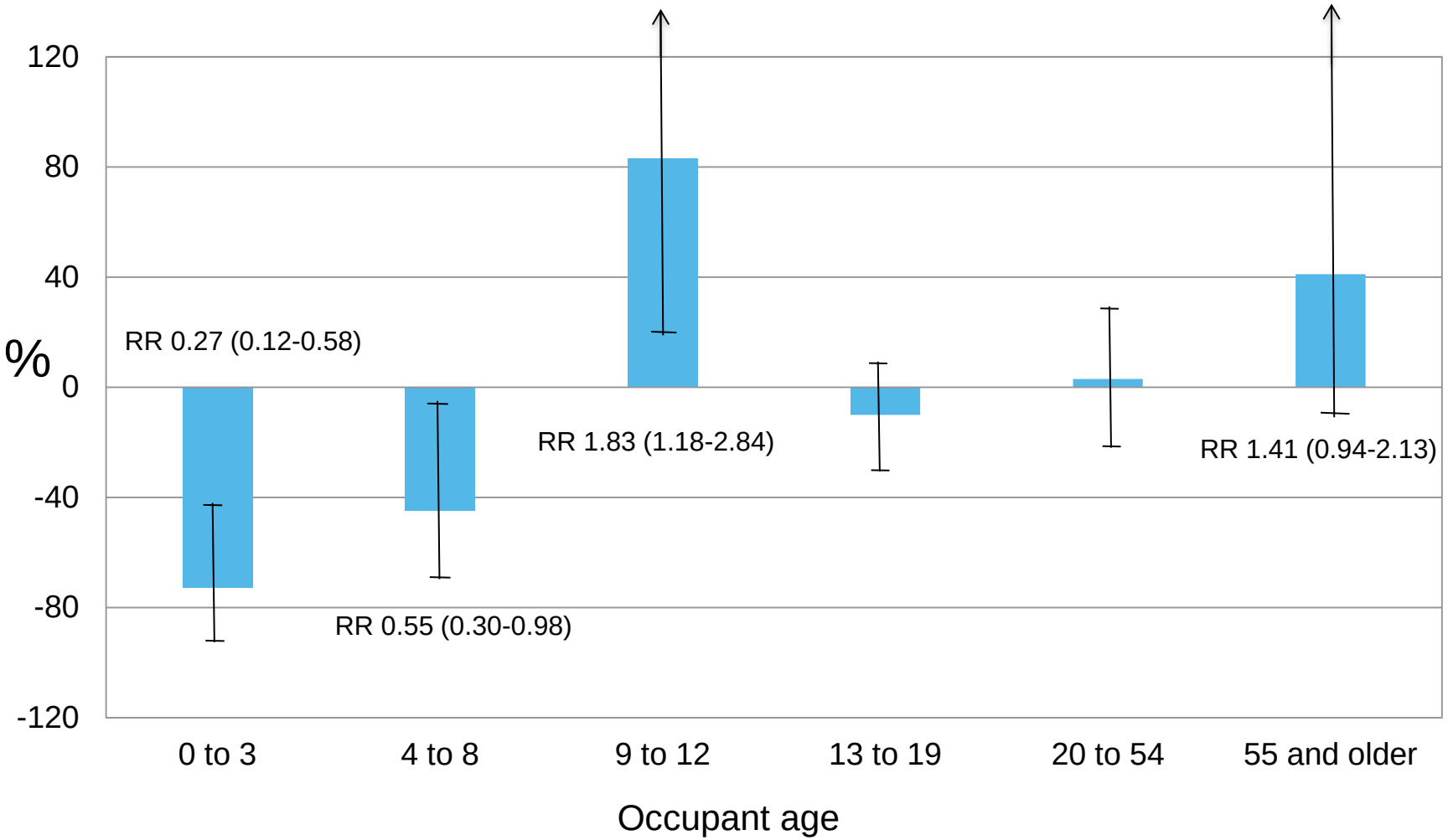


RR_{SI} unrestrained vs. restrained 7.9 (5.1, 12.3)

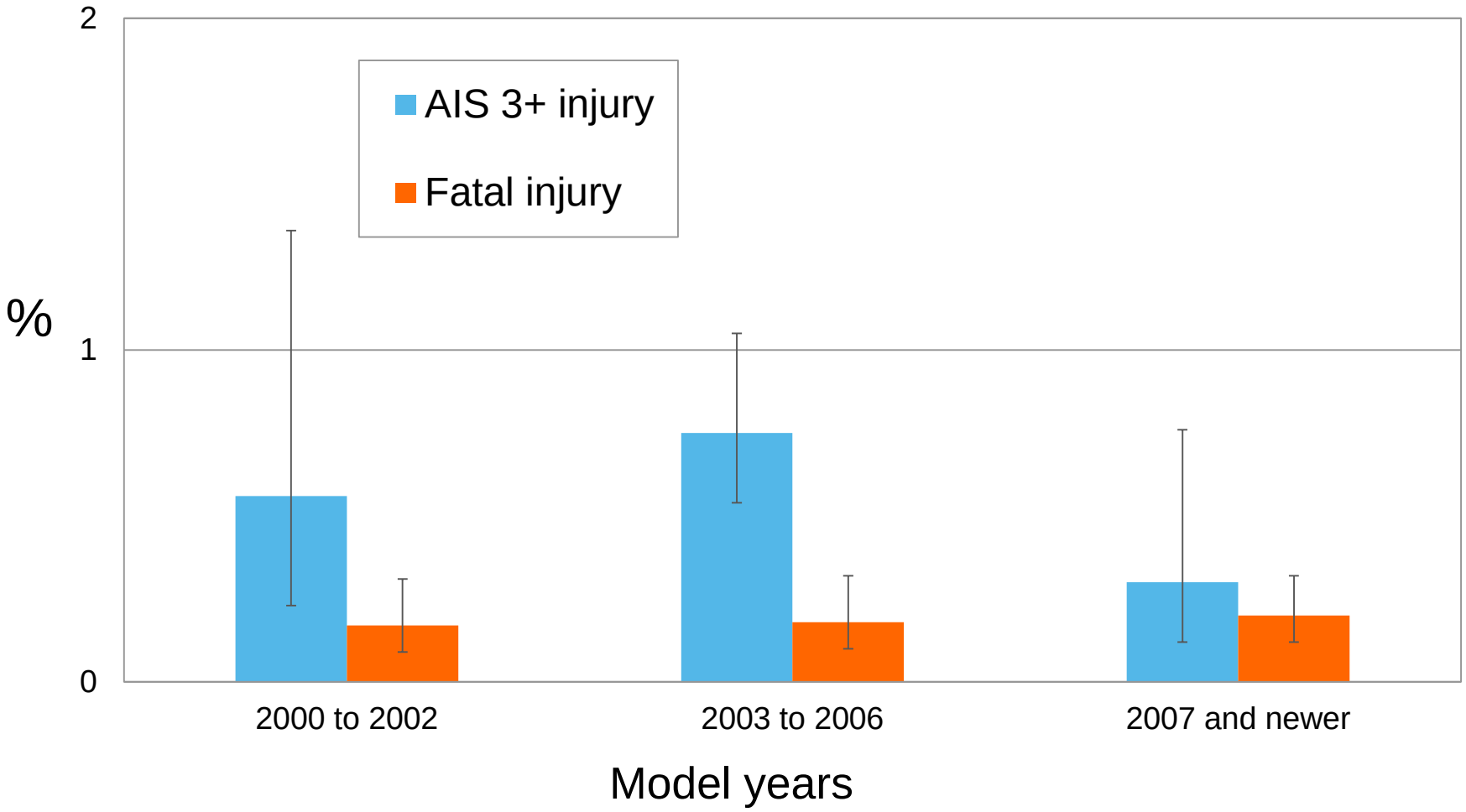
RISK OF SERIOUS OR FATAL INJURIES BY AGE AMONG RESTRAINED REAR ROW OCCUPANTS



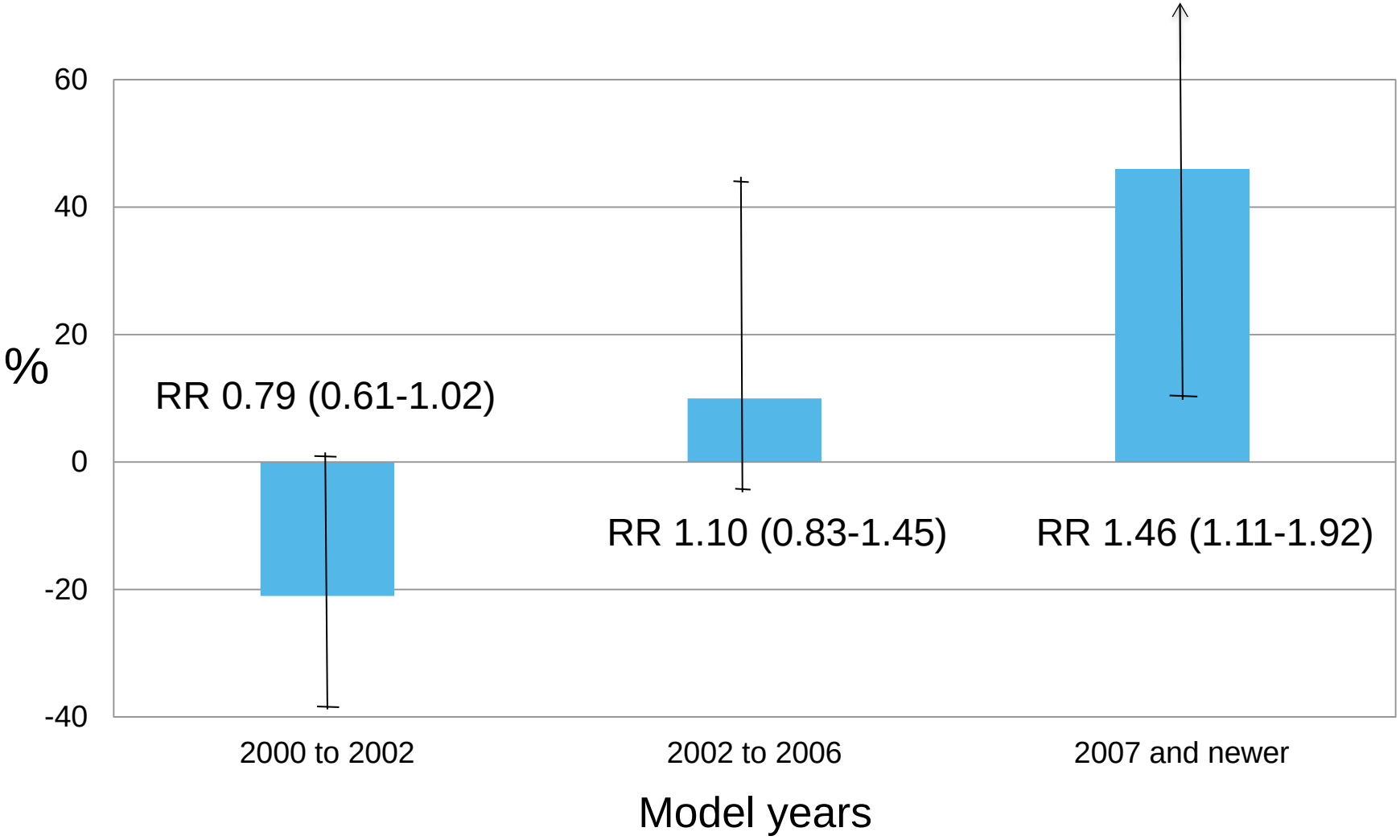
Difference in risk of fatal injury for rear vs. front row passengers by occupant age



Risk of serious and fatal injury for restrained rear row occupants by vehicle model year



Difference in risk of fatal injury for rear vs. front row passengers by vehicle MY



Summary Observations

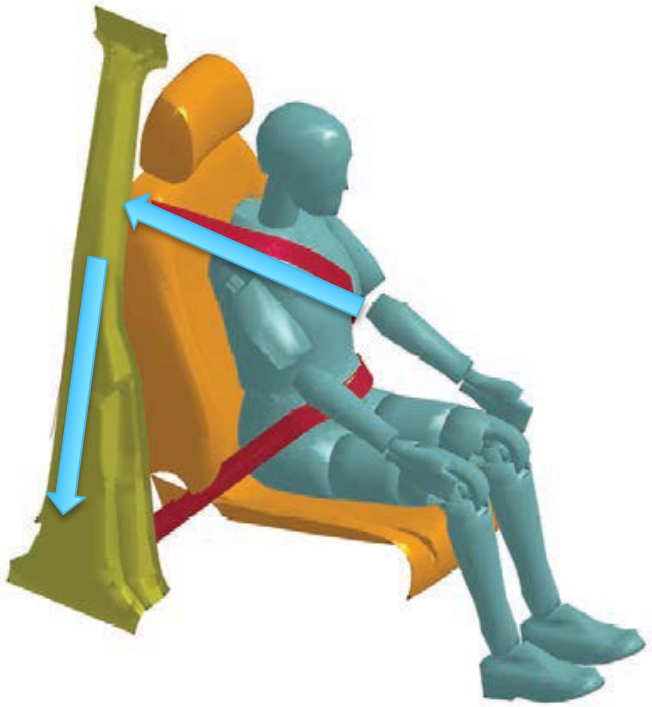
- Children under age 13 account for over half of rear seat occupants
  - Adults account for only 1 in 5 rear seat occupants
- More rear seat occupants ride unrestrained, which substantially increases risk of serious and fatal injury
- Restrained children 8 years and younger continue to be well-protected in the rear
  - Evidence of increased relative risk of death in the rear for 9-12 year olds requires further study

Summary Observations

- Restrained passengers 55 years and older
  - highest risk of serious and fatal injuries
  - increased relative risk of death in the rear compared with front passengers
- Increased relative risk of death for 2007 and newer vehicles likely due to front rows getting safer, not increased crash pulse severity in the rear
- Challenge is to improve safety for older adults while maintaining the current safety for younger occupants

Advanced Restraint Technology

- **Seat belt pretensioners**
  - Remove belt slack prior to impact
- **Seat belt load limiters**
  - Release excess belt webbing after threshold force is reached
- **Curtain air bags**
  - Deploy from roof rail along entire length of vehicle
- **Inflatable seat belts**
  - Distribute belt forces, reduce head rotation and neck flexion



Current Rating systems

NHTSA Tests

- **Full Frontal**
  - No rear seat ATD
- **Side Impact**
  - Small adult female in left rear

IIHS Tests

- **Frontal Offset**
  - No rear seat ATD
- **Side Impact**
  - Small adult female in left rear
- **Small Overlap Frontal**
  - No rear seat ATD

ACKNOWLEDGEMENTS

- Insurance Institute for Highway Safety
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- Center for Injury Research and Prevention at The Children's Hospital of Philadelphia
  - Kristy Arbogast, PhD
  - Mark Zonfrillo, MD, MSCE
  - Rachel Myers, MS

What factors are associated with adult use of seat belts in the rear seat?

