Update of Far-side NASS Data

Summary of Data Analysis from 2015 ESV Paper by Bahouth

2015

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Earlier NASS/CDS Studies of Far-side Belted Front Outboard Occupants

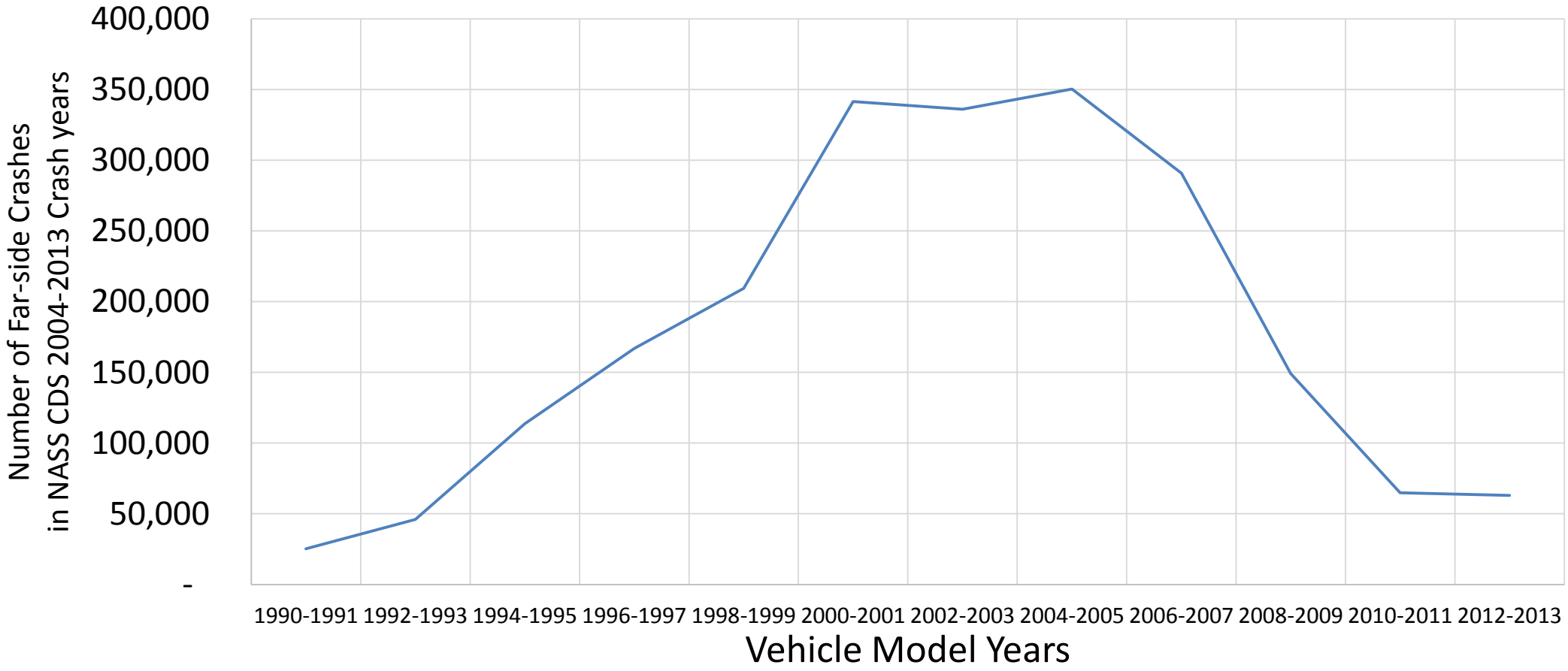
- Digges (ESV 2001) [Analysis by Dr. Peter Martin]
  - NASS 1988-1998; 4,696 MAIS 3+ far-side occupants
  - Median lateral deltaV for MAIS 3+ - 30 k/hr
  - MAIS 3+ injury frequency - Chest/Abdomen- 58%; Head/Face- 24; Spins 16%
- Gabler (2005 SAE)
  - NASS 1993-2002; 2,386,6332 far-side occupants
  - Median lateral deltaV – 19 k/hr
  - Median lateral deltaV for MAIS 3+ - 28 k/hr
  - MAIS 3+ injury frequency - Chest/Abdomen- 41%; Head/Face- 32%
- Yoganandan (2014 AAAM)
  - NASS 2009-2012; 519,195 far-side occupants
  - Median lateral deltaV – 12 k/hr
  - Median lateral deltaV for MAIS 3+ - 42 k/hr
  - AIS 3+ injury frequency - Chest/Abdomen- 82%; Head- 50%; Spine- 14%

