

Benefits of a Low Severity Frontal Crash Test

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Kennerly Digges¹ and Dainius Dalmotas²

(1) GW University and ASRI

(2) D. J. Dalmotas Consulting

Acknowledgement

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- The final analysis is that of the authors and was not funded by the Canadian Government.
- The views expressed and the conclusions reached are those of the authors do not represent those of the Canadian Government.

Elements of Proposed Canadian Standard (Low Severity Test)

- 40 k/hr full frontal rigid barrier test
- 2 belted 5th % female dummies in front
- More stringent chest deflection requirement

Elements of a Benefits Analysis

- Test a group of vehicles to the standard
 - Selected vehicles to be representative of the on-road fleet
 - Determine the degree to which current vehicles meet the standard
- Estimate the injuries that would occur in a fleet of these vehicles
- Estimate the in injuries that would occur if all vehicles met the standard

Objectives of the Study

(Conducted for Canadian Dept. of Transport)

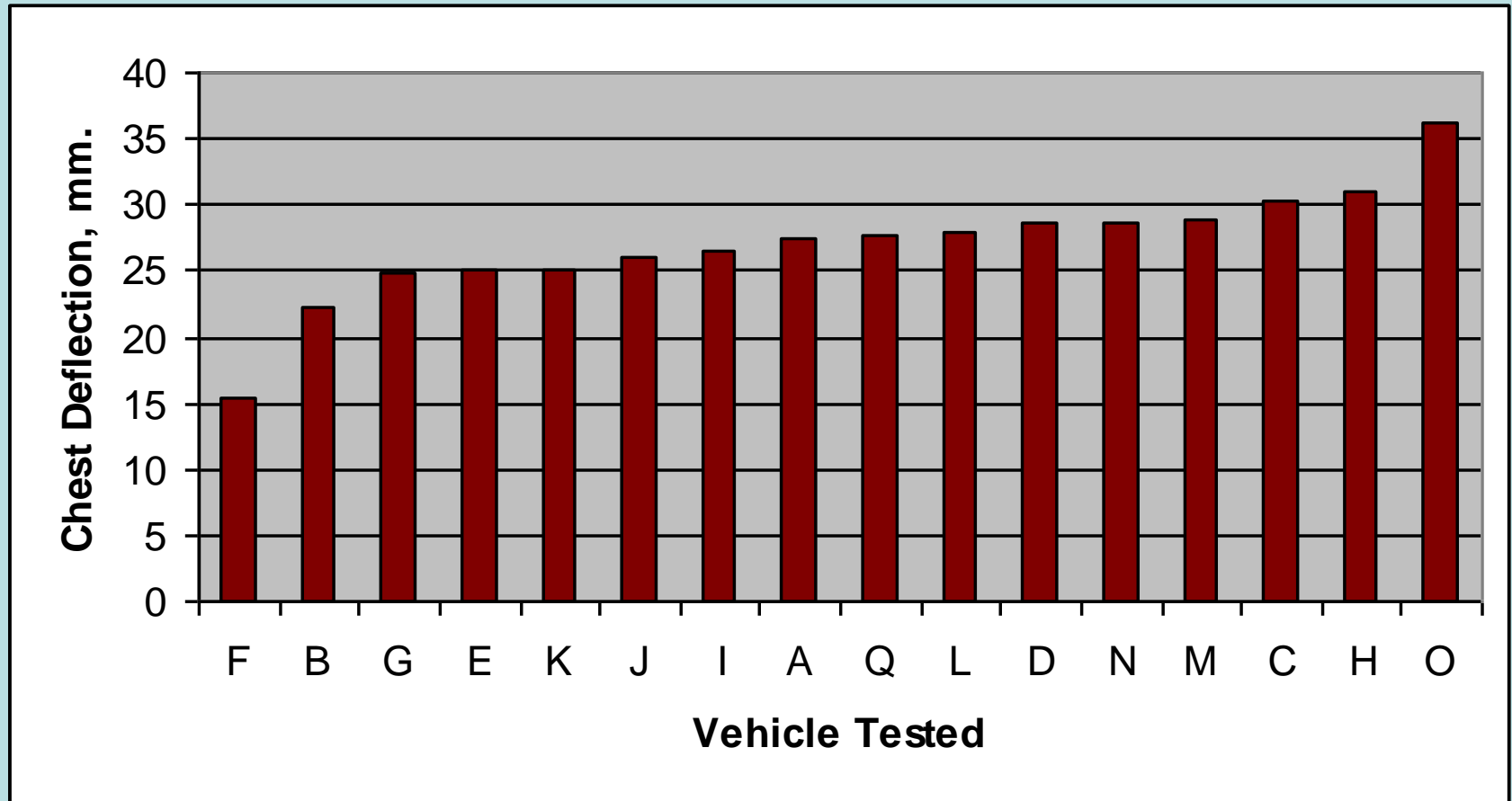
- Examine Crash Tests from Transport Canada (40 kph) and NCAP (56 kph)
- Examine the chest injuries in NASS
 - Frontal crashes
 - Belted front outboard occupants
 - Age groups 15-49 and 50 to 97
 - Male and female gender
 - Delta-V 0-40 kph; 41-56 kph
- Calculate the benefits of the Canadian Test (Full frontal rigid barrier at 40kph.)