Laurie F. Beck, MPH

Transportation Safety Team
Division of Unintentional Injury Prevention
National Center for Injury Prevention and Control
Centers for Disease Control and Prevention

TRB Webinar: Improving Rear Seat Passenger Safety: Challenges and Strategies
October 27, 2016

CDC and Transportation Safety

- CDC mission:

  Protect public health and safety through control and prevention of disease, injury, and disability

- Motor vehicle crashes are a leading cause of death in the U.S. and a CDC "Winnable Battle"

CDC and Transportation Safety

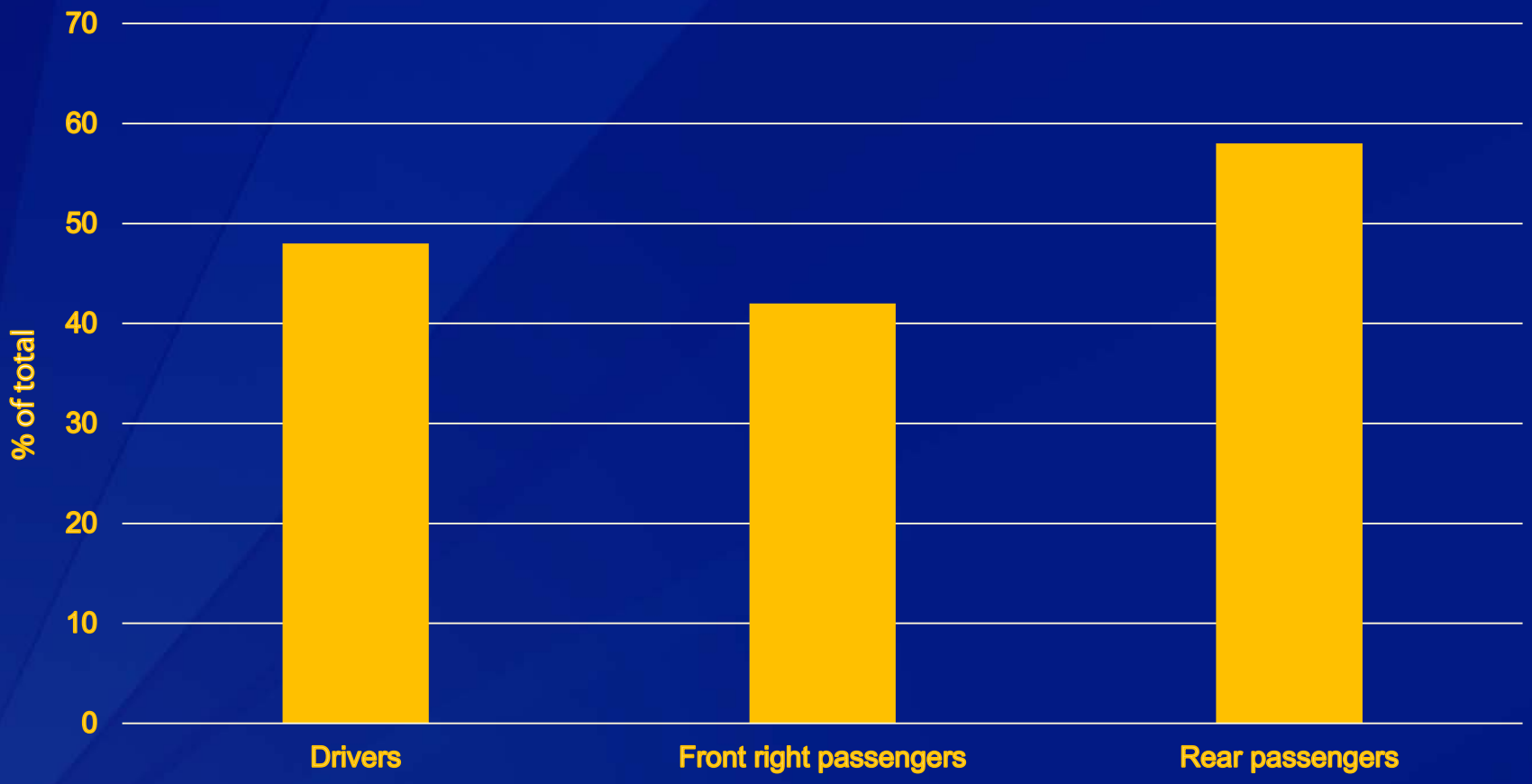
- Transportation Safety Team priorities:
  - Restraint use
  - Impaired driving
  - American Indian and Alaska Native tribes
  - Older adults

Working together, we can help keep people safe on the road--- every day.

What do we know about seat belt use in the U.S.?

- Nationally, seat belt use relatively high
  - 2014, front row, observational = 87%
  - 2013, self-reported = 87%
- Some groups have much lower use rates than others, e.g.:
  - Males
  - Young adults
  - Drinking drivers
  - Overweight/obese occupants
  - Rear seat occupants

Unrestrained passenger vehicle occupant deaths (%), by seating position, US, 2014



Source: National Highway Traffic Safety Administration, Report No. DOT HS 812 262

Why buckle in the back?

- To reduce the risk of death by half
- To reduce the risk of injury or death to drivers and other passengers

Study Purpose: What makes them click?

- Improve understanding of predictors of seat belt use among adult passengers in the rear seat

Study Methods: Data Sources

- HealthStyles, 2012
  - Self-report survey, health-related attitudes & behaviors
  - Nationally representative
  - Adults (18+ years)
  - Sample size n=3953
- Insurance Institute for Highway Safety (IIHS)
  - Identify states by type of seat belt laws in 2012

HealthStyles 2012 Data

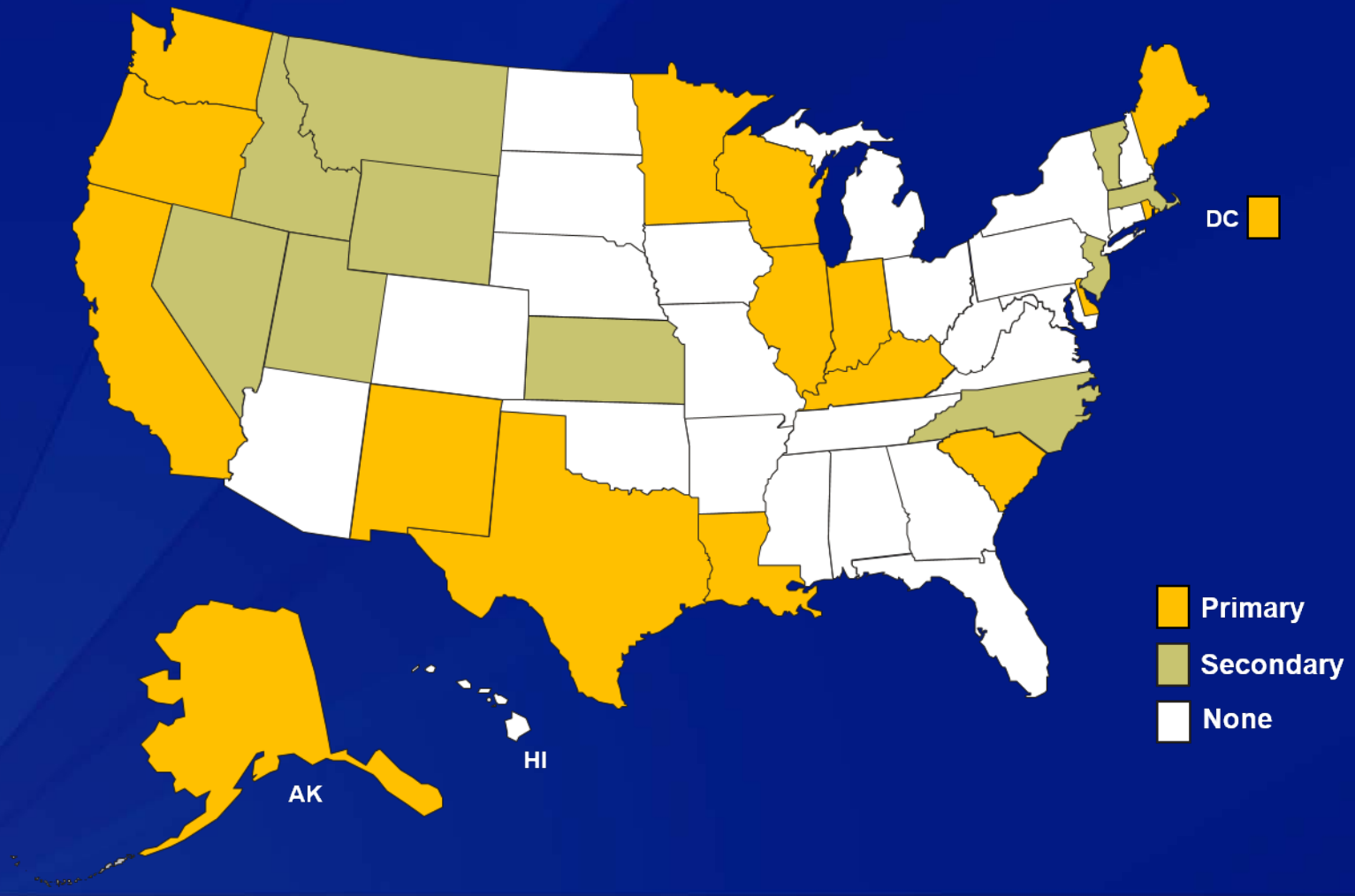
- How often do you wear seat belts when you ride in the back seat of a car, truck, van, or SUV (sport utility vehicle)?
  - Always
  - Nearly always
  - Sometimes
  - Seldom
  - Never
  - Never ride in the back seat

HealthStyles 2012 Data

- Demographic and geographic variables
  - Gender
  - Age group
  - Race/ethnicity
  - Marital status
  - Household income
  - Census region
  - Metropolitan status

Type of Rear Seat Enforcement, Adults, 2012

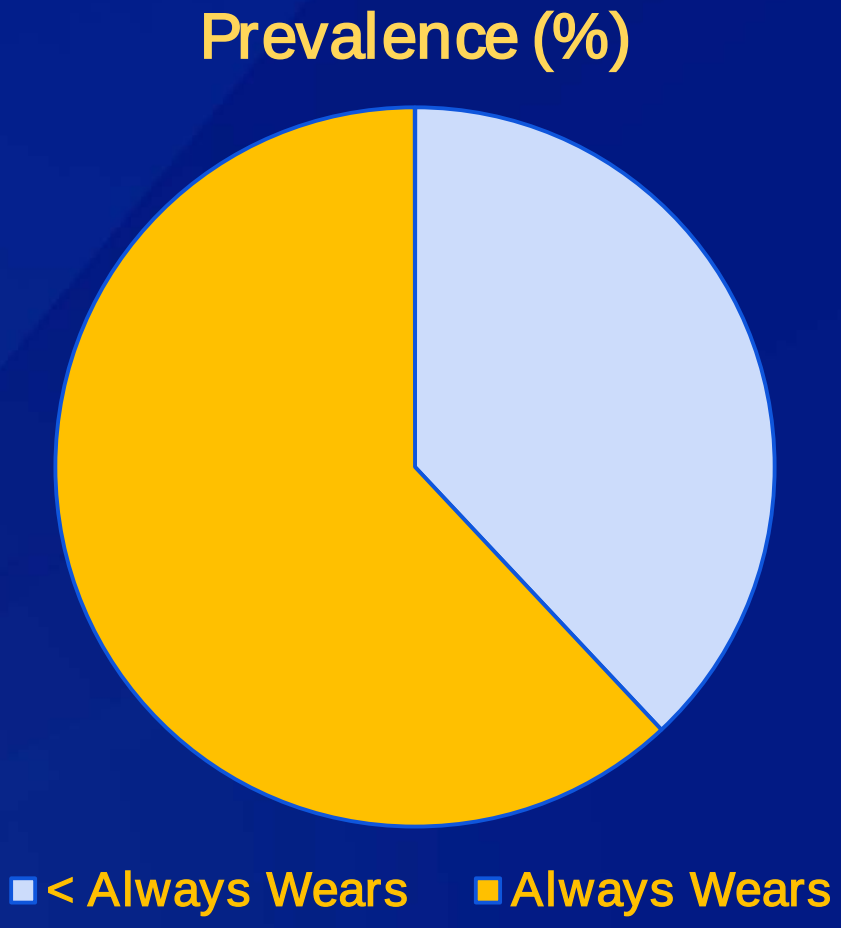
Source: Insurance Institute for Highway Safety



Data Analysis

- Prevalence of rear seat belt use (always wears) by demographic, geographic, and state law variables
- Multivariable regression to calculate adjusted prevalence ratios for rear seat belt use (always wears)

Results: Seat belt use among adults in the rear seat, 2012



Rear seat belt use among adults, prevalence and adjusted prevalence ratios, 2012

	Weighted %	aPR (95% CI)
Rear Seat Enforcement		
Primary	71	1.23 (1.16, 1.30)
Secondary	62	1.11 (1.02, 1.20)
None	54	1.00

Rear seat belt use among adults, prevalence and adjusted prevalence ratios, 2012

	Weighted %	aPR (95% CI)
Metropolitan status		
Non-metropolitan	57	1.00
Metropolitan	63	1.11 (1.03, 1.19)
Region		
Northeast	52	0.96 (0.87, 1.06)
Midwest	58	1.00
South	60	1.05 (0.98, 1.13)
West	75	1.25 (1.16, 1.33)

Rear seat belt use among adults, prevalence and adjusted prevalence ratios, 2012

	Weighted %	aPR (95% CI)
Gender		
Male	60	1.00
Female	63	1.04 (1.00, 1.09)
Age (years)		
18-24	62	1.09 (1.00, 1.18)
25-44	56	1.00
45-64	64	1.14 (1.08, 1.21)
65+	67	1.16 (1.09, 1.24)

Rear seat belt use among adults, prevalence and adjusted prevalence ratios, 2012

	Weighted %	aPR (95% CI)
Marital Status		
Married	63	1.00
Not Married	60	0.98 (0.93, 1.03)
Race/Ethnicity		
White	63	1.00
Black	56	0.95 (0.87, 1.03)
Hispanic	63	0.97 (0.91, 1.03)
Other	52	0.80 (0.71, 0.89)

Rear seat belt use among adults, prevalence and adjusted prevalence ratios, 2012

	Weighted %	aPR (95% CI)
Education		
<=High School	60	1.00
Some College	64	1.03 (0.97, 1.08)
>=College Grad	61	0.99 (0.92, 1.05)
Income		
<$25k	58	1.00
$25k to <$50k	62	1.01 (0.94, 1.10)
$50k to <$75k	59	0.95 (0.89, 1.08)
$75k+	65	0.99 (0.92, 1.05)

Implications for Increasing Belt Use in Rear Seat

- Potential target populations identified for intervention:
  - 25-44 year olds
  - Rural residents
  - Residents of Northeast, Midwest, Southern regions
  - Residents of states not covered by rear seat enforcement
- Opportunity exists to improve seat belt use for all adults in rear seats

Acknowledgements

- Geeta Bhat, PCORI (formerly CDC/Injury Center)
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- Marcie-jo Kresnow, CDC/Injury Center

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

For more information:
Laurie Beck, MPH
CDC/Injury Center
770-488-4327 or LDF8@cdc.gov

Belts in Back –

How to Raise Rear Seat Belt Use

Jim Hedlund

Highway Safety North

TRB Webinar

October 27, 2016


ATTENTION!