2015 ESV Analysis by Bahouth ESV 15-0444

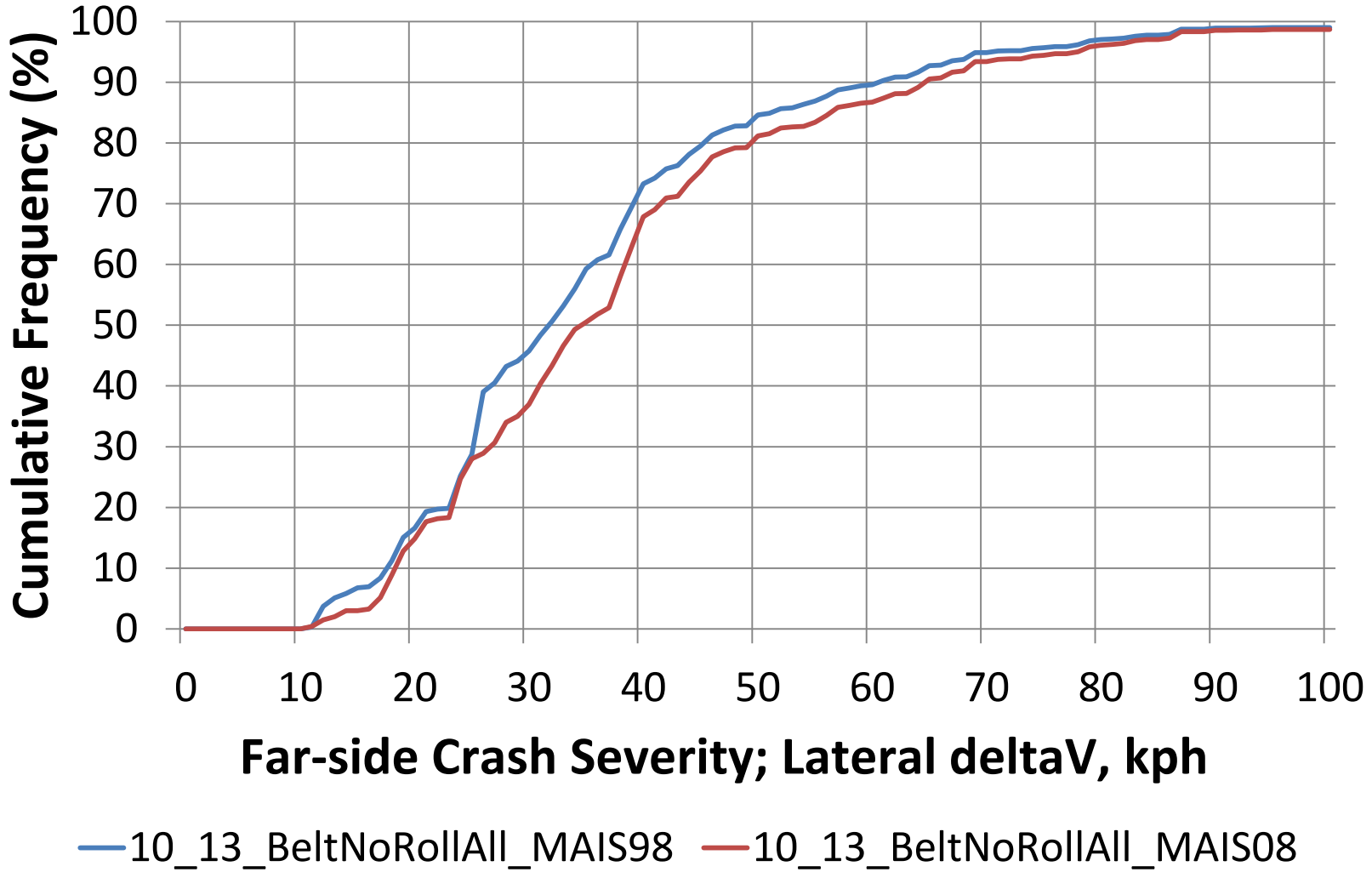
- Bahouth (2015 ESV)
  - NASS 2004-2013; 2,894,915 far-side crashes; 54,954 far-side MAIS 3+
  - Median lateral deltaV – 15k/hr
  - Median lateral deltaV for MAIS 3+ - 36 k/hr
  - AIS 3+ injury frequency - Chest/Abdomen- 43%; Head- 23%; Spine- 7%; Limbs- 28%

- Yoganandan (2014 AAAM)
  - NASS 2009-2012; 519,195 far-side occupants
  - Median lateral deltaV – 12 k/hr
  - Median lateral deltaV for MAIS 3+ - 42 k/hr
  - AIS 3+ injury frequency - Chest/Abdomen- 82%; Head- 50%; Spine- 14%