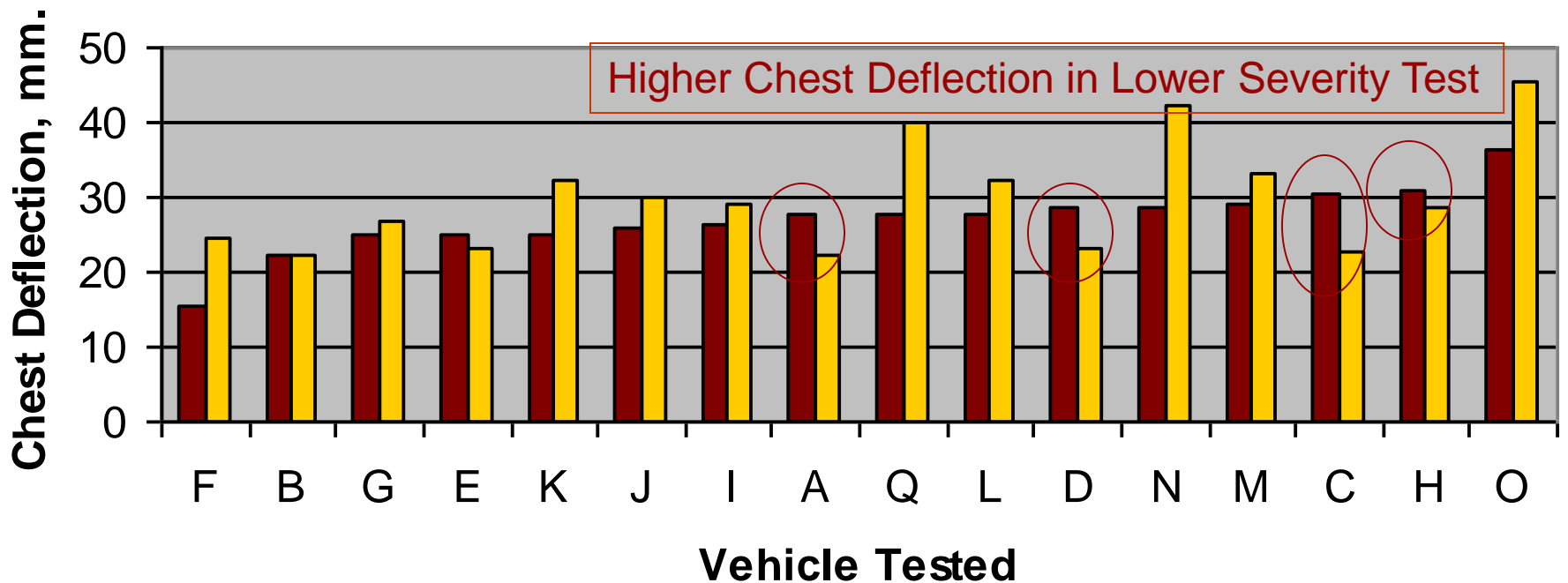
Canadian Test Results – Drivers

Chest Deflection - 5% HII Female

Dummy – 40 kph Rigid Barrier

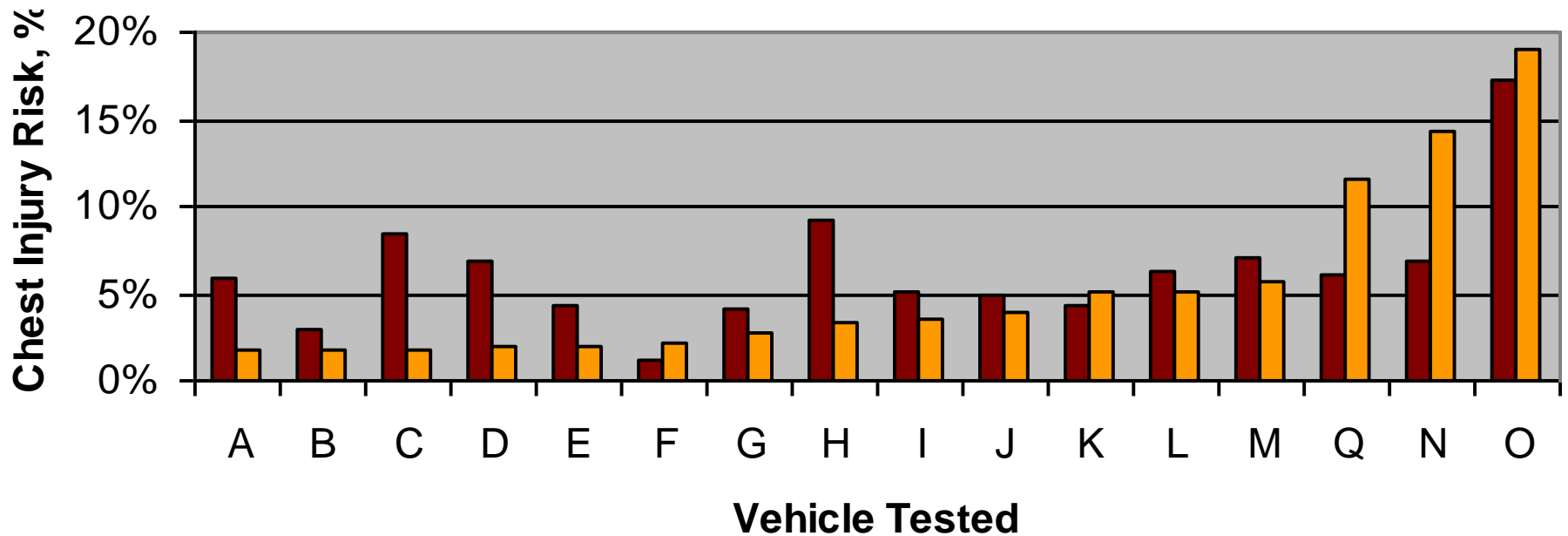


Canadian & NCAP Test Results – Drivers Chest Deflection



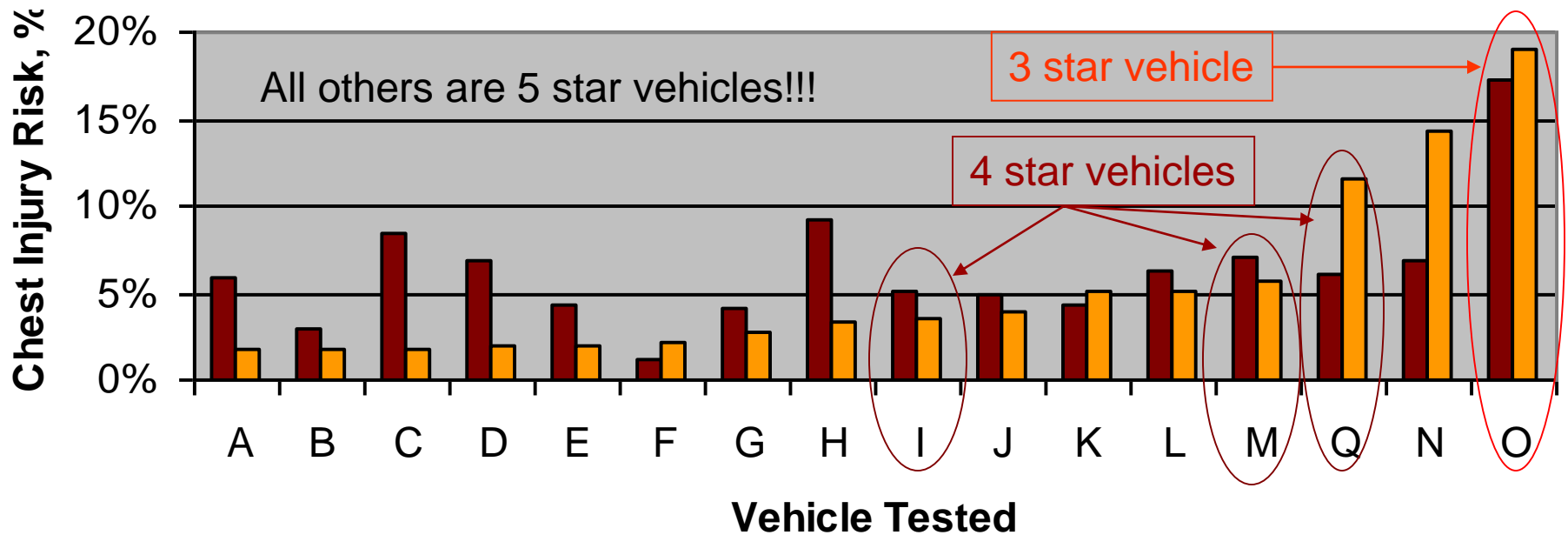