Unbuckled in Back: An Overlooked Issue in Occupant Protection

Sponsored by the Governors Highway Safety Association

Project oversight by

Jonathan Adkins, Executive Director, and

Kara Macek, Communications Director

Available at

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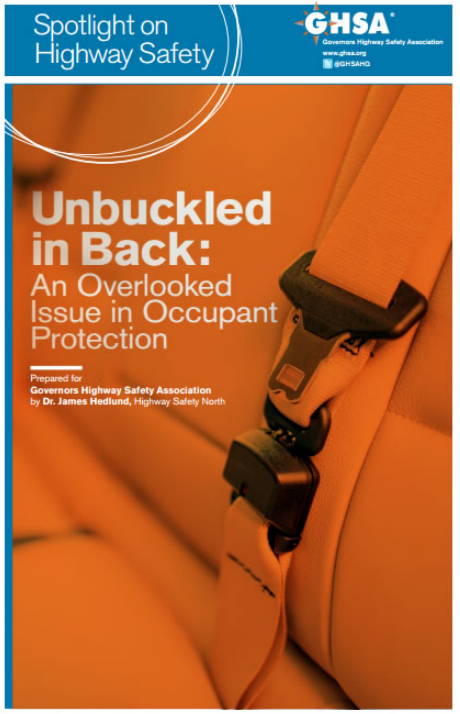
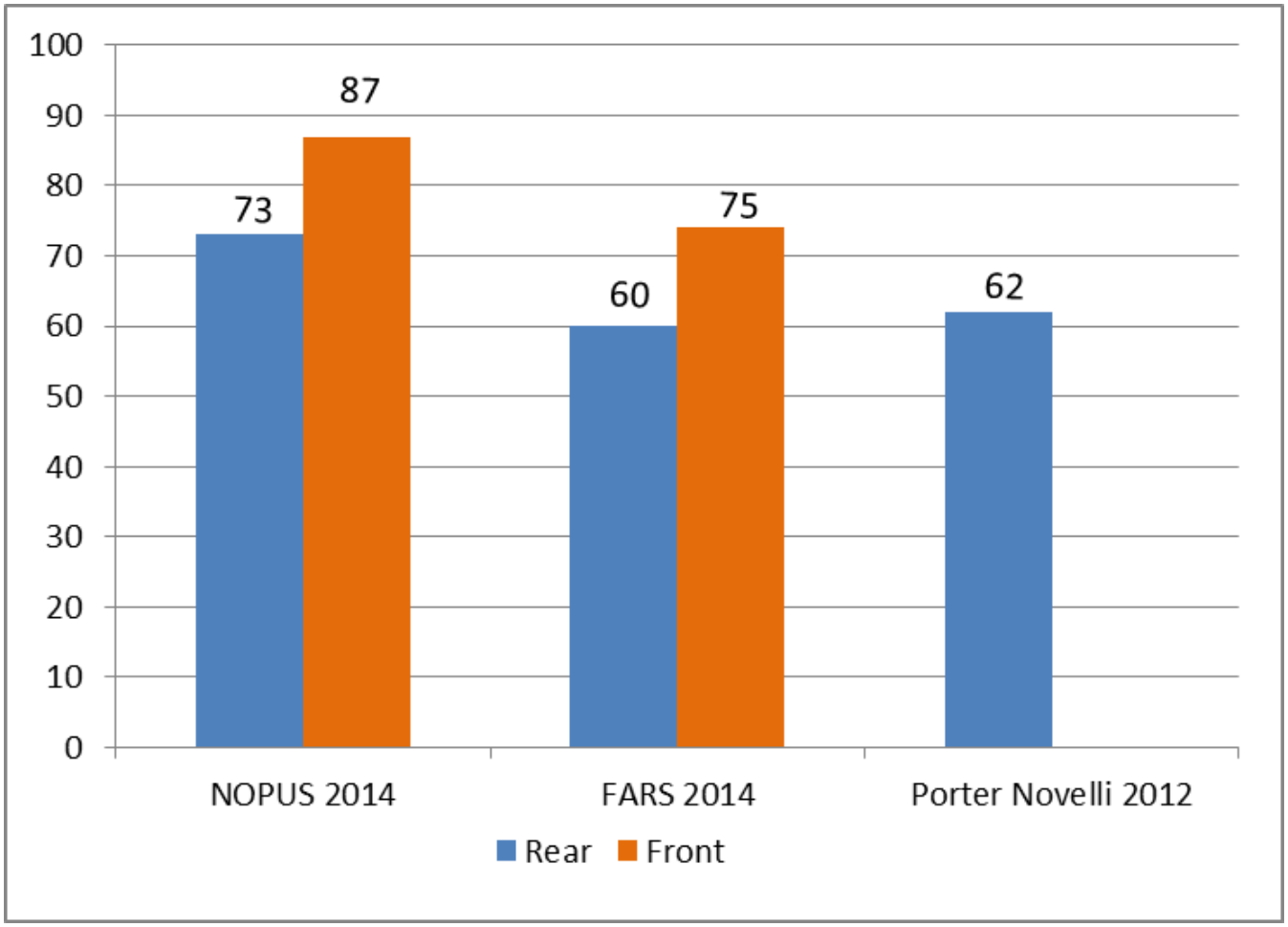


Overview

- Adult belt use lower in rear seats than in front
  - Data
  - Consequences
- Reasons
  - Laws and enforcement
  - Programs and messaging
  - Beliefs
- Special case: taxis and limos
- Solutions

  [if I tell you the solutions, you won't listen to the next 10 minutes]

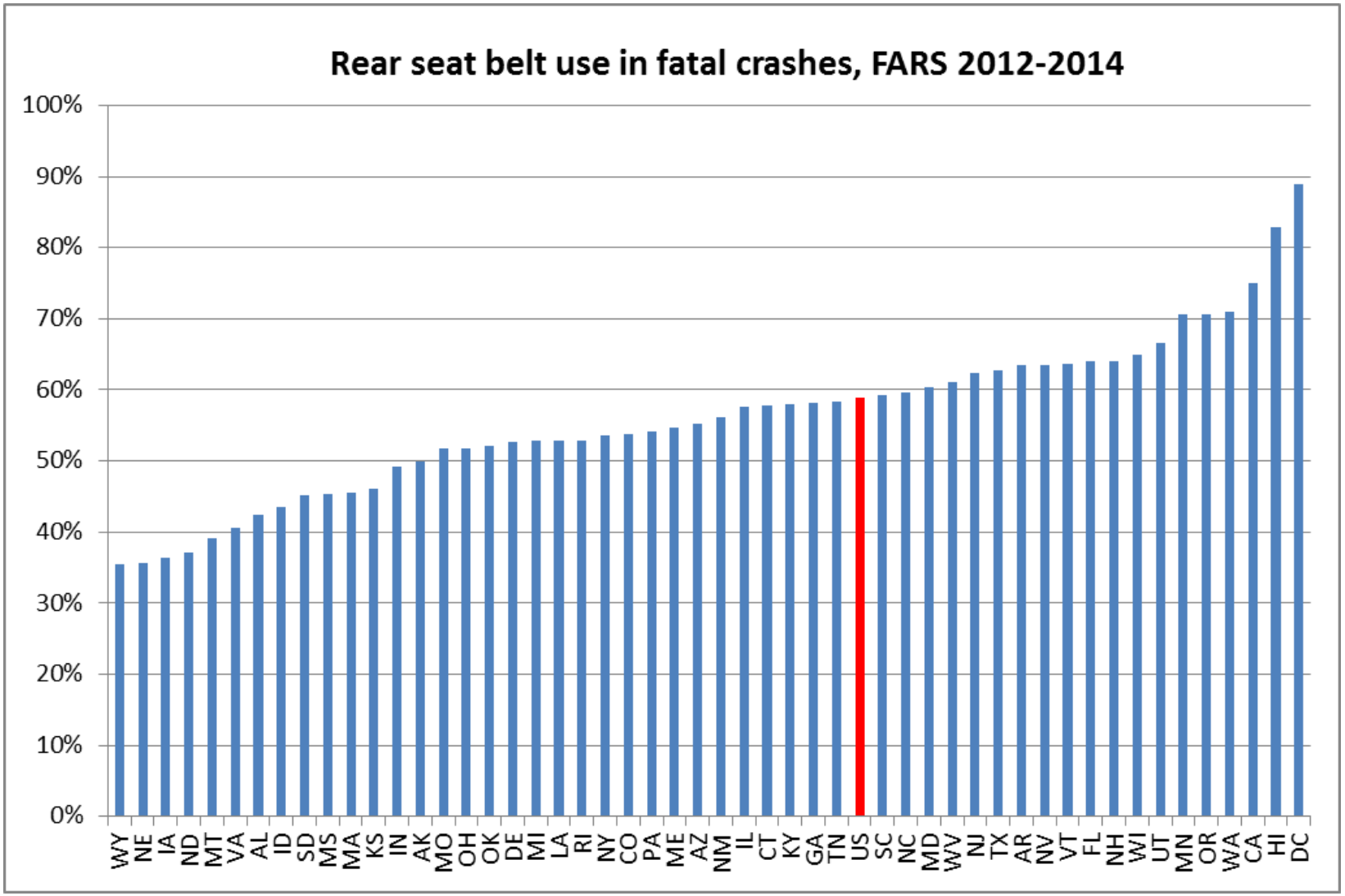
Adult seat belt use rates 2014



Passenger vehicle occupants age 8 and older

Porter Novelli survey “always use”

Adult rear seat belt use rates 2012-2014



Consequences of lower belt use

- 838 unbelted rear seat adult fatalities in 2014 (FARS)
- Rear seat belt effectiveness: 44% cars, 78% LTVs (NHTSA)
- If all 838 had been belted:
  about 414 would have survived
- If use rate had been 75% (the FARS front seat rate):
  about 155 would have survived

Reason: Laws

Adult Law	Front Seat	Rear Seat
Primary	35	19
Secondary	15	10
No law	1	22

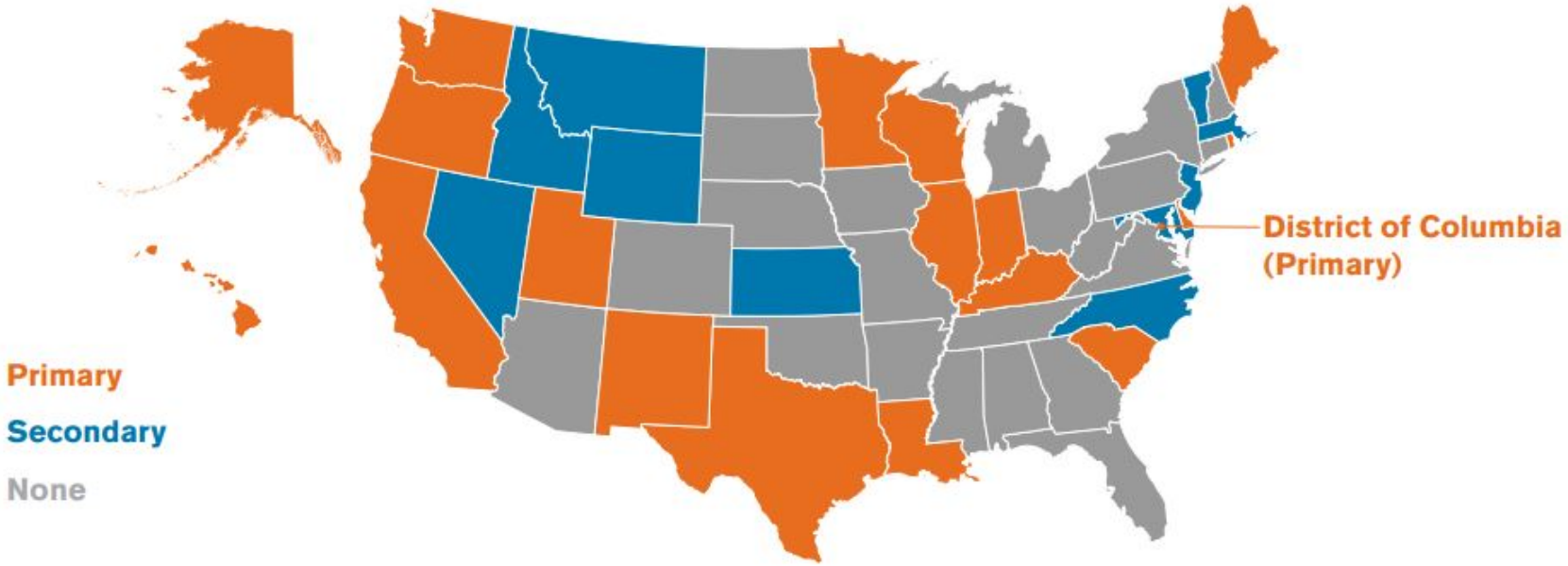
Primary: any unbelted occupant may be ticketed at any time

Secondary: unbelted occupants may be ticketed only if police stop the vehicle for another reason

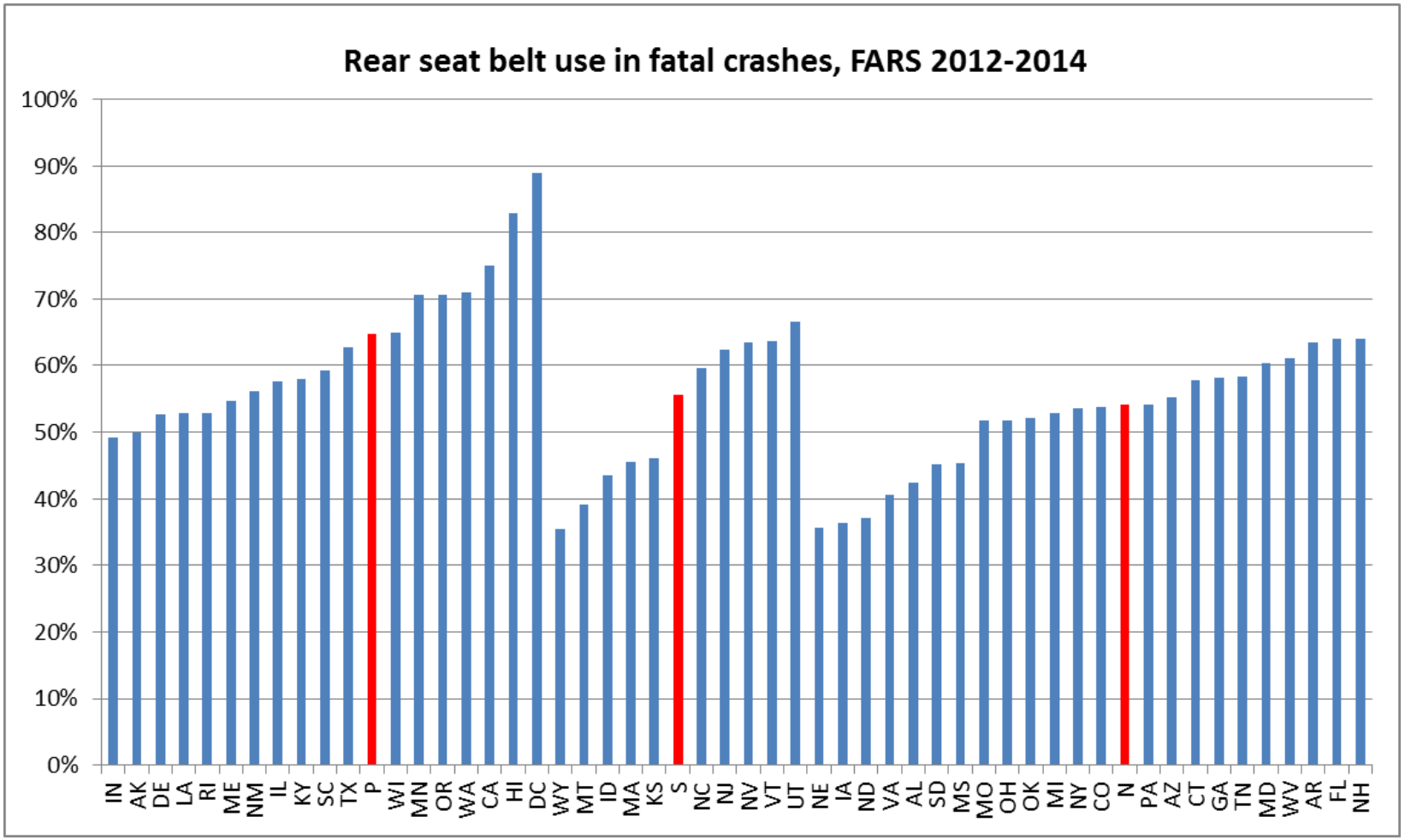
Last state to enact or upgrade a rear seat law: MD secondary law 2013

Laws

Figure 1. Rear seat belt use laws for adults, November 2015.