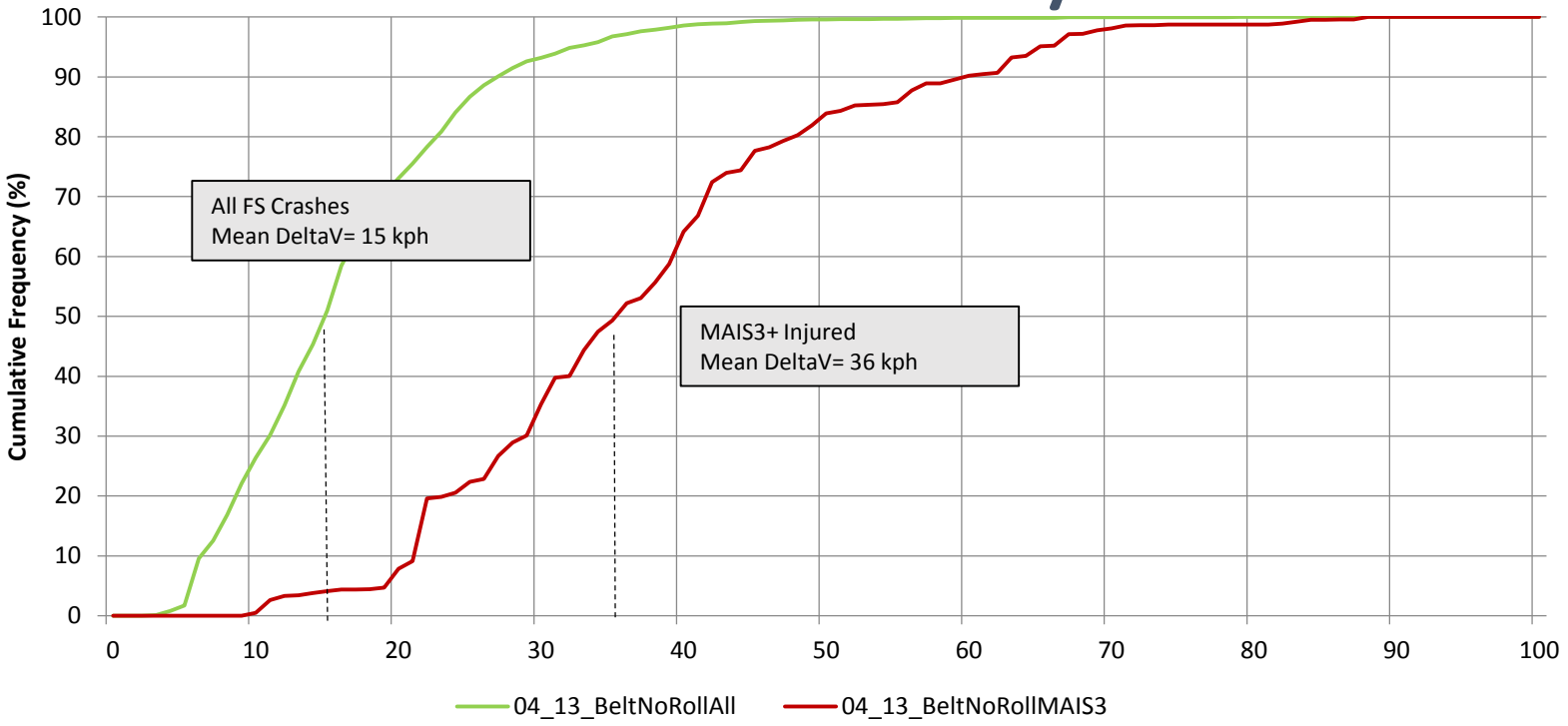
Population of NASS CDS 2004-2013 Light Vehicles Involved In Far-side Crashes By Vehicle Model Year



AIS 1998 vs AIS 2008 for Identical NASS 2010-13 Far-side Data; MAIS 3+ Injuries Cumulative Distribution



Farside Crashes and MAIS3+ Injured- Cumulative Distribution Function by deltaV

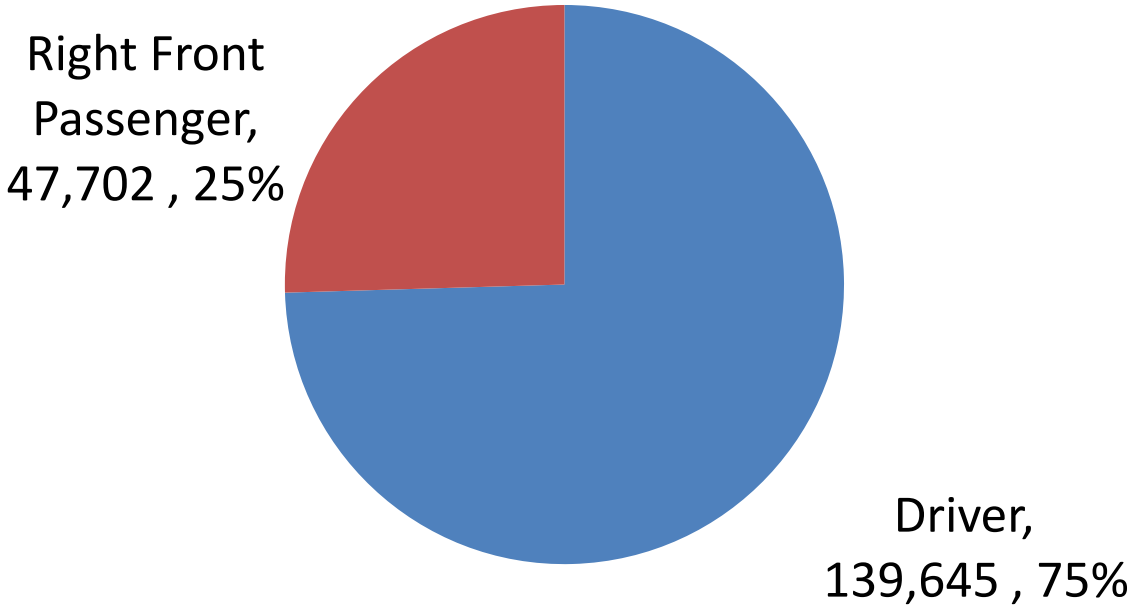


- CY2004-2013
- Belted Occupants
- Front Outboard Seats
- Farside Crashes
- Rollovers Excluded
- No ejection
- MAIS3+ = (AIS3-6, Fatal)