■ Canada 5% Dummy - 40 Kph
■ NCAP 50% Dummy - 56 Kph

Canadian & NCAP Test Results – Drivers - Chest Injury Risk



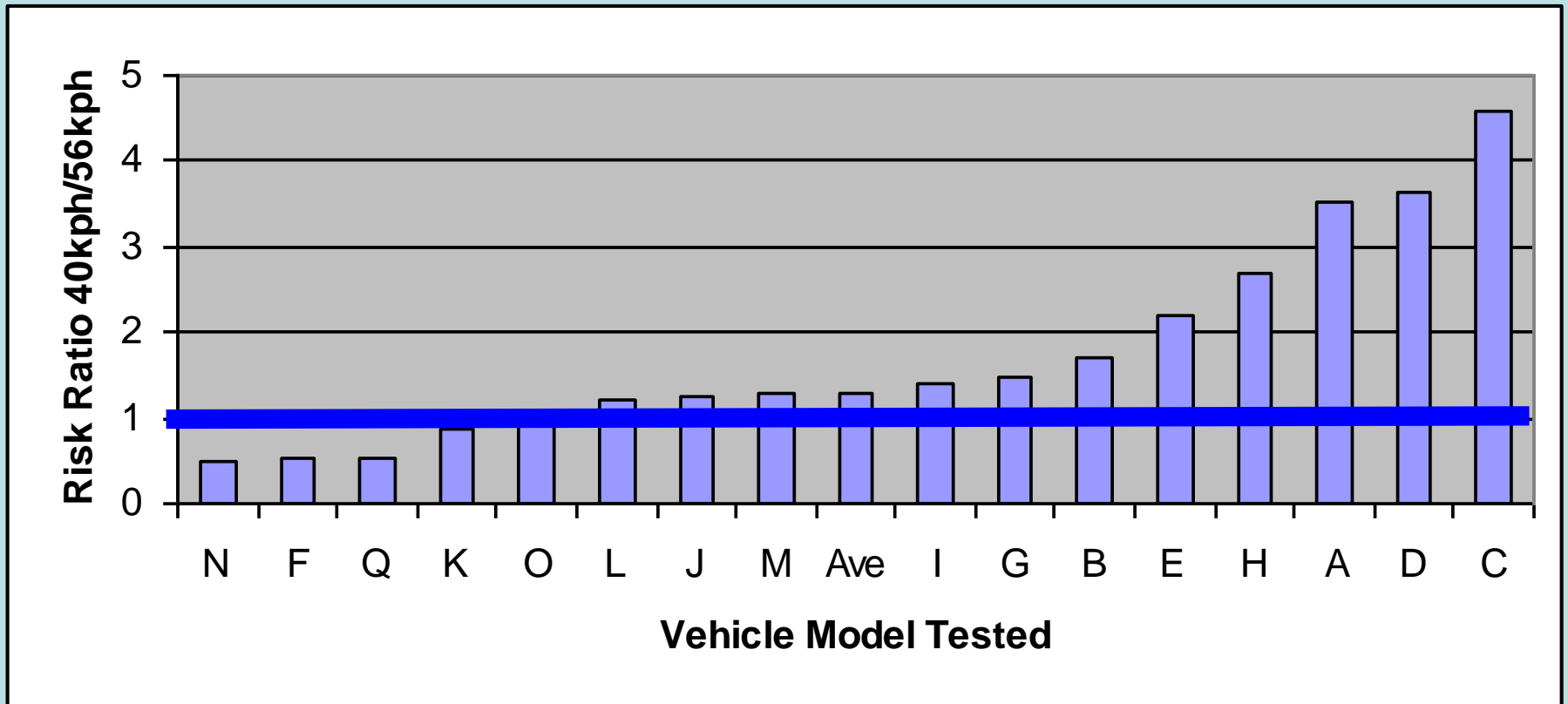
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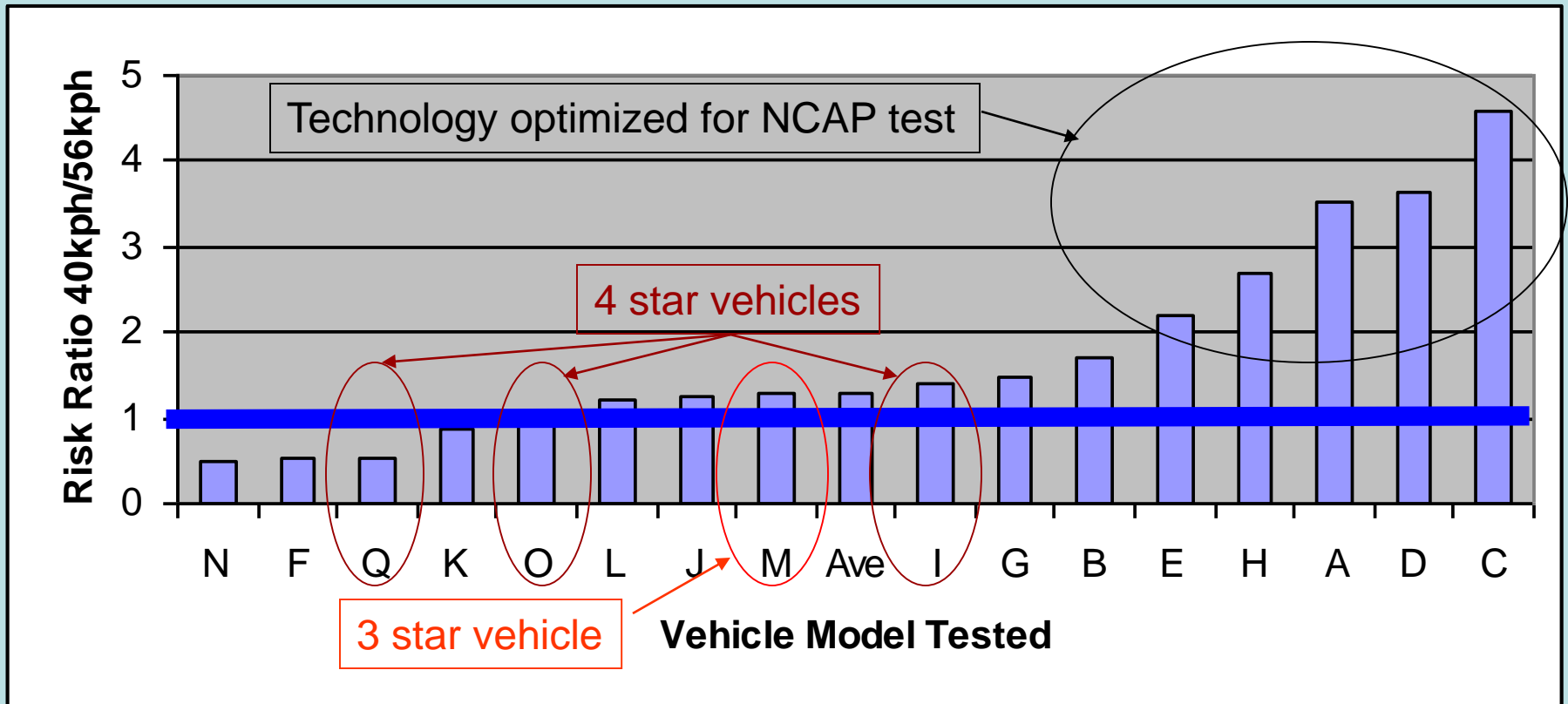