Belt use by law type: primary, secondary, none



Reason: Messaging and programs

- Most law states have “belt use required in all seats” messages

  But …

- No state or national campaigns explicitly target rear seat belt use by adults

Reason: Beliefs – “I’m safe in the back seat”

- True for older vehicles, but little difference in newer ones
- Perhaps due to “kids safer in back” campaigns

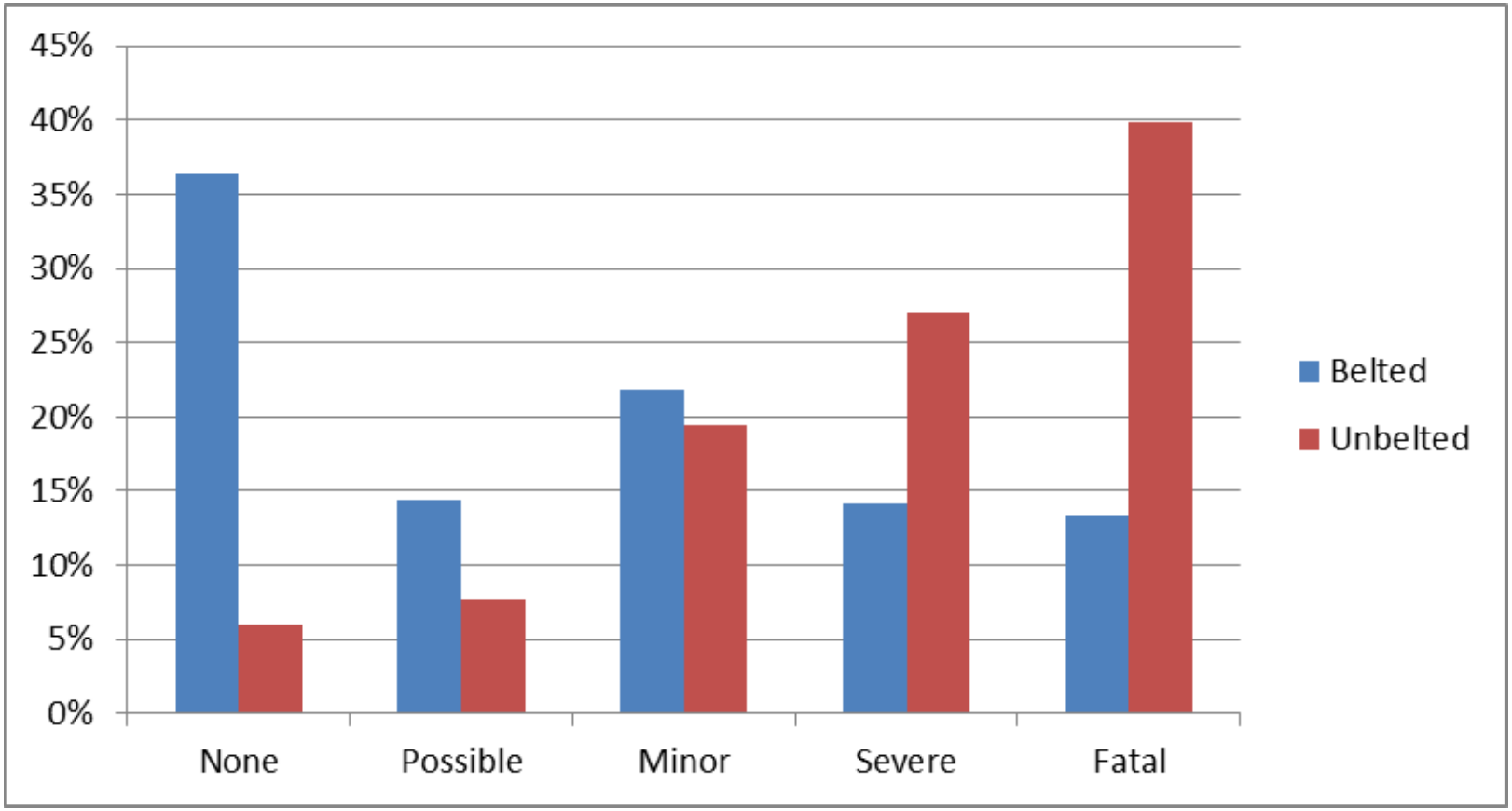
- The real message point: rear seat adults are 3 times more likely to die in a crash if they are unbelted (FARS)

Reason: Beliefs – “I’m safe in the back seat”

Injury	Belted	Unbelted
O - None	36.3 %	6.0 %
C - Possible	14.4 %	7.7 %
B – Minor	21.8 %	19.4 %
A - Serious	14.1 %	27.1 %
K - Fatal	13.3 %	39.8 %
	100 %	100 %

Rear seat passenger vehicle occupants age 8 and older in fatal crashes, 2014

Here's a picture



Rear seat passenger vehicle occupants age 8 and older in fatal crashes, 2014

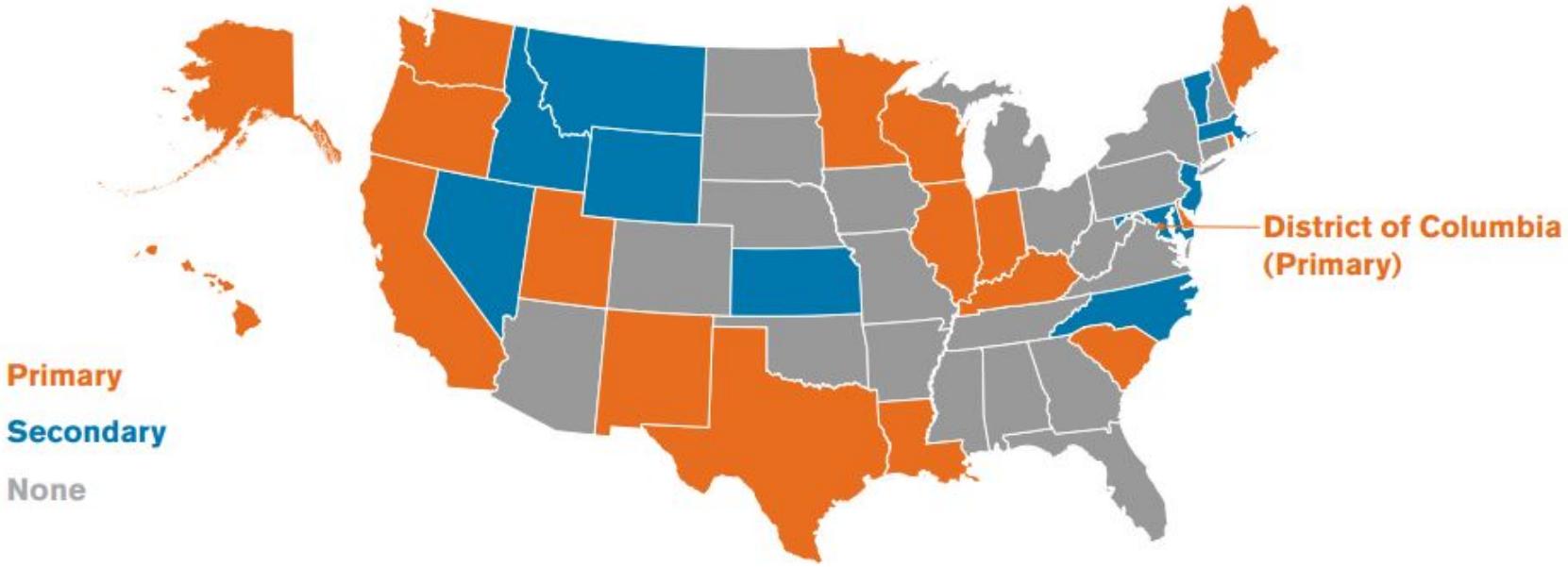
Taxis and limousines

- Some states exempt taxis and limos from rear belt laws
- Self-reported belt use in New York City taxis, 2012-13: 38%
- John Nash and Bob Simon fatalities– unbelted in rear seat
- Some NYC emergency rooms now have a term for the frequent injuries they see when unbelted rear seat passengers strike a taxi's partition:

  "partition face" (NY Times)

Solution #1: Laws

Figure 1. Rear seat belt use laws for adults, November 2015.



Solution #2: Enforcement

- Enforce rear seat belt laws with the same vigor as front seat laws

Solution #3: Education

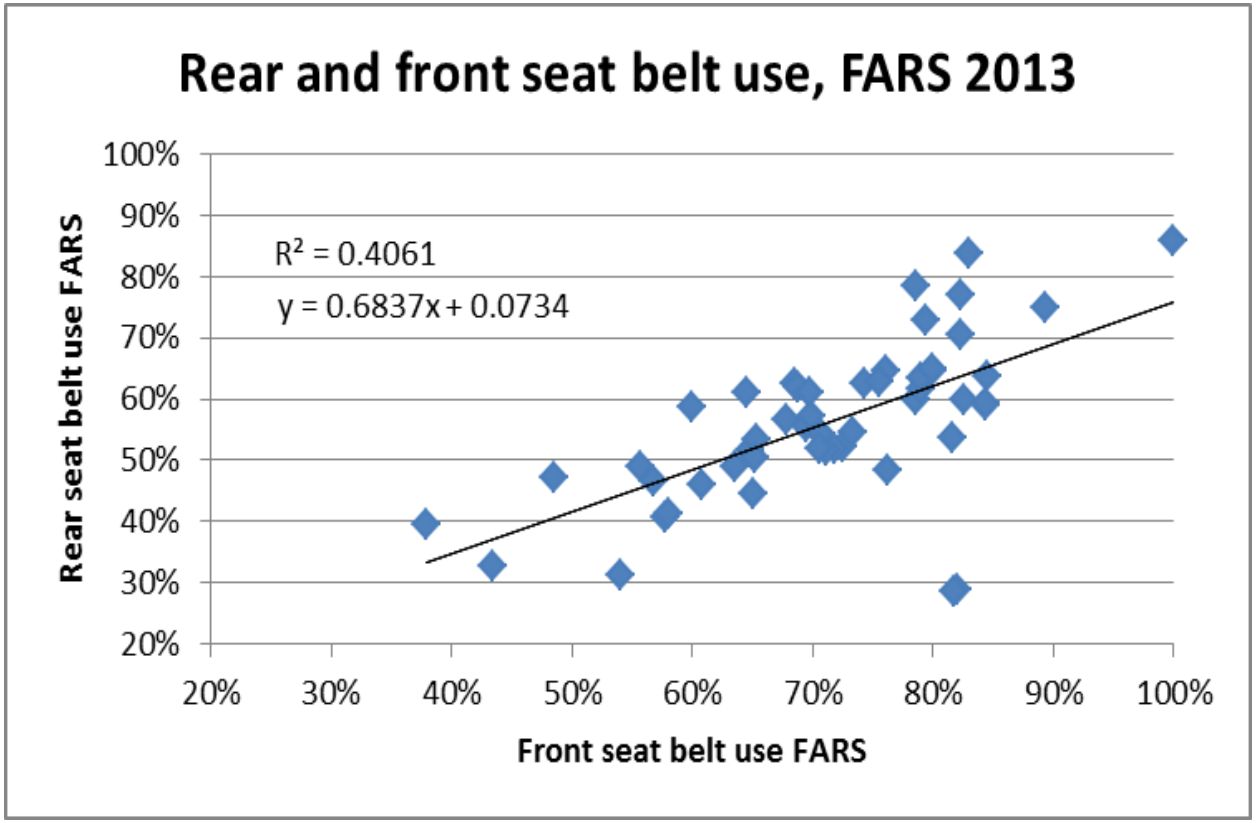
- Include rear seat positions in belt use education
- Consider campaigns directed to rear seat occupants

Solution #4: Taxis and limos

- Include taxis and limos in belt use laws, enforcement, and education

Solution #5: Front seat belt use

- Higher front seat use produces higher rear seat use



Conclusion

Increasing rear seat belt use is a quick, easy, and cheap way to save lives and reduce injuries

Questions and comments

Jim Hedlund

- Highway Safety North, Ithaca, NY
- jhedlund@sprynet.com

Factors Associated with Restraint Use in Rear-Seated Occupants

Joyce C. Pressley, PhD, MPH
Chang Liu, MPH

October 27, 2016

Columbia University
Departments of Epidemiology and Health Policy and Management

Data Sources

Restraint Status and Outcomes

- FARS
  - Census of all fatal crashes
- NASS/GES
  - Sample fatal and nonfatal crashes
- NY State CODES
  - 2010-2013

Primary and secondary rear seat law enforcement

- GHSA
- IIHS
- Supplementation where needed from individual state highway departments

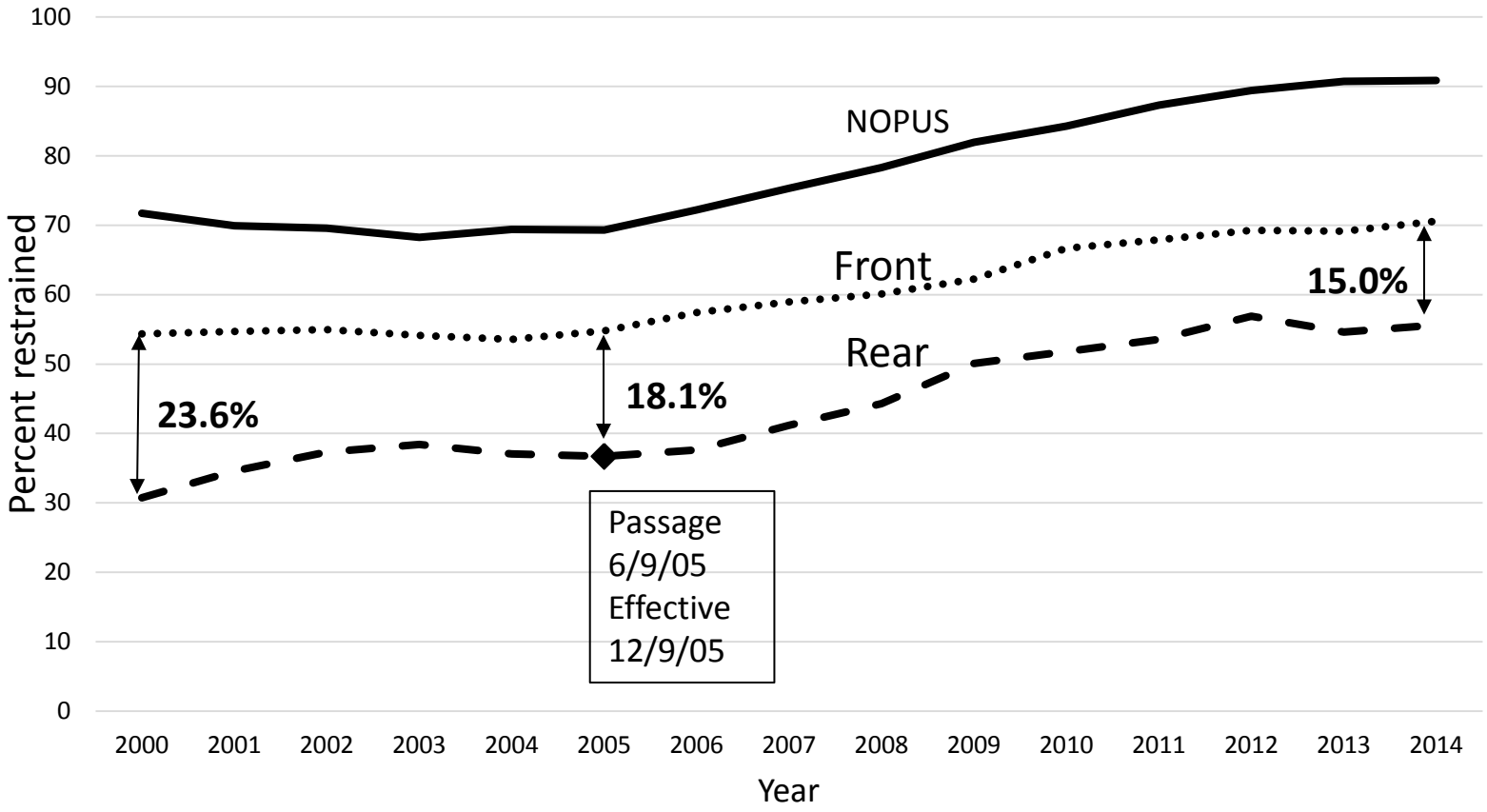
Statistics

- Logistic regression
- Adjusted for violations of assumptions of independence for multiple passengers in same vehicle
  - Multivariable, multilevel models use Glimmix