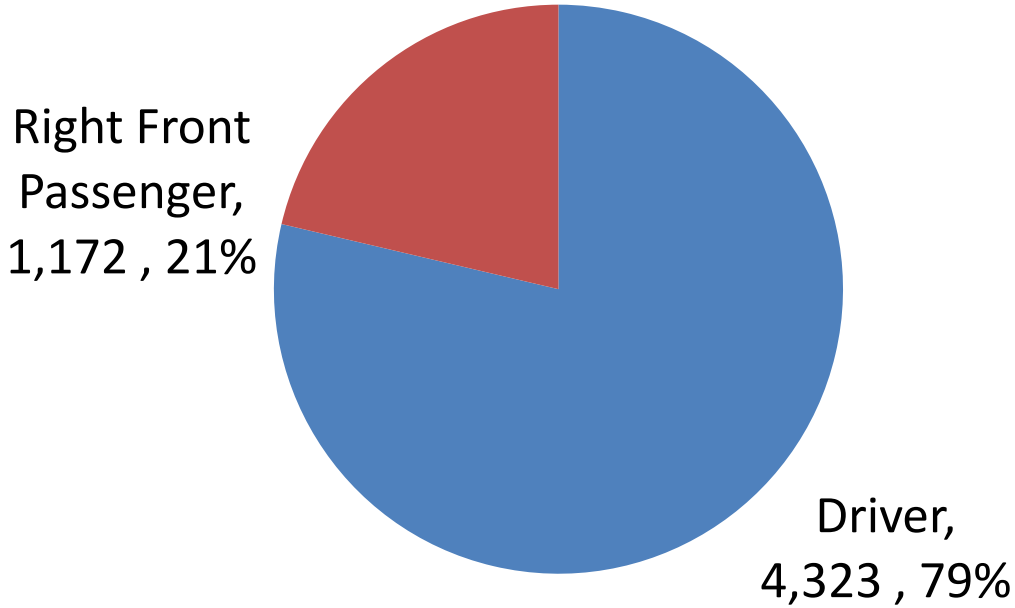
The mean deltaV for MAIS3+ injured occupants is 36 kph. This deltaV is a field relevant severity appropriate for future farside crash testing.

Driver vs. Right Front Passenger Involvement and MAIS 3+

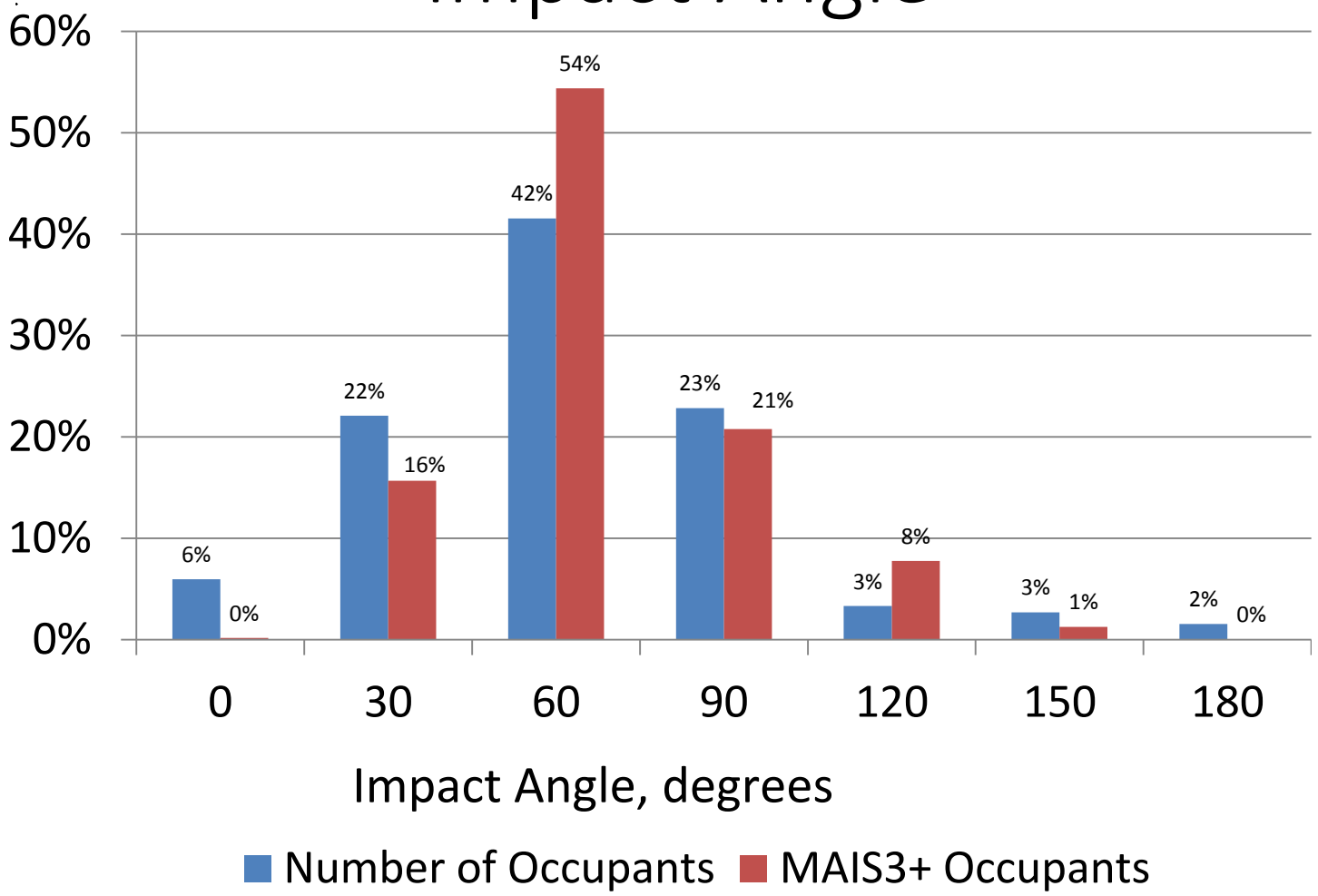
Farside Crash Involved Occupants (annual counts)