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Chest Injury Risk Ratio – 40kph/56kph Tests (Canadian/NCAP)



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Observations – Crash Tests

- Most vehicles tested in Canada had higher risks of chest injury for a small female tested at 40 kph than for a mid-size male tested at 56 kph.
- There was no relationship between NCAP star rating and chest injury risk for the tests at 40 kph

The Canadian Test Proposal

Revised C208 Regulation

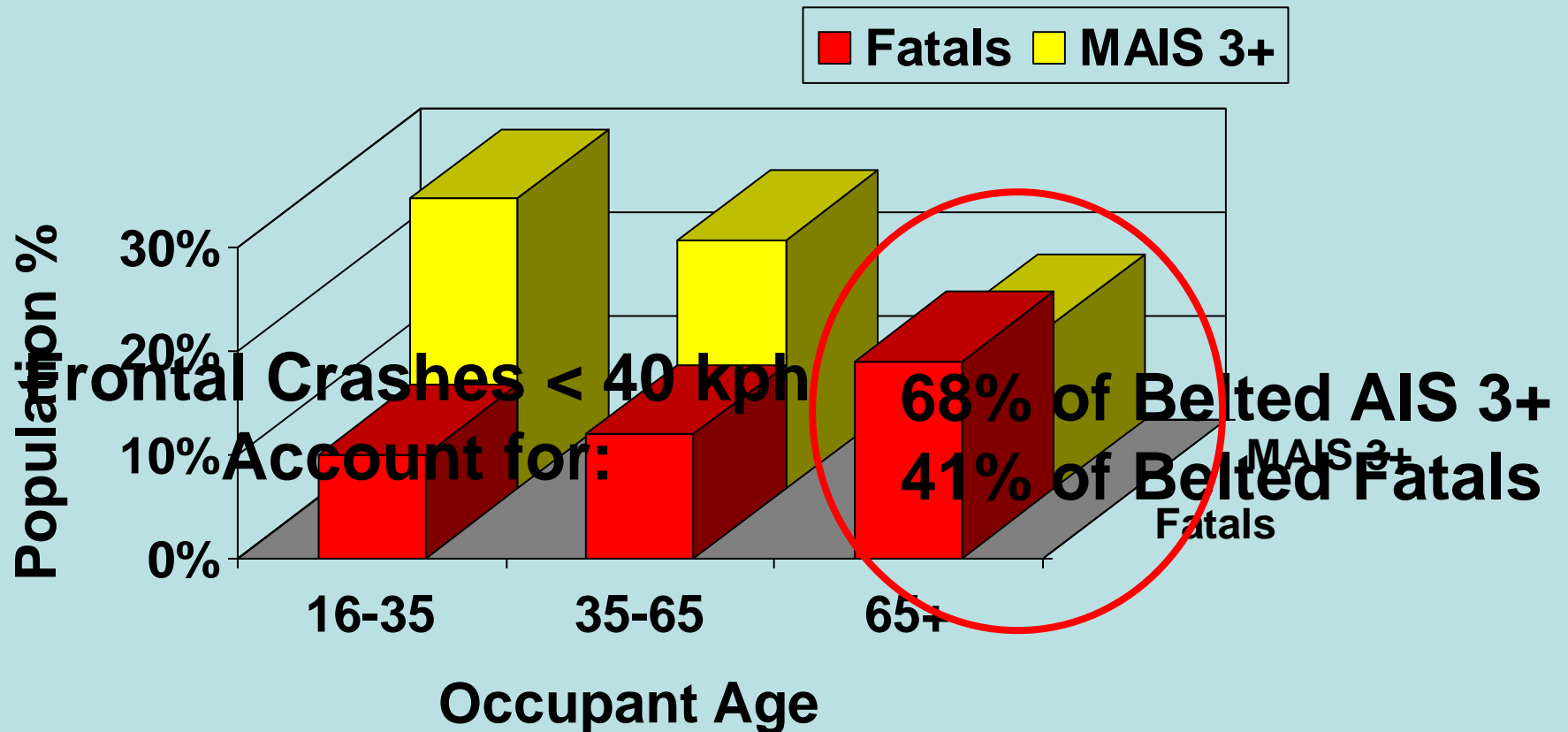
- Rigid Barrier Crash
- 40 Kph Test Speed (25 mph)
- 5th% Female Belted HIII Dummies at Outboard Positions
- More Stringent Chest Injury Requirements
 - Based on chest compression rather than chest acceleration
 - Better measurement of safety belt induced injuries