Law Transitions Examined for Rear Seated Adults in Ten States

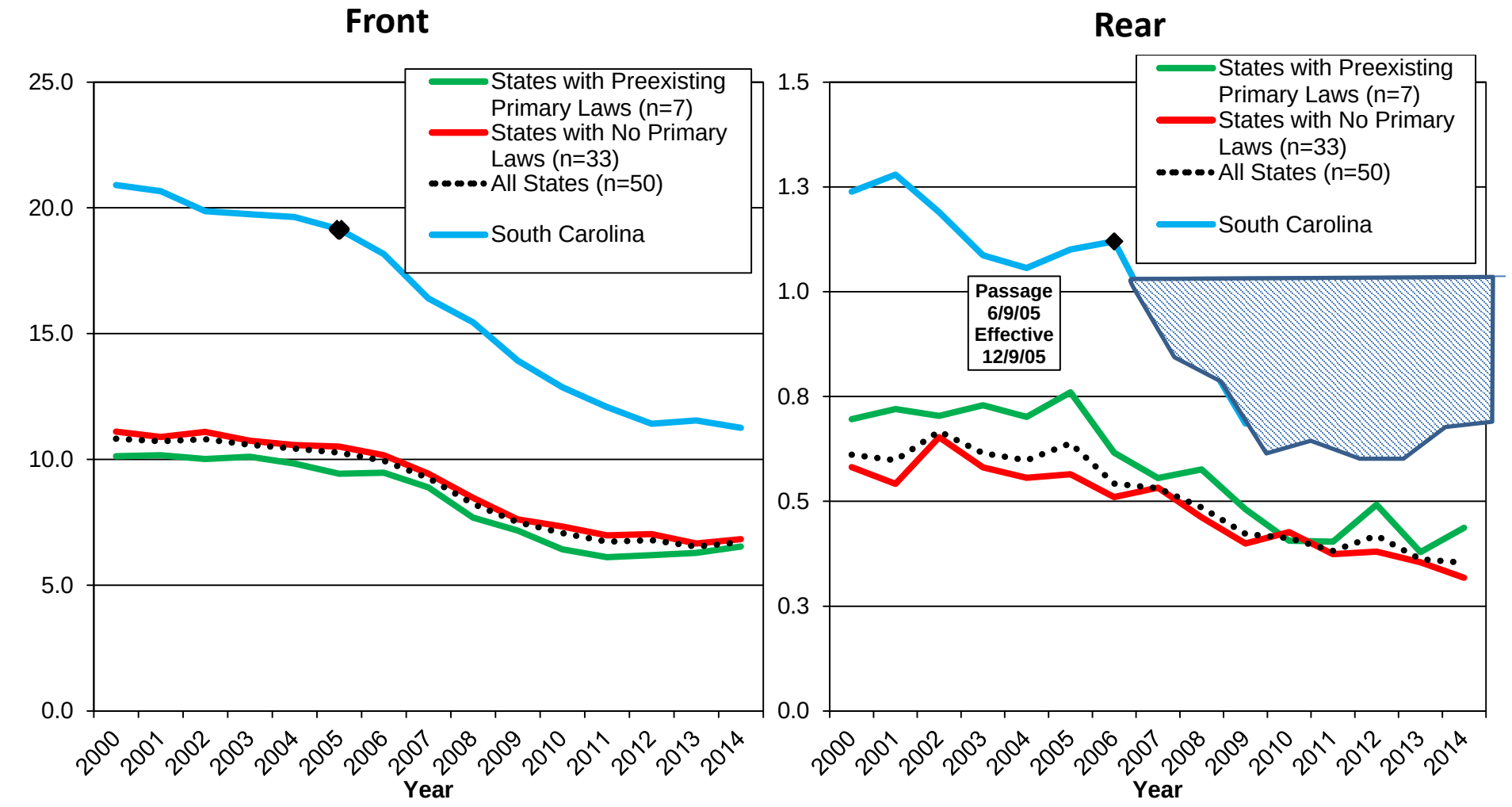
- The Fatality Analysis Reporting System (2000-2013) (FARS) was used to examine motor vehicle occupant crash data in adults aged 18 and older for 10 states:
  - Alaska
  - Delaware
  - Illinois
  - Kentucky
  - Maine
  - Minnesota
  - Rhode Island
  - South Carolina*
  - Washington
  - Wisconsin*
- Passage of a primary law is not always temporarily associated with the expected declines in mortality
- Two example states are shown for illustrative purposes

South Carolina: Trends in Front and Rear Seat **Restraint** Use with the Front to Rear Belt Use Gap

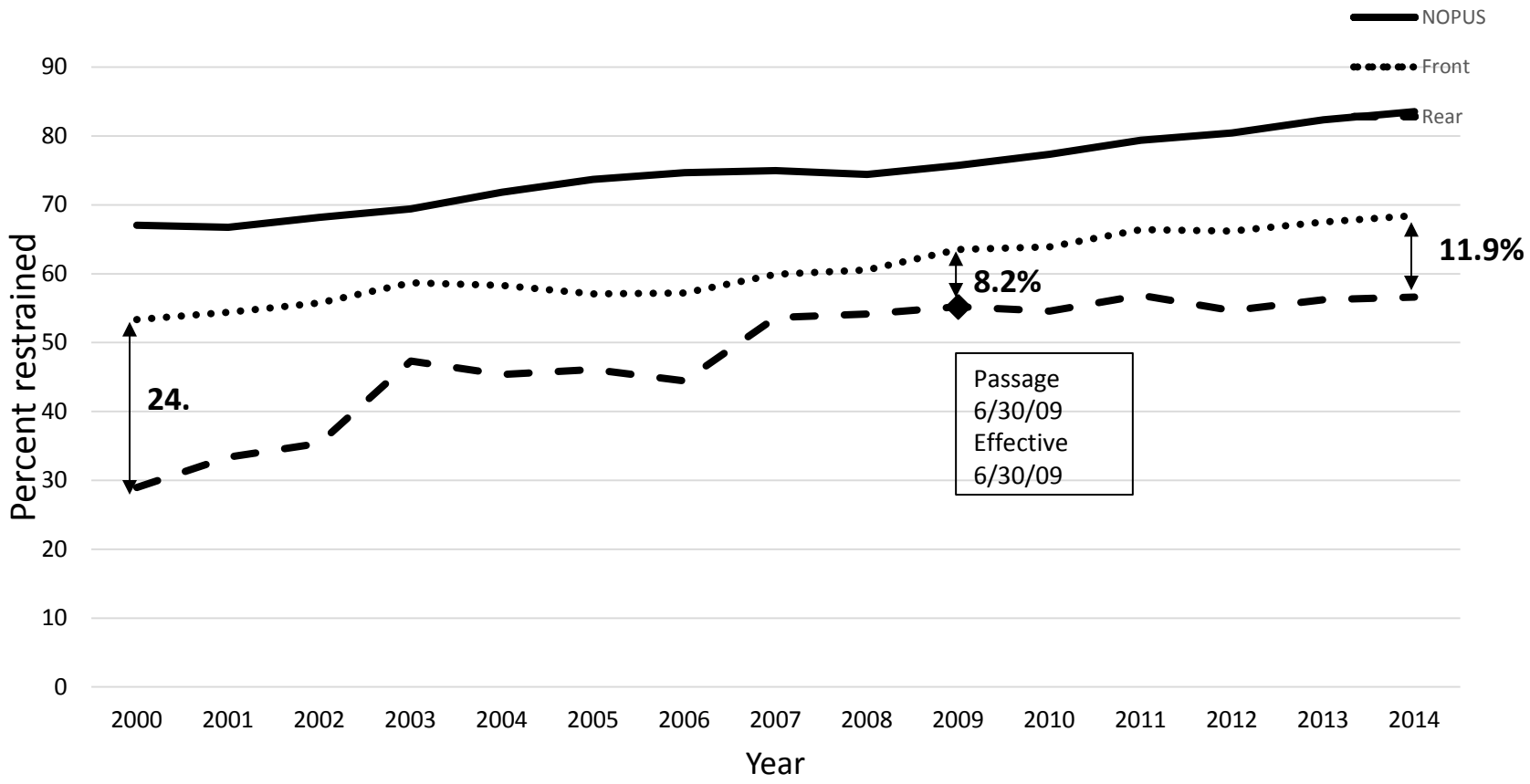


[1] Front and rear belt use is from FARS

South Carolina: Front Seat and Rear Seat **Mortality Rates** (per 100,000) Before and After Passage of a Primary Rear Seat Law

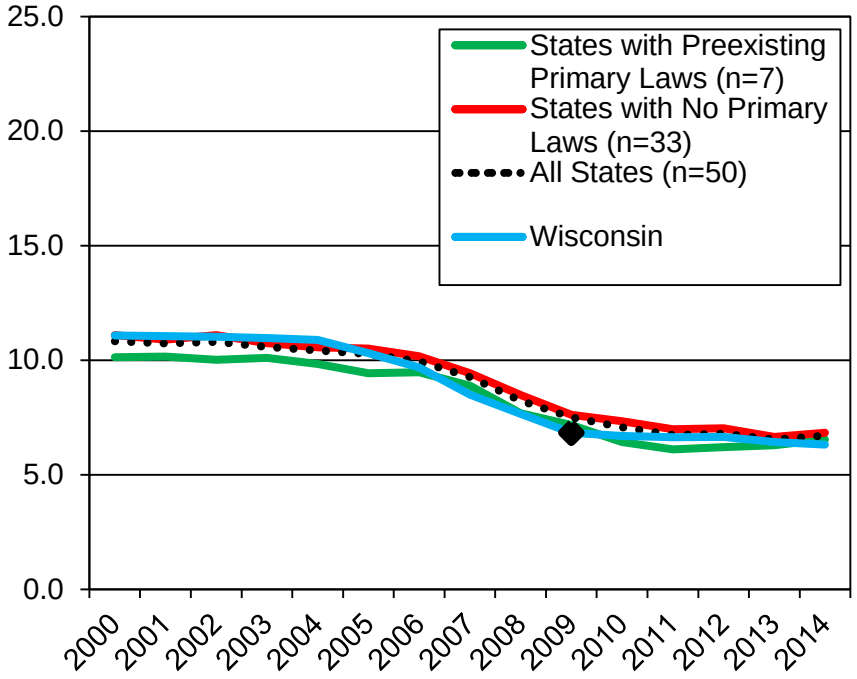


Wisconsin: Trends in Front and Rear Seat Restraint Use with the Front to Rear Belt Use Gap (FARS)

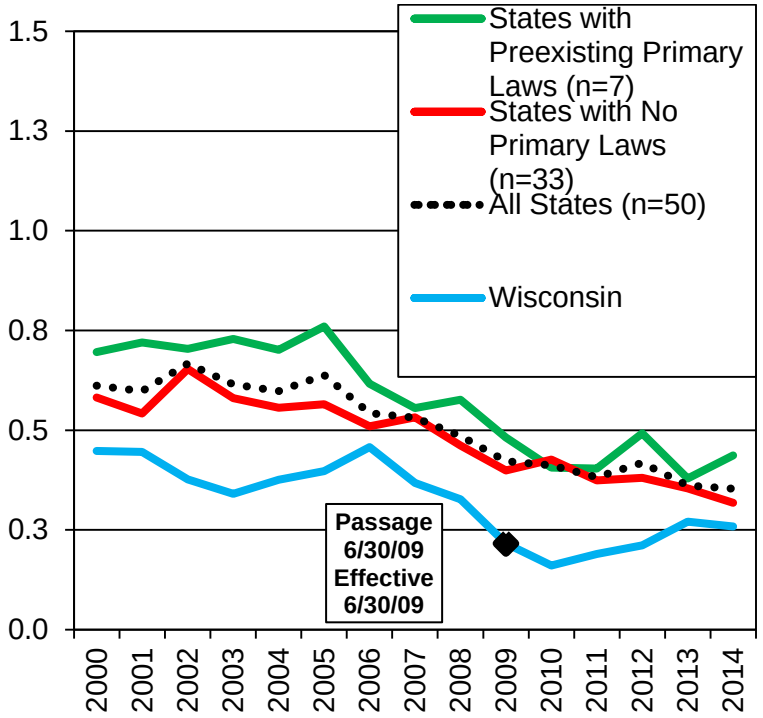


Wisconsin: Front Seat and Rear Seat Mortality Rates

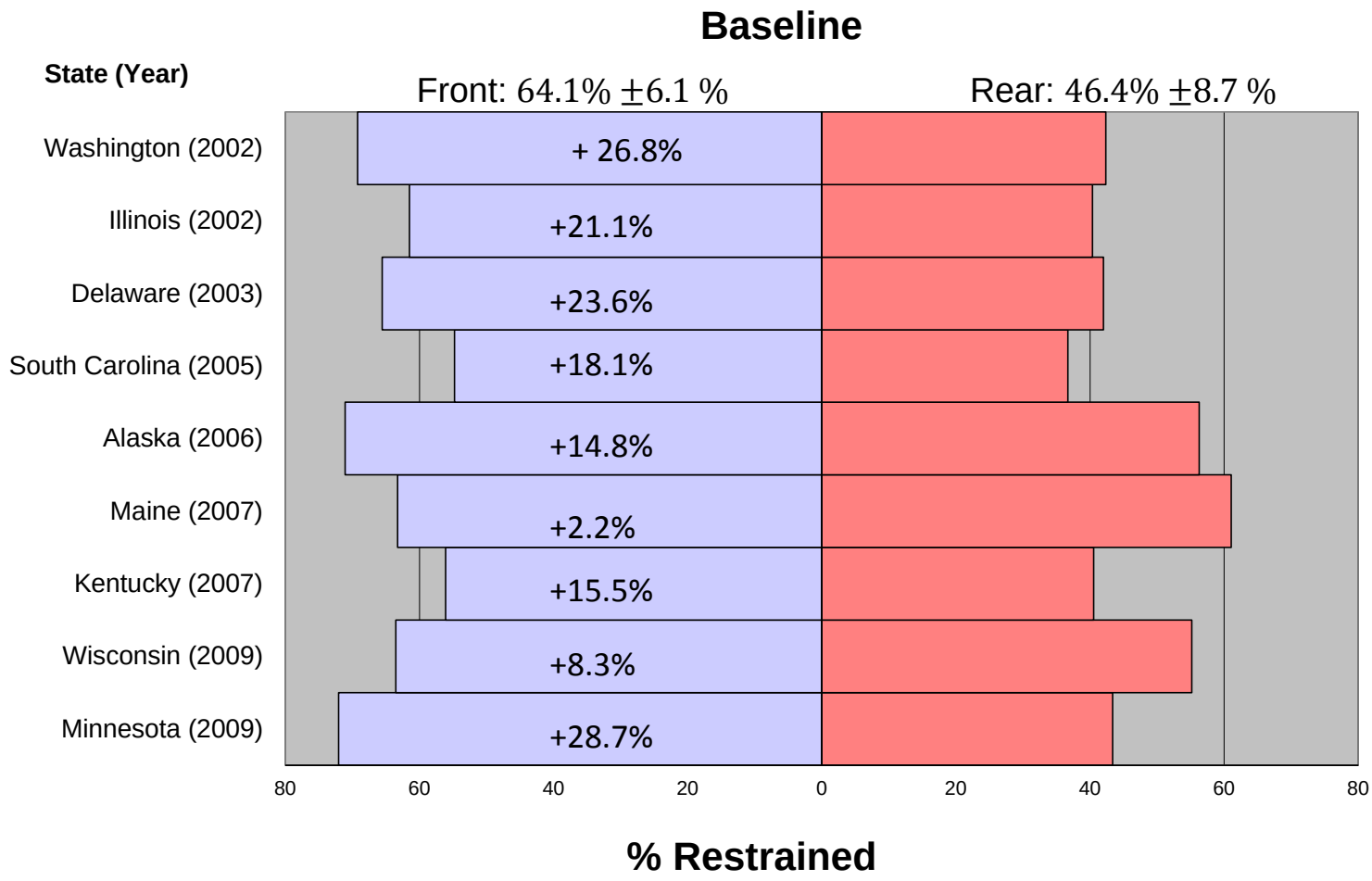
Front seat fatalities per 100,000



Rear seat fatalities per 100,000



Percent Higher Front Seat Belt Use than Rear Seatbelt Use at The Time of Passage of Primary Rear Seat Belt Law-- FARS Data on Fatal Crashes



*Preexisting states: California, Hawaii, Indiana, Louisiana, New Mexico, Oregon, Texas

**No law: 33 states had no primary rear seat law covering adults

***Rhode Island is not shown due to small numbers of death each year

Rear Seatbelt Use and the Rear-Front Seat Belt Gap in States Transitioning to a Primary Rear Belt Law (FARS)