MAIS3+ Injured Farside Involved Occupants (annual counts)

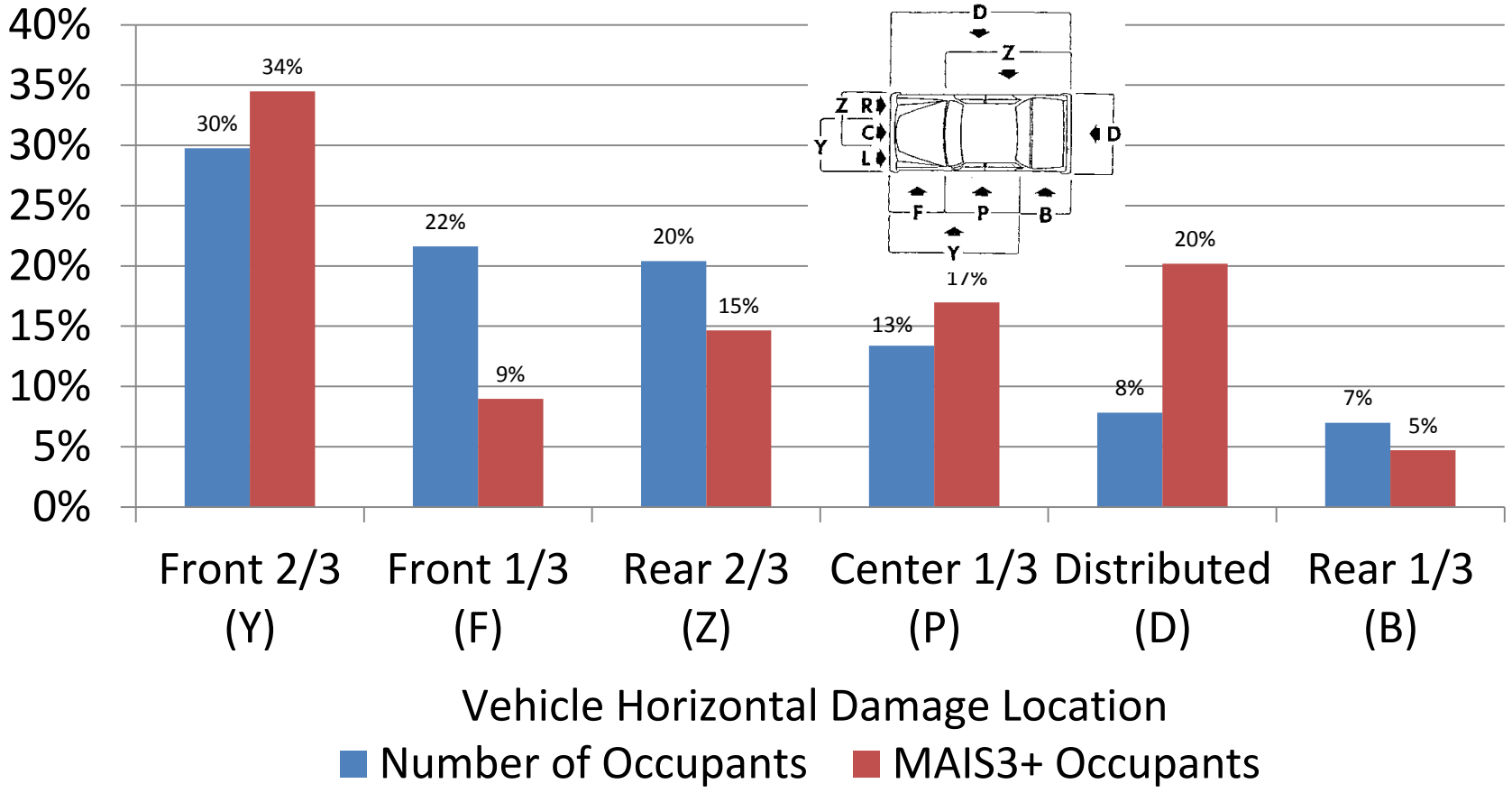


Distribution of Belted Outboard Front Seat Occupants and Those with MAIS 3+ Injuries by Impact Angle