Examine MAIS 3+ Injuries in Lower Severity Crashes

- Frequency
- Injured body region (for vehicles MY 1998 and later)
- Injury tolerance by age

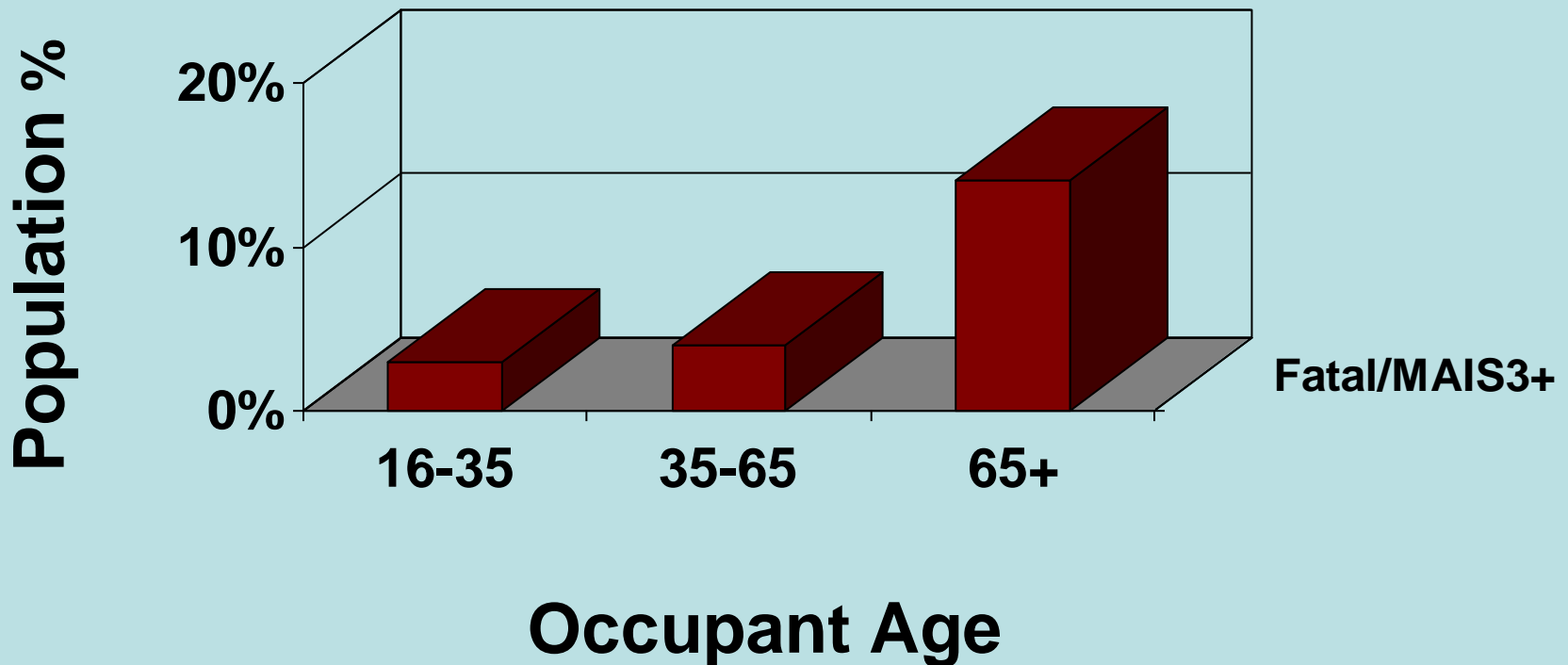
Age Distribution of Belted Casualties

Delta V Less than 40 kph