State (Effective Year)	Baseline	
	Rear (% Belted)	Rear-Front Gap (%)
Preexisting Law*	-	-
Alaska (2006)	56.3	-14.8
Delaware (2003)	42.0	-23.6
Illinois (2002)	40.4	-21.1
Kentucky (2007)	40.6	-15.5
Maine (2007)	61.1 Highest	-2.2
Minnesota (2009)	43.4	-28.7
South Carolina (2005)	36.7 Lowest	-18.1
Washington (2002)	42.4	-26.9
Wisconsin (2009)	55.2	-8.3
No Law**	-	-

*Preexisting states: California, Hawaii, Indiana, Louisiana, New Mexico, Oregon, Texas

**No law: 33 states have no primary rear seat law covering adults ***Rhode Island is not shown due to small numbers

Rear Seatbelt Use and the Rear-Front Seat Belt Gap in States Transitioning to a Primary Rear Belt Law (FARS)

State (Effective Year)	Current (2014)		% Difference in Restraint Use Post Law
	Rear (% Belted)	% Rear Lags Front Belt Use	
Preexisting Law*	52.7	-23.5	-
Alaska (2006)	55.0	-19.5 W	-1.3
Delaware (2003)	53.8	-23.6 S	11.8
Illinois (2002)	48.7	-24.4 W	8.3
Kentucky (2007)	51.7	-10.3 N	11.1
Maine (2007)	57.3	-10.8 W	-3.8
Minnesota (2009)	67.8	-12.3 N	24.4
South Carolina (2005)	55.6	-15.0 N	18.9
Washington (2002)	65.6	-16.0 N	23.2
Wisconsin (2009)	56.6	-11.9 W	1.4
No Law**	39.5	-24.6	-

*Preexisting states: California, Hawaii, Indiana, Louisiana, New Mexico, Oregon, Texas

**No law: 33 states have no primary rear seat law covering adults ***Rhode Island is not shown due to small numbers

Multi-level Models by Primary and Secondary Rear Seat Law Coverage Compared to No law (FARS)

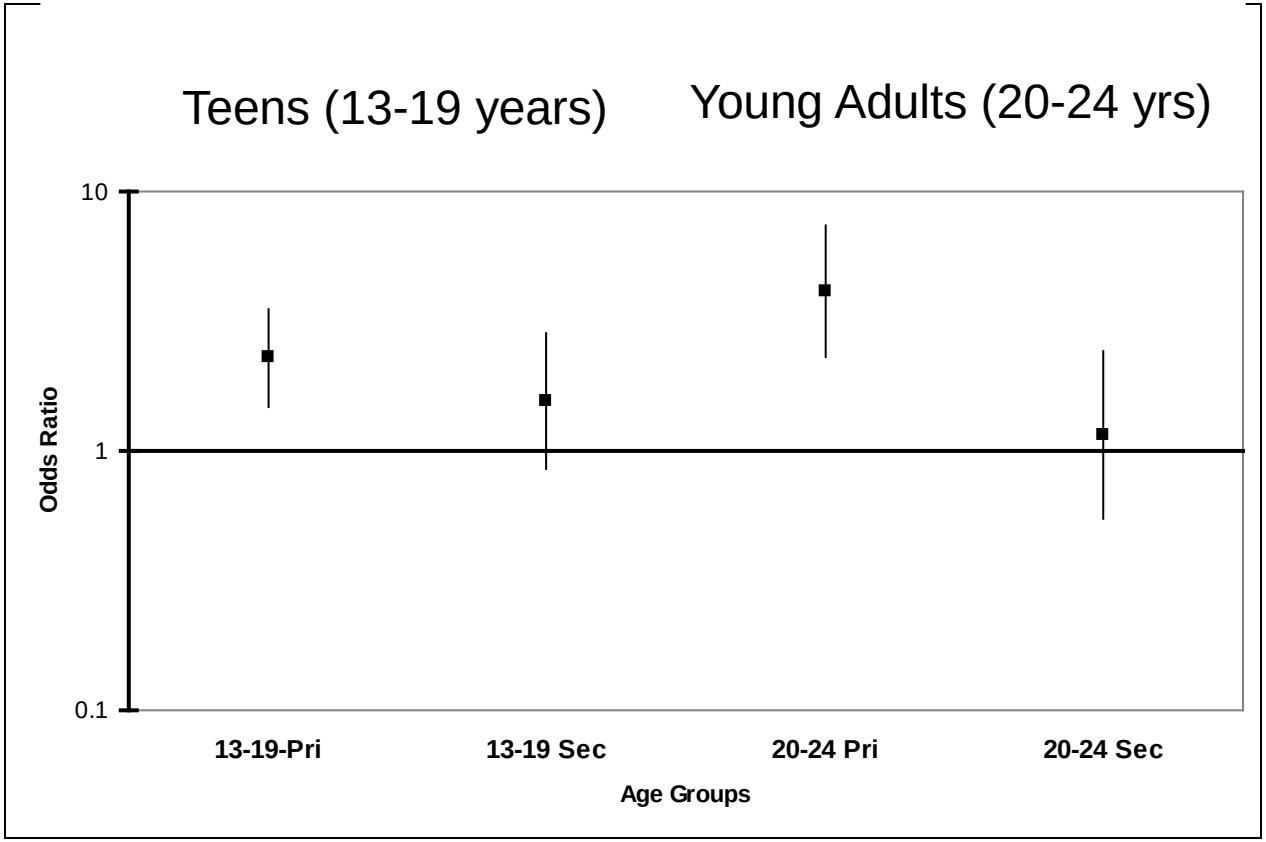
Despite the state by state variability just observed--

In multivariable[1], multi-level models across the age span, coverage by a **primary rear-seat restraint law was associated with an increased odds of being restrained**:

- Primary (2.29, 1.48-3.54)
- But not secondary law coverage (1.59, 0.85-2.86)
  - Secondary laws were limited by small sample size

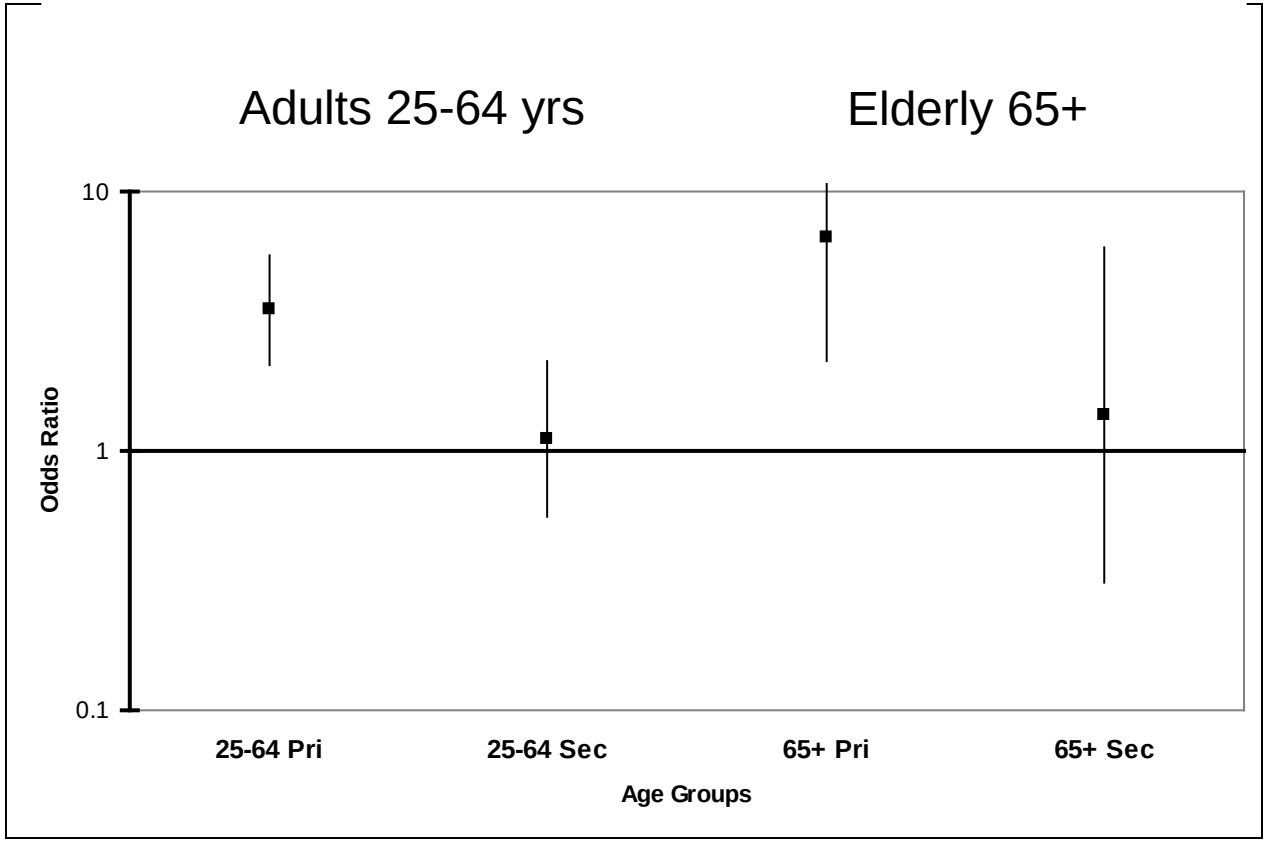
[1] controlled for passenger age and gender; driver age, gender, driver restraint status, impairment and crash time of day

Multilevel Models[1] for Teen (13-19) and Young Adult (20-24) Rearseat Seatbelt Use by Primary and Secondary Law Coverage (FARS)



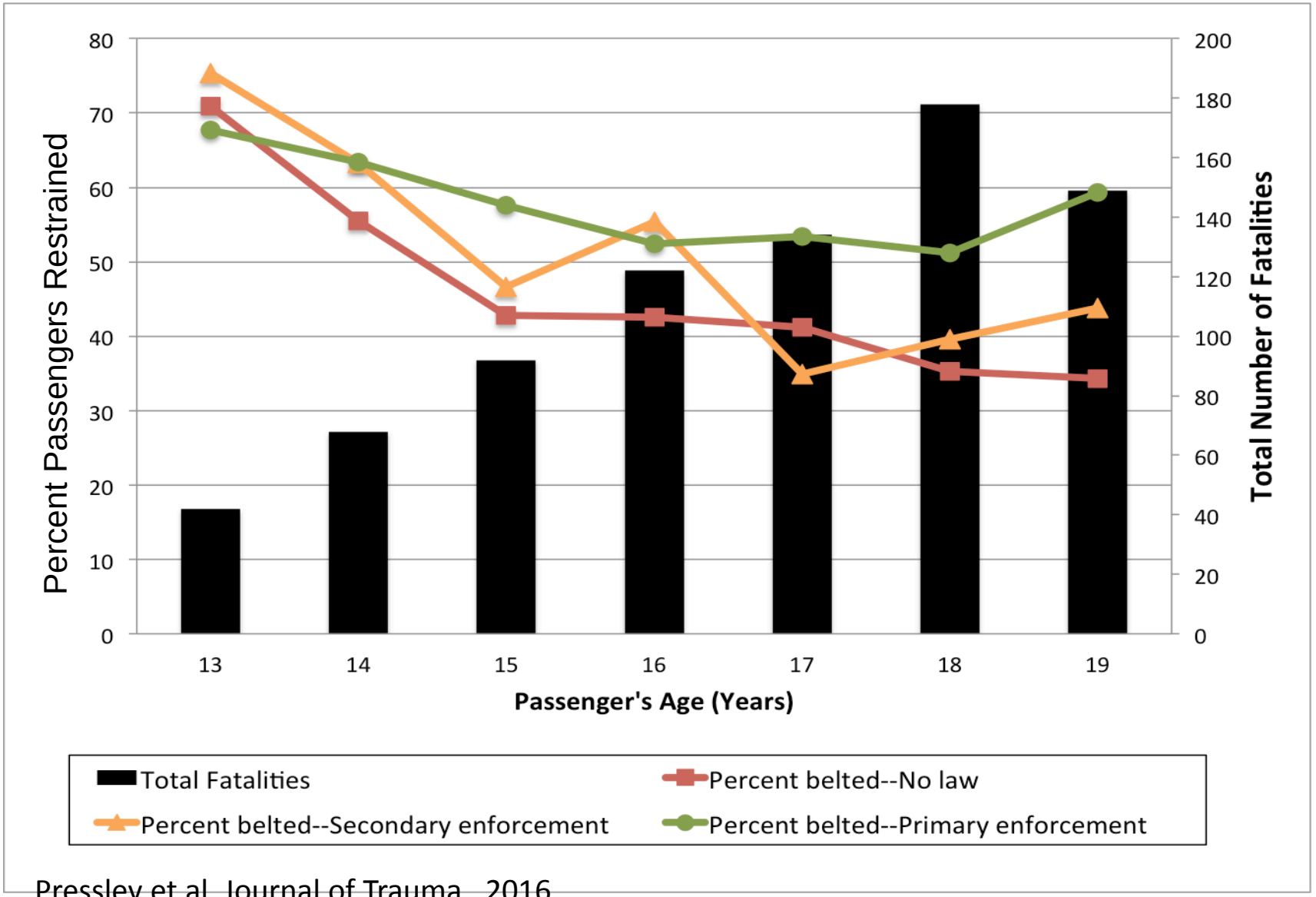
1 Controlling for age and gender of passenger, driver age, driver gender, belt status, driver impairment and crash time of day

Multilevel Models[1] for Adult (25-64) and Elderly (65 and older) Rear Seat Seatbelt Use by Primary and Secondary Law Coverage (FARS)



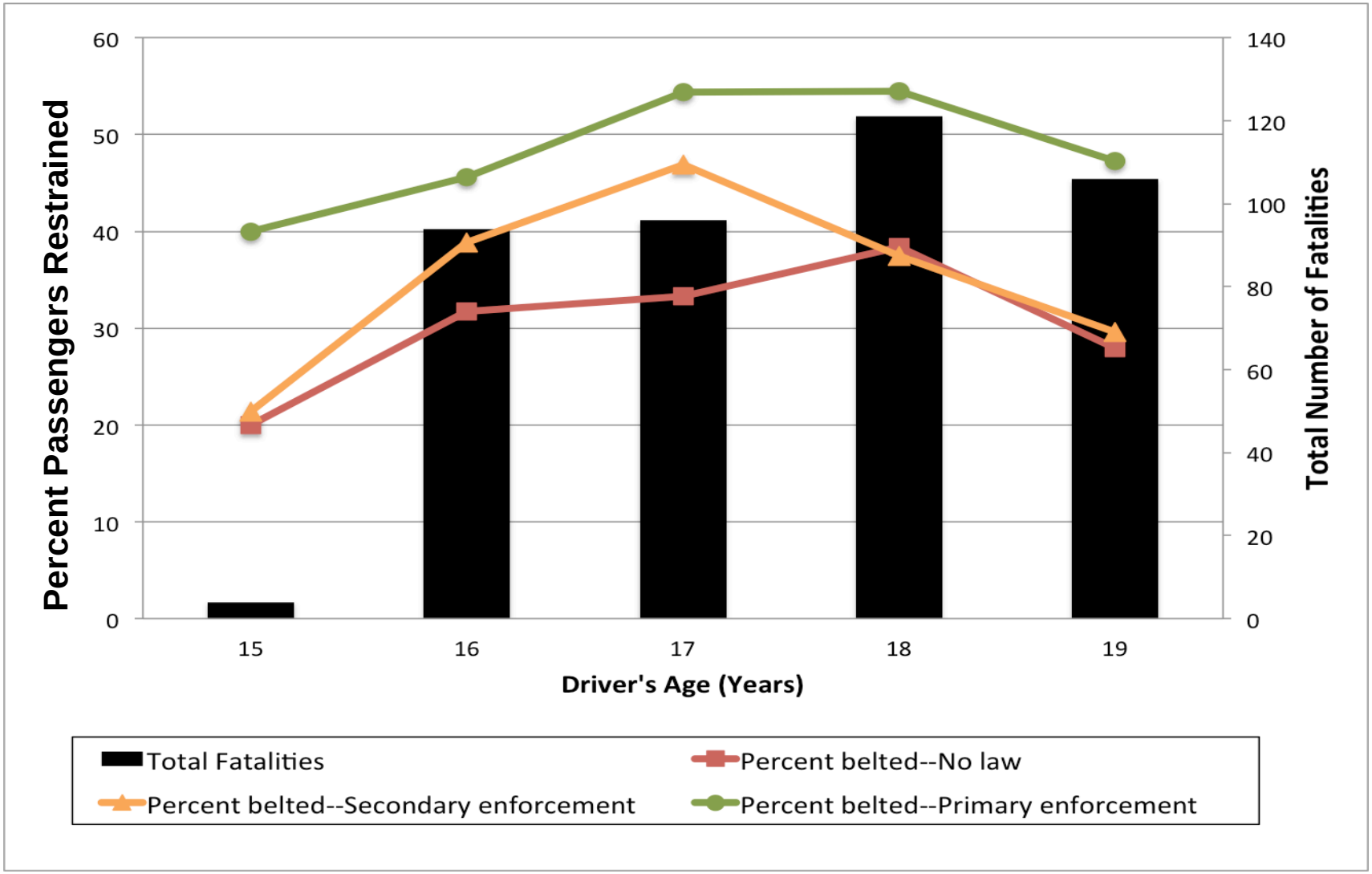
1 Controlling for age and gender of passenger, driver age and gender, driver restraint status, impairment and crash time of day