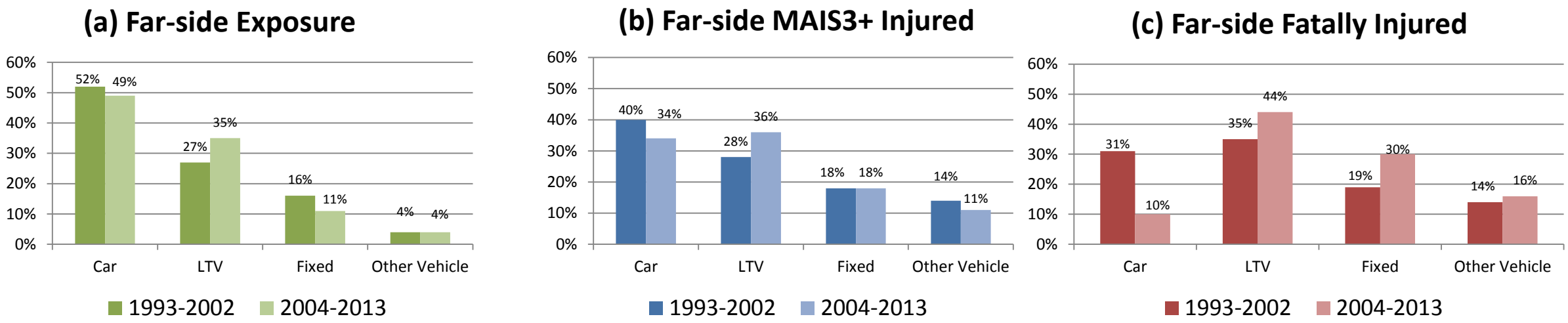
far-side crashes by crash direction, NASS CDS 2004 to 2013 (AIS 1998)

Distribution of Belted Outboard Front Seat Occupants and Those with MAIS 3+ Injuries by CDC Horizontal Damage Location



far-side crashes by crash direction, NASS CDS 2004 to 2013 (AIS 1998)

Distributions by collision partner
NASS CDS (1993-2002 vs. 2004 to 2013)

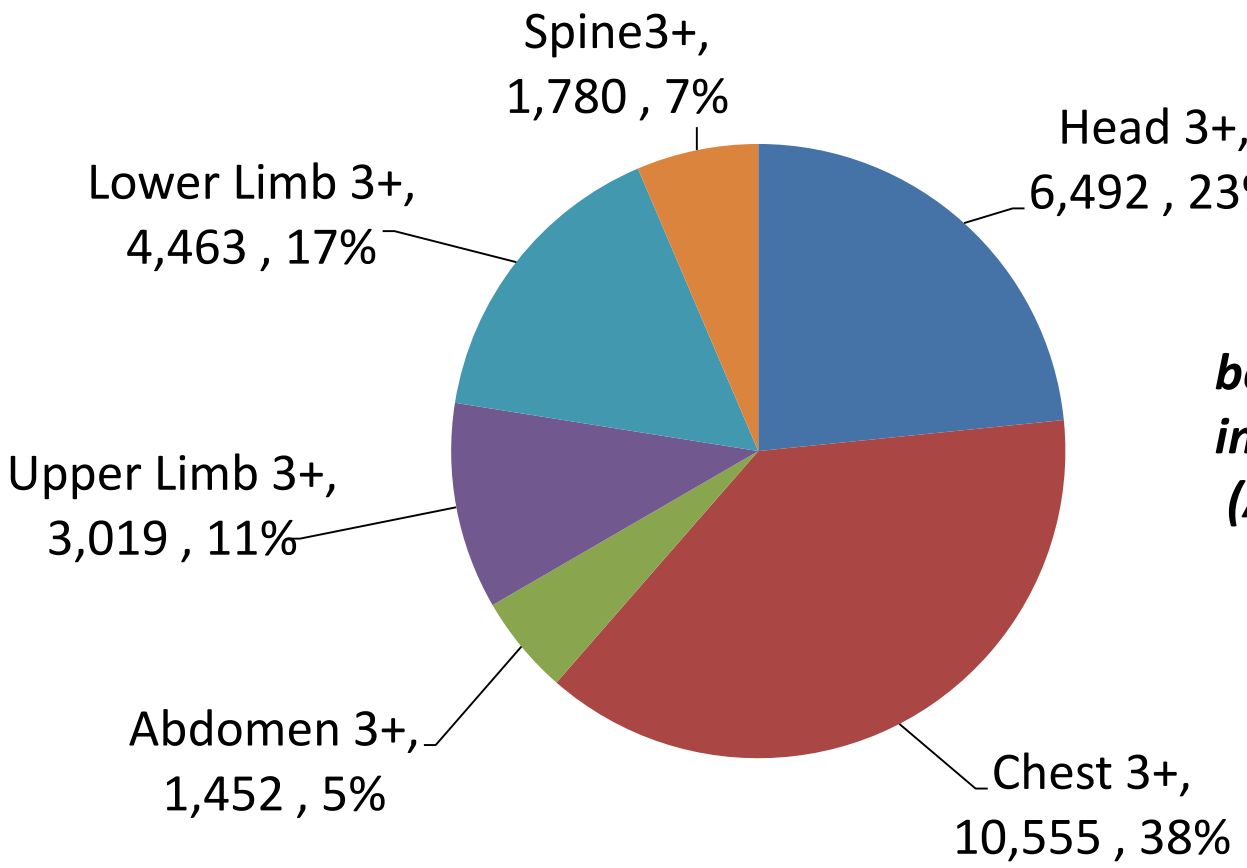


(a) Occupants (b) Those with MAIS 3+ injuries (AIS 1998) and (c) Those fatally injured

belted outboard front seat occupants in far-side crashes, NASS CDS (1993-2002 vs. 2004 to 2013).