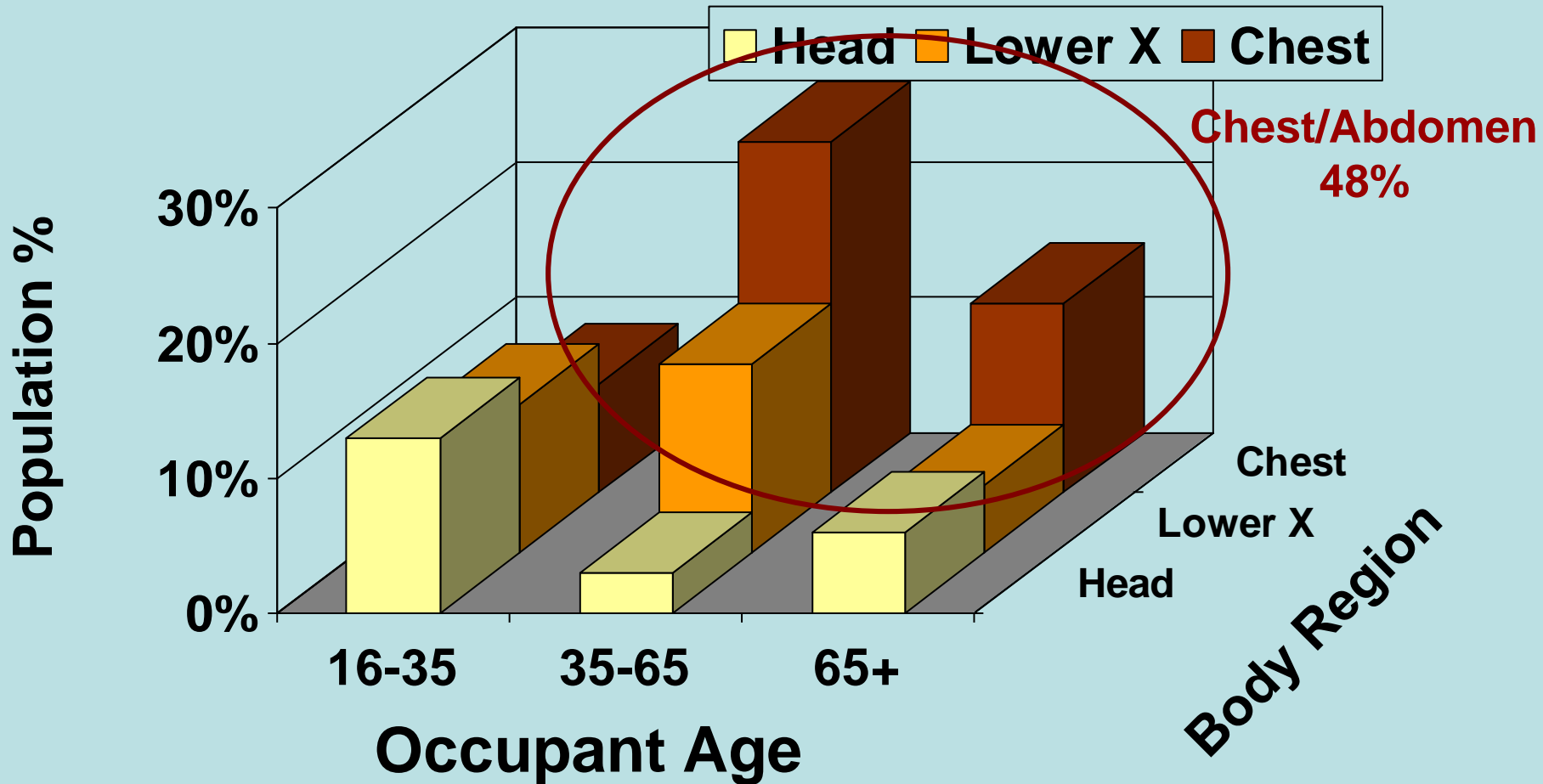
Fatality Rate - Belted Fatal/MAIS3+

Frontal Crashes Less than 40 kph



65+ age 3 times more likely to die from AIS 3+ injury

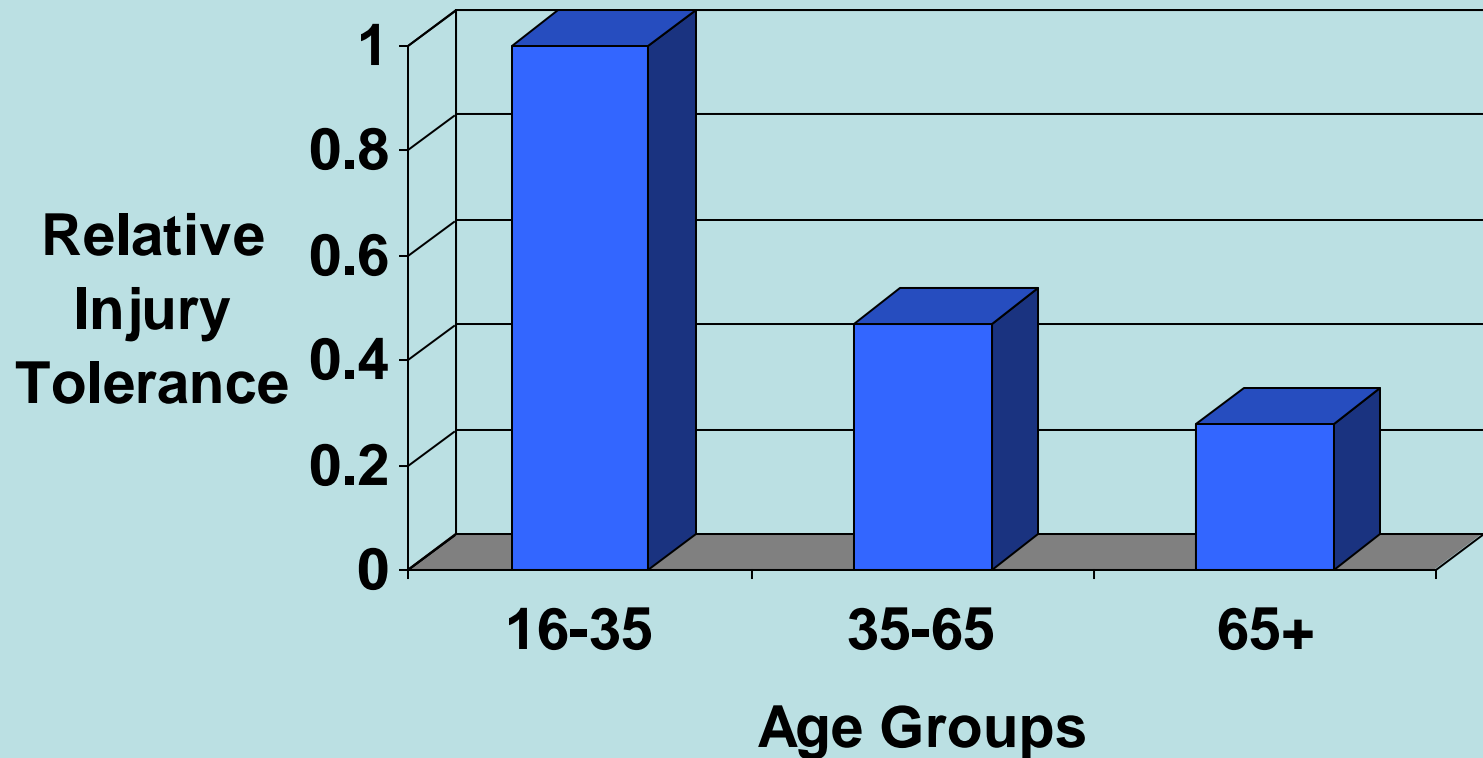
Distribution of MAIS 3+ LT 40 kph by Age & Body Region