Percent of Rear-Seated Passengers Belted for Primary, Secondary, and No Rear Seat Law Coverage by Passenger Age (FARS 2010-2011)



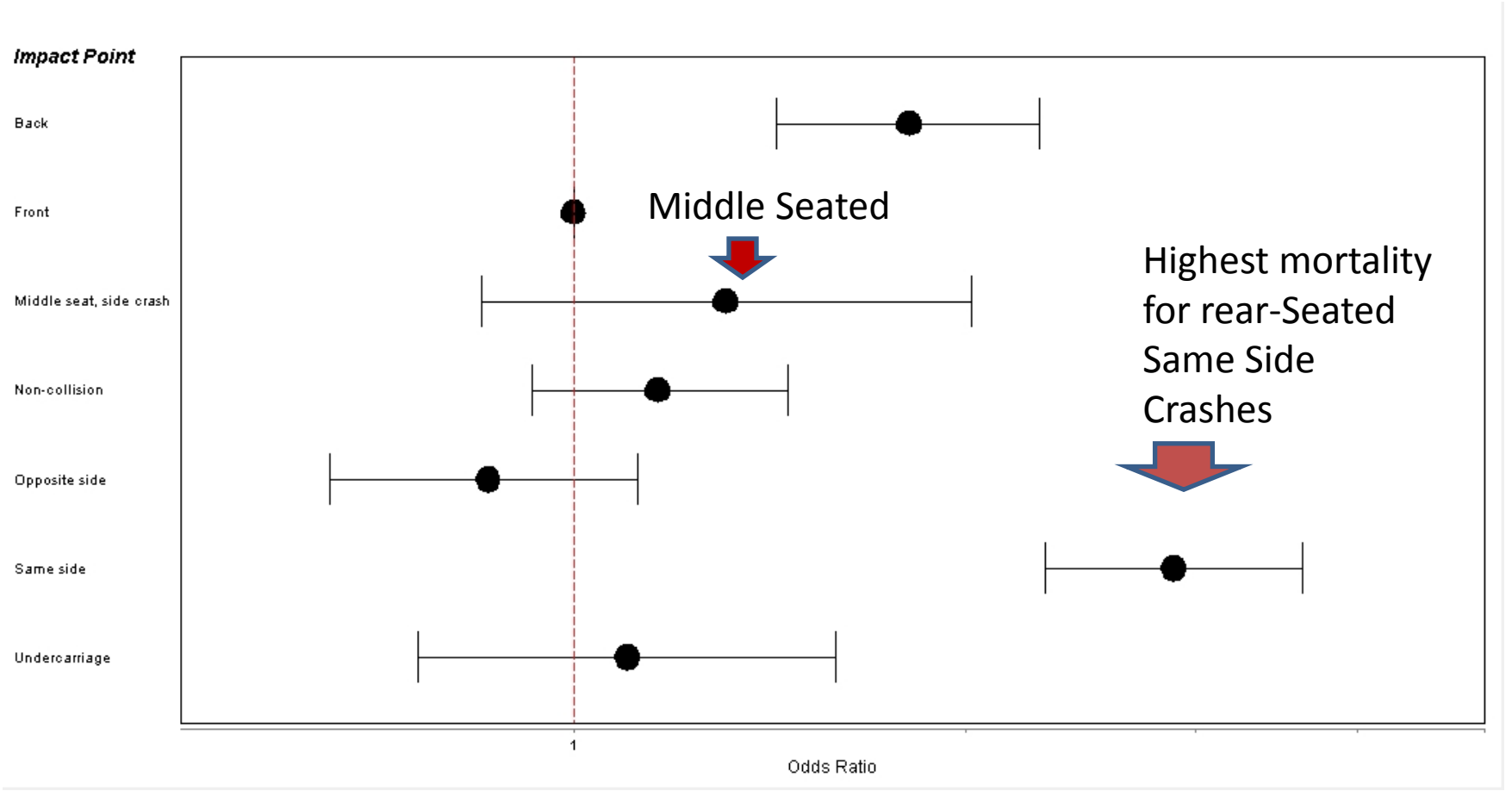
Pressley et al. Journal of Trauma, 2016

Percent of Rear-Seated Passengers Belted for Primary, Secondary, and No Rear Seat Law Coverage by Passenger Age (FARS 2010-2011)



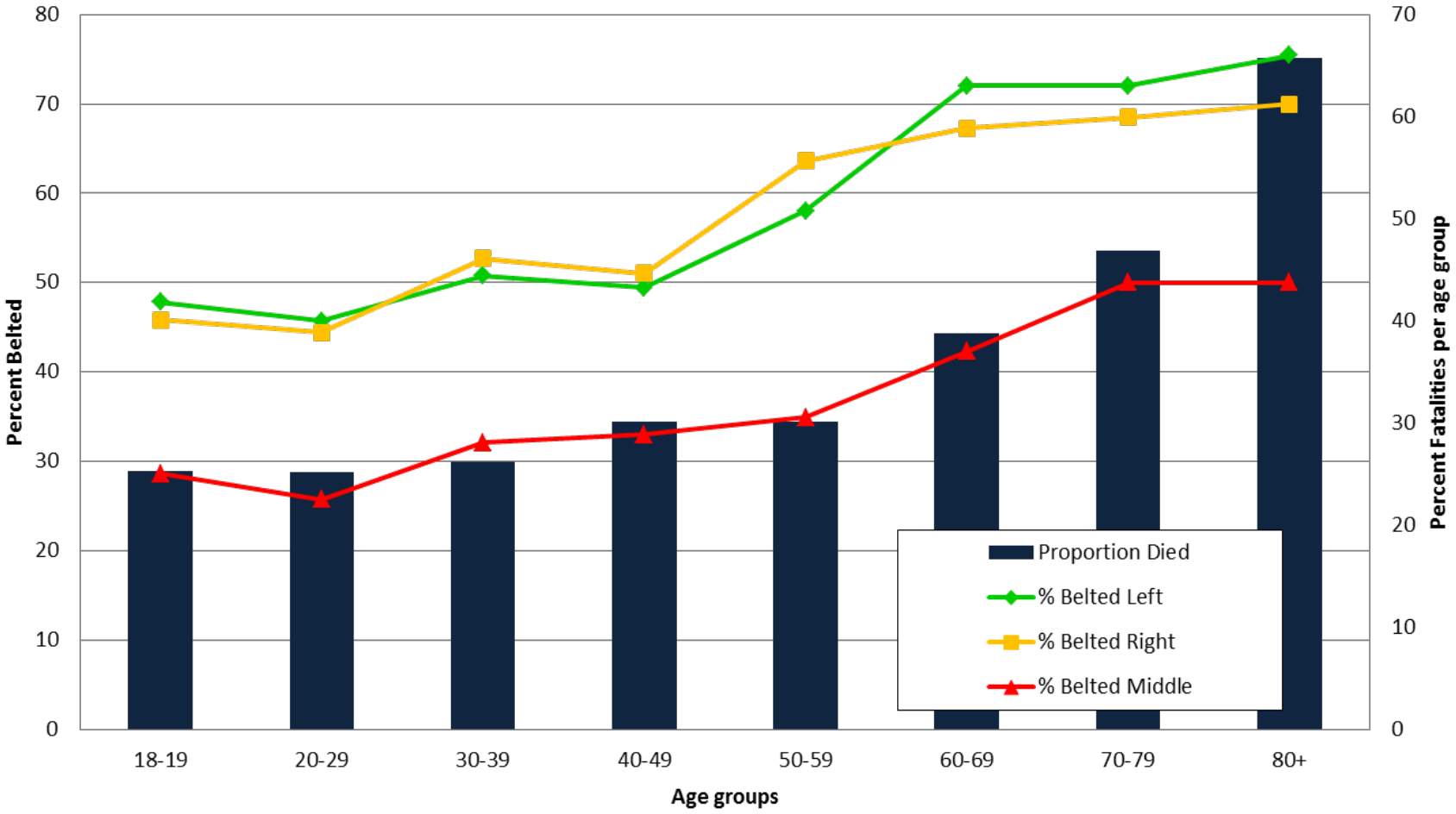
Pressley et al. Journal of Trauma, 2016

Same Side Impact Point is Associated with the Highest Adjusted Odds Ratio of Mortality for Rear Seated (FARS)

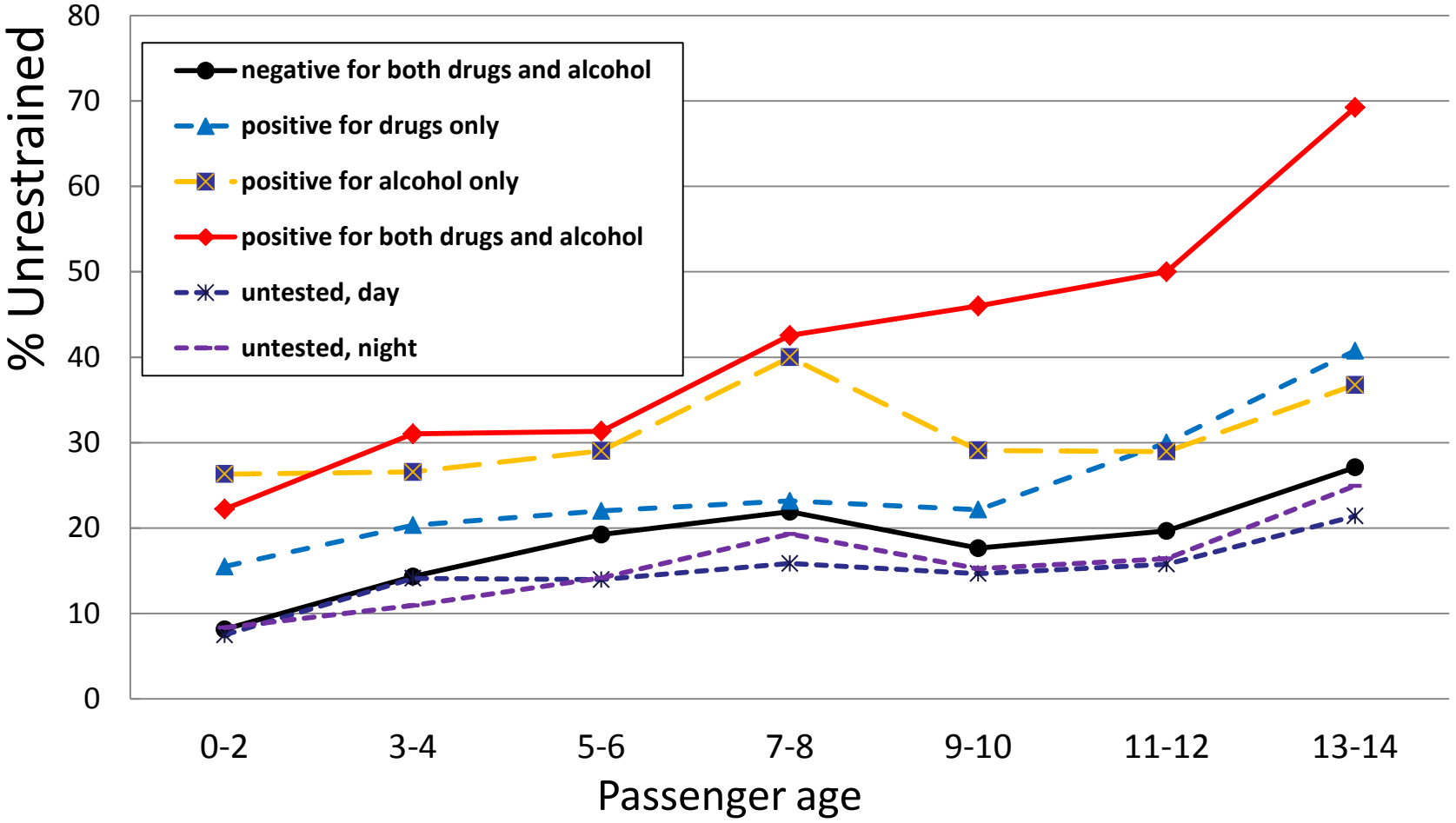


Raneses and Pressley , Injury Epidemiology 2015

Disparities in Belt Wearing by Seating Position (FARS 2010-2013)



Percent Child Passengers Unrestrained by Passenger Age and Driver Drug and Alcohol Status (FARS)



Huang, Liu and Pressley, Pediatrics 2016

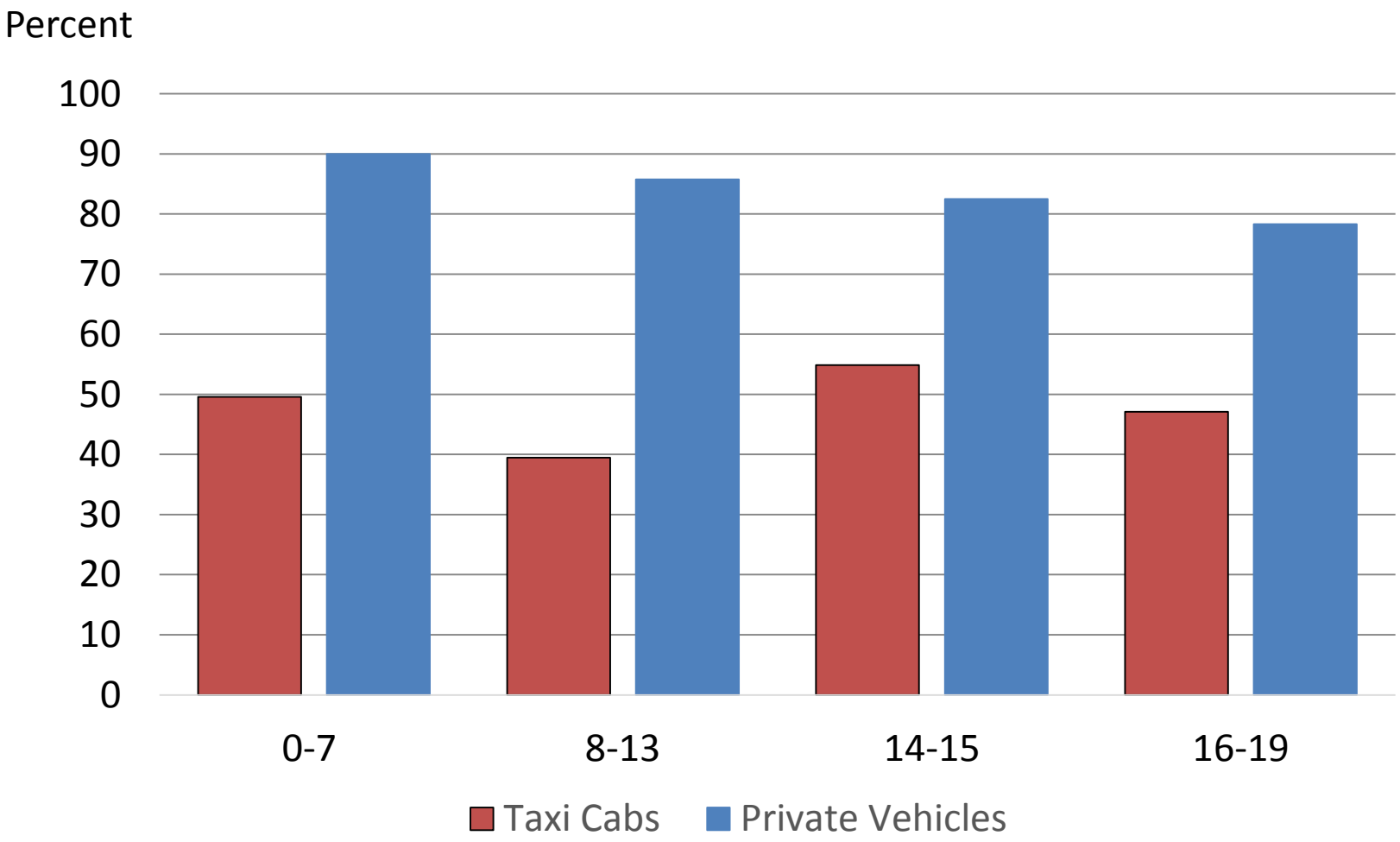
Linked NYC DMV Crash and Hospital Admissions (CODES Data) for Pediatric Passengers in Private (n=23,615) vs Taxi's (n=1,631)