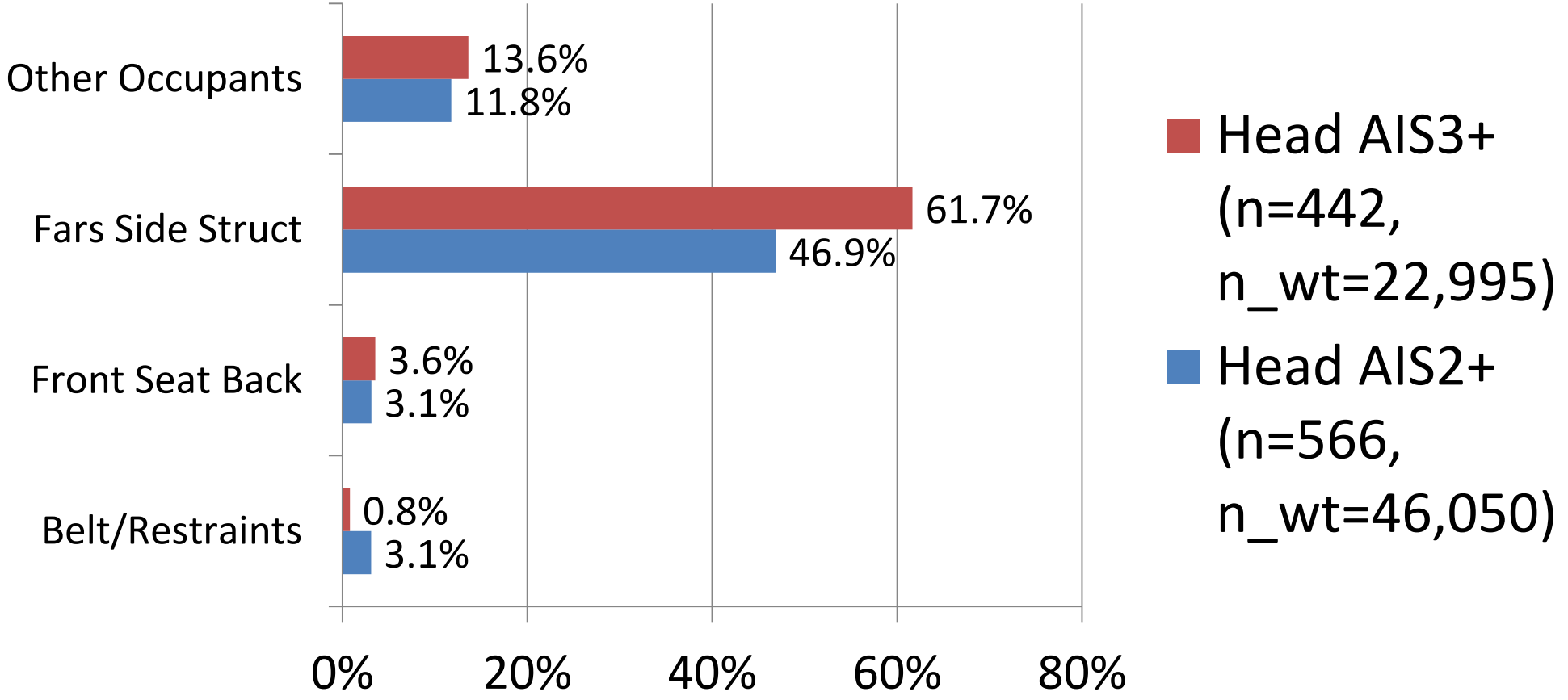
LTV and Fixed Object Overinvolved in Injuries