MY 1998 & Later Vehicles

Frontal Crashes, Belted Occupants

Chest Injury Tolerance Reduction for Belt Loading by Age



Reference: Zhou, Rouhana & Melvin – SAE 962421

Observations – Less than 40 kph

- Occupants over 65 are the largest fraction of fatalities below 40 kph (46%)
- Fatality per MAIS 3+ injury is 3 times higher for 65+ age group
- Chest injuries are the most frequent – 48%
- Elderly have lower tolerance – 28%

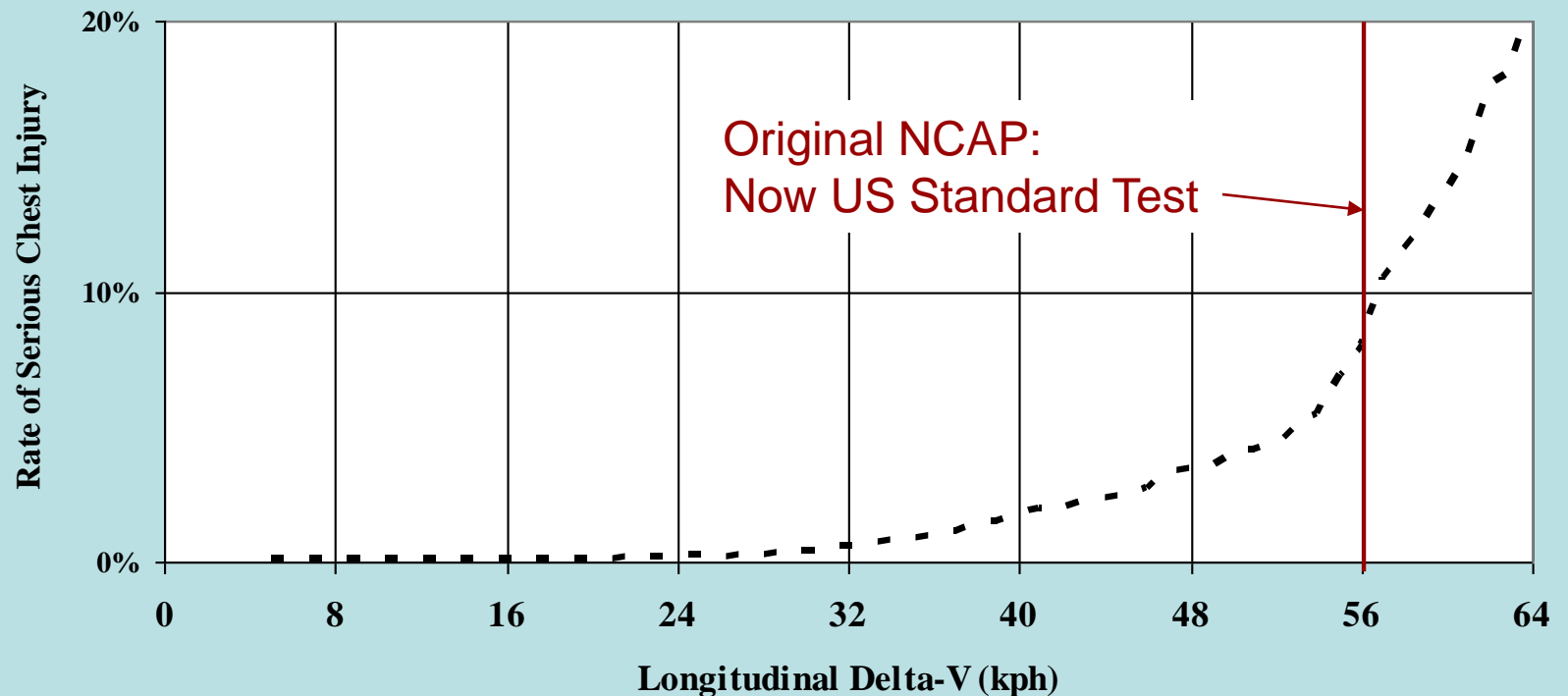
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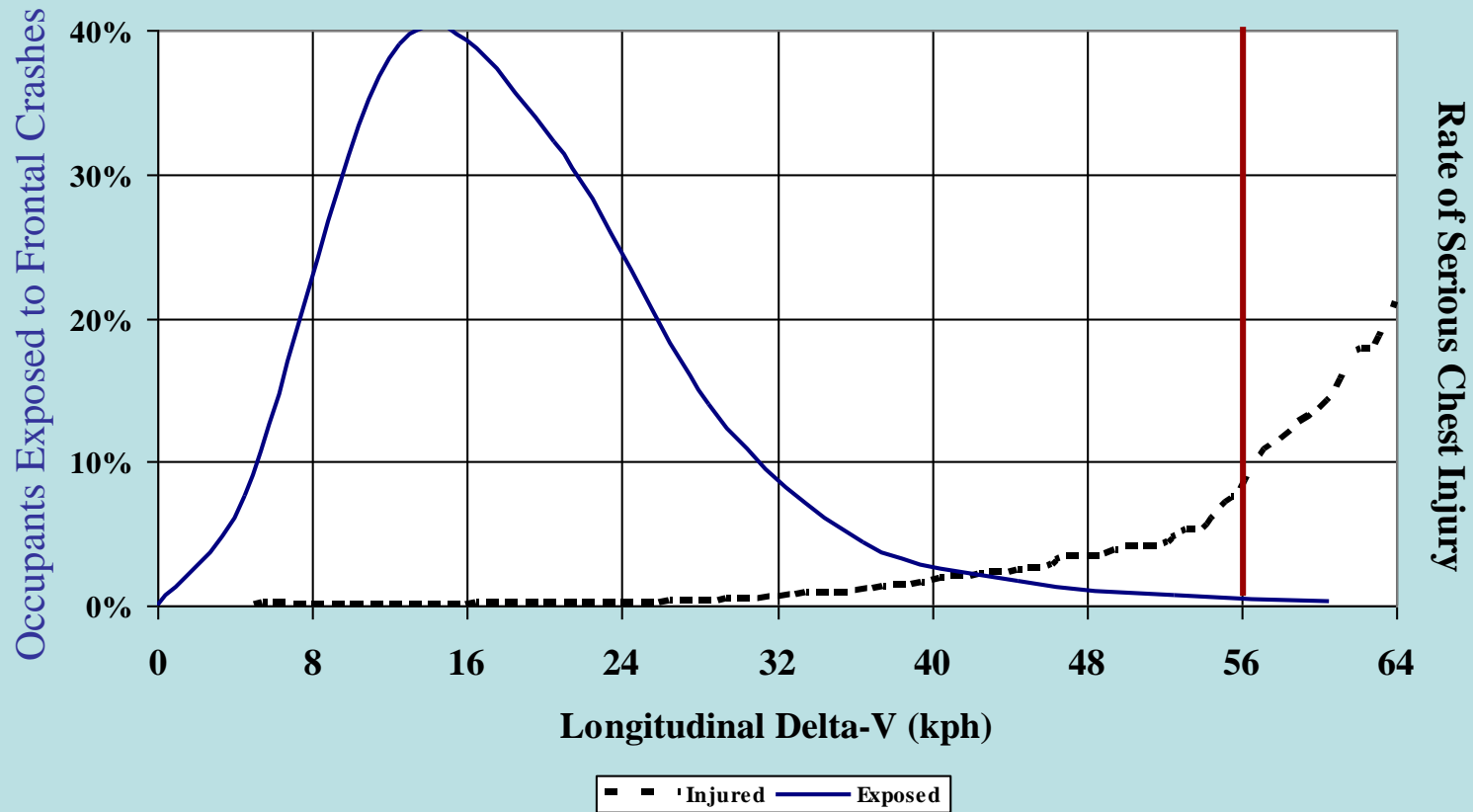
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Chest Injury Rate for Belted Front Seat Occupants in Frontal Crashes