In DMV crash data linked to hospital records:

- Belt use was higher in privately-owned compared to taxi's
- In taxi cabs, fewer than 6% of children younger than 8 years old were restrained in a infant, child or seat
- For the total population, rear-seated unrestrained passengers were 1.7 times more likely to be injured
- Passengers in taxis were 1.8 times more likely to be injured compared to those in private vehicles
- Passengers in taxi cabs were more than twice as likely to have facial and /or traumatic brain injury

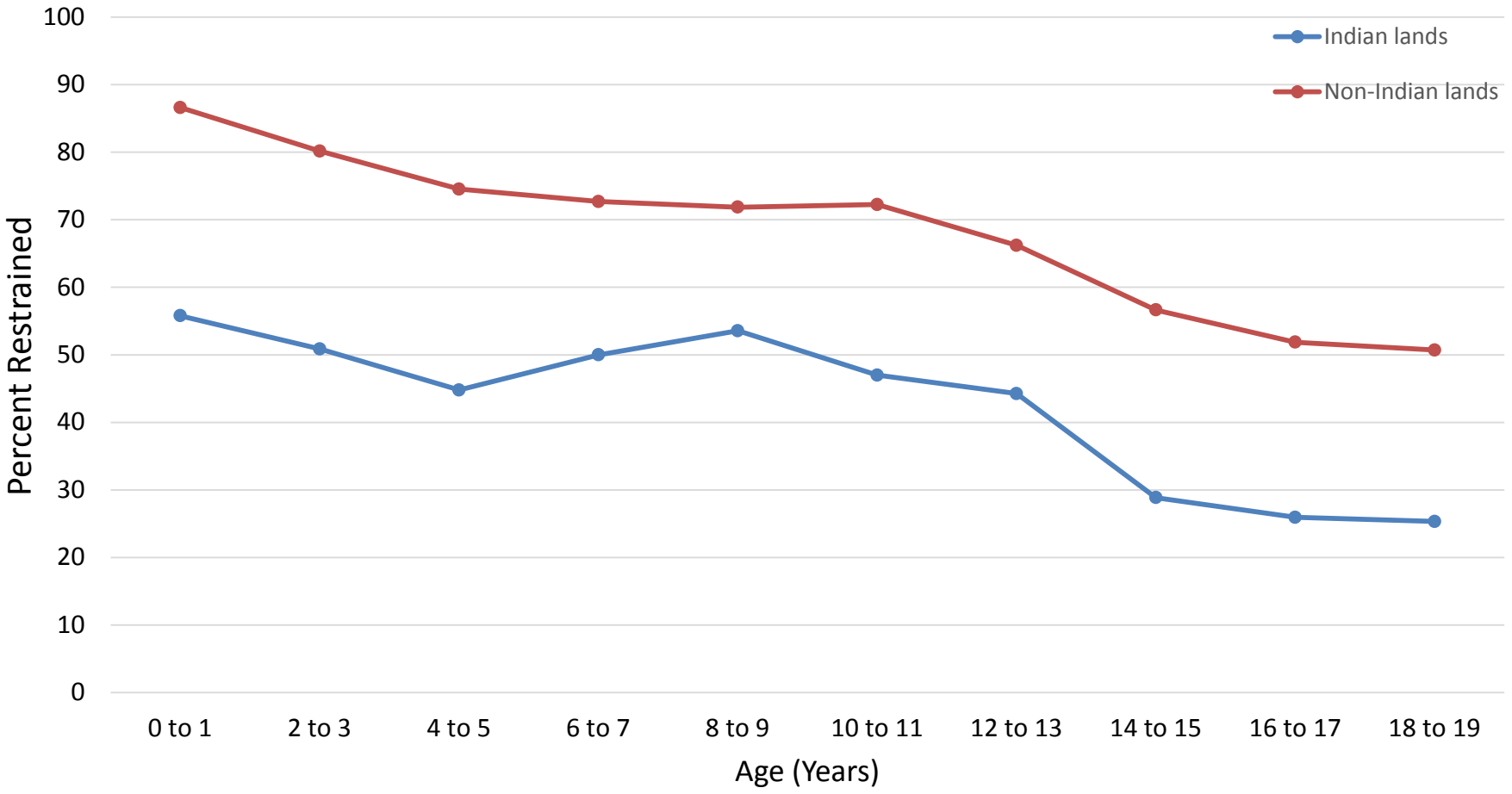
Prince, Hines, Bauer, Liu and Pressley, 2016

Percentage of NYC Rear Seated Pediatric Passengers Using a Seatbelt or in a Child Restraint System by Age Category
Private Passenger Vehicles vs. Taxi Cabs, NYS CODES 2011-2013

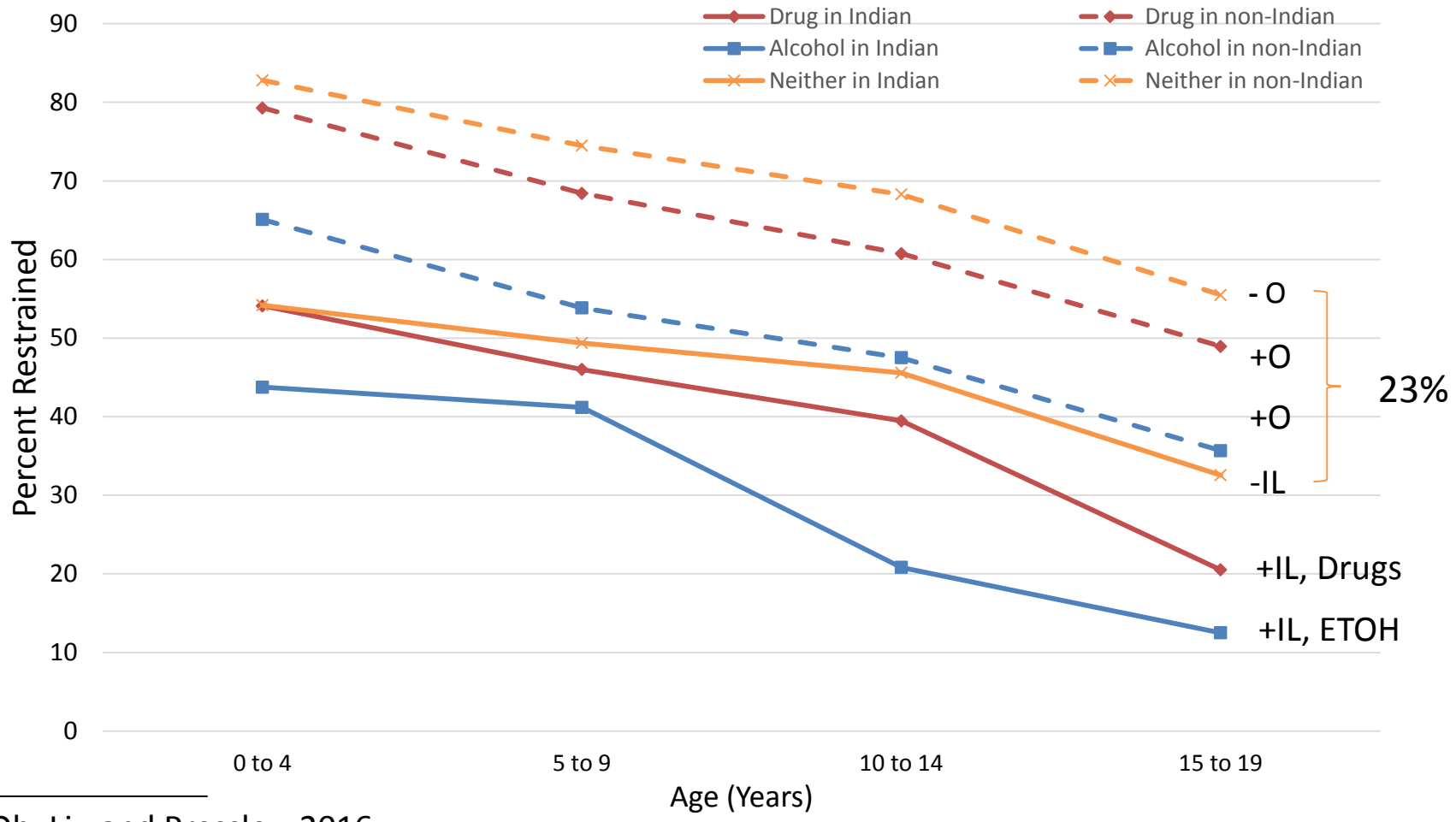


Prince, Hines, Bauer, Liu and Pressley, 2016

Restraint use in pediatric population in federally designated Indian lands vs. Non-Indian lands, FARS 2000-2014

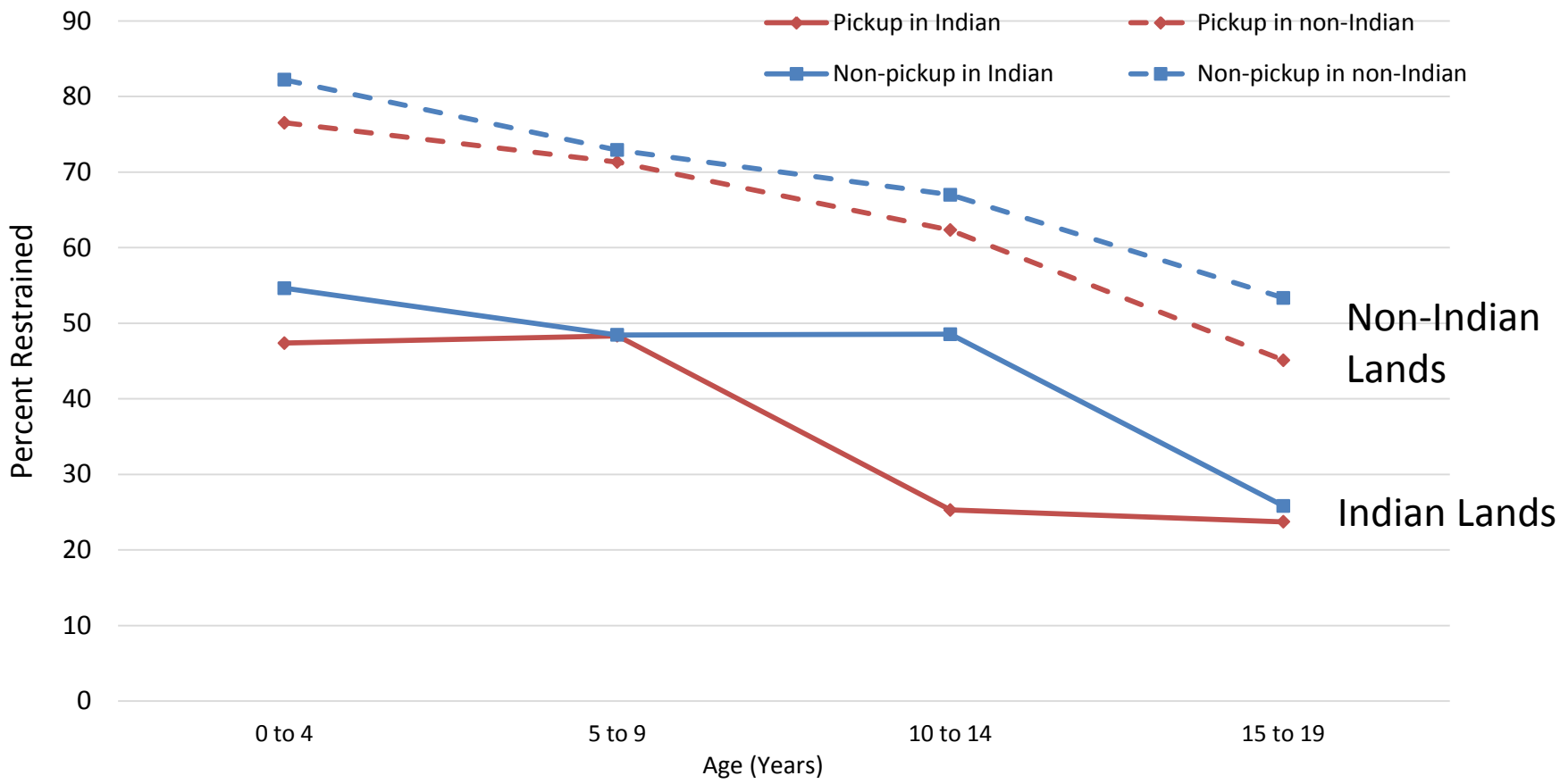


Driver Drug and Alcohol Status by Pediatric Passenger Restraint Status -- Fatal Collisions on Federal Designated Indian lands Compared to Adjacent State FARS 2000-2014



Oh, Liu and Pressley, 2016

Differences are not Explained by Pickup Trucks on Indian Lands



Oh, Liu and Pressley, 2016

Conclusions

Primary laws are associated with higher belt status use

- Having a primary vs. no law or a secondary law is associated with higher belt wearing across all teen, young adult, adults including elderly adult age groups examined
  - However, temporal trends in rear seat restraint use and outcomes vary across states transitioning to a primary law
  - At the individual state level, passage of a primary rear seat belt law was not always sufficient to produce increased belt wearing and lower population level mortality
  - GDL produces increased rear seat belt wearing, but this change is not sustained
- Special geographic jurisdictions (IL) have low rear seat belt use, placing their populations at increased risk
- Drug use, including cannabis, in drivers of pediatric populations is associated with increased child endangerment
- Strong association with driver belt status and rear seat restraint use may represent an opportunity for enforcement

Future Directions: Emerging Issues With Rear Seat Safety Implications

- There are several emerging social and legal changes that have potential to impact road safety including rear seat safety
- These changes are outpacing our surveillance systems– our current data collection efforts do not allow for tracking these rapidly growing trends
- Standards need to encourage and guide our state level DMVs on data changes needed to track these “here to stay” trends
- Examples of issues associated with the rapid growth of ride sharing and electronically hailed vehicles for hire
    - Taxi’s and vehicles for hire are generally exempt from rear seatbelt laws– including for infants, children, teens and adults in NYC
    - Multipurpose vehicles that crossover from use as a private vs. vehicle for hire (Ubers/Lyft/Ride hailing services)
    - Current data systems based on vehicle registrations do not accurately capture when a vehicle was in “for hire” mode or in private use
    - Driver training and licensing is required for known vehicles for hire, but not for cross over vehicles

Future Directions: Emerging Issues With Rear Seat Safety Implications

Changing drug laws, particularly legalization of cannabis, for medicinal and recreational purposes

- Lower proper seating for children of drivers who are positive
- Lower restraint use in rear-seated children driven by positive drivers
- Scientific obstacles to road side testing and lacks of standards for “under the influence”