Distribution of AIS 3+ injuries (AIS 1998) by body region



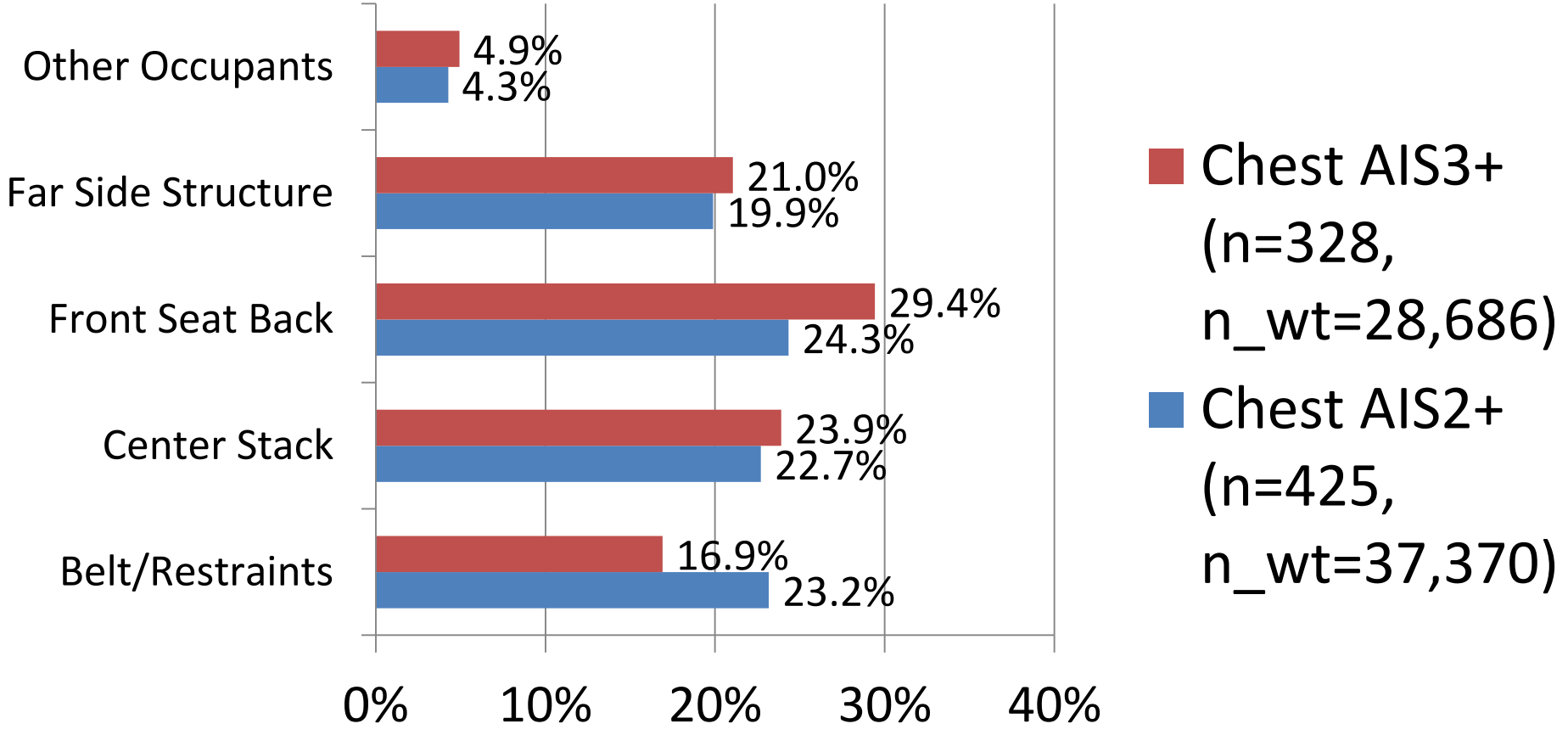
belted front seat outboard occupants in far-side crashes NASS CDS 2004-2013 (Annualized data, weighted).

Top 4 Contributors Amenable to Far-side Countermeasures: AIS 2+ and AIS 3+ Head Injuries



by injuring contact for belted front outboard seat occupants in far-side crashes NASS CDS 2004-2013

Top 5 Contributors Amenable to Far-side Countermeasures: AIS 2+ and AIS 3+ Chest Injuries



by injuring contact for belted front outboard seat occupants in far-side crashes NASS CDS 2004-2013

Take-away Summary

- MAIS 3+ injury exposure: 79% driver; 21% right front passenger
- Median crash severity for MAIS 3+; lateral delta V - 36 kph.
- Most frequent crash directions for AIS 3+ occupants -
  - 54% of MAIS 3+ at 60 degrees
  - 21% of MAIS 3+ at 90 degrees
- Most frequent vehicle horizontal damage areas for AIS3+ occupants-
  - Front 2/3 (Y) - 34%
  - Distributed (D) - 20%
  - Center passenger compartment (P) – 17%

Take-away Summary

- Far-side occupant exposure: 75% driver; 25% right front passenger
- Far-side MAIS 3+ injury exposure: 79% driver; 21% right front passenger

- Most frequent head injuring contacts for **23%** of MAIS 3+ (belted outboard front seat occupants,)
  - Far-side structure - 61.7%
  - Other occupant – 13.6%
-
- Most frequent chest/abdomen injuring contacts for **43%** of MAIS 3+ (belted outboard front seat occupants,)
  - Front seat and center stack - 53.3%
  - Far-side structure – 21.0%
  - Safety belt - 16.9%
  - Other occupant – 4.9%

Largest Far-side Head and Chest Opportunities

- Seat and center stack – 24% (largely chest)
- Far-side contacts – 23%   (largely head)
- Seatbelt – 7% (chest/abdomen)
- Other Occupant – 5% (head and chest)

Observations

- Far-side is more complex than frontal or near-side (but less than rollover)
  - Longer distance to contacts
  - Vehicle rotation may influence occupant kinematics
  - Injuries occur at higher crash severities – intrusion frequently involved
  - Current shoulder belts have limited ability to restrain the upper body
  - Loading of the abdomen by lap/shoulder belt introduces new dummy requirements
- A crash test that is representative and effective may be illusive
- What is really needed is better upper body restraint!!!
- Restraints can be evaluated with a sled test