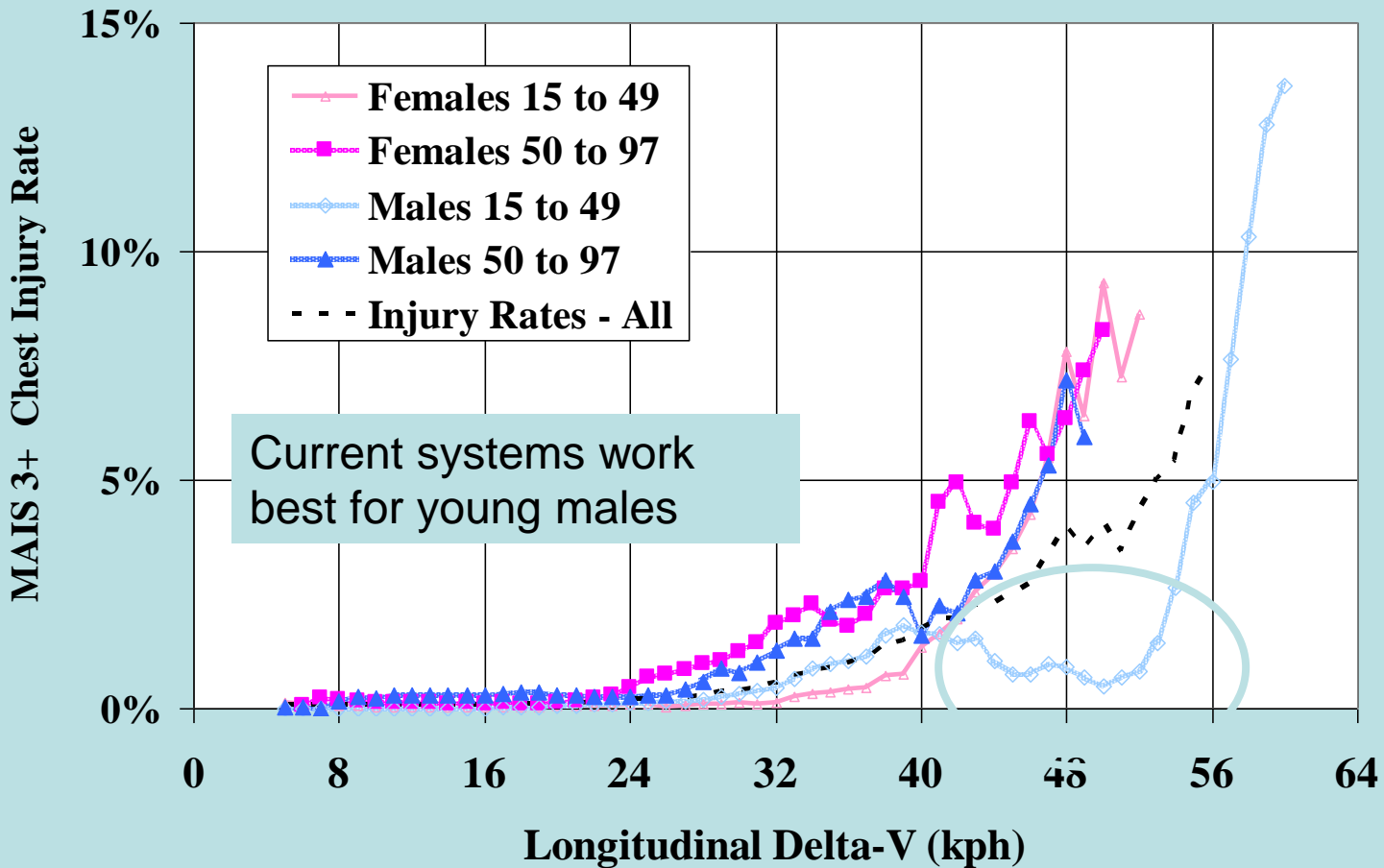
Exposure and Injury Rate in Frontal Crashes



Examine the Basis for the Canadian Test

- Examine the chest injury risk in field data by age and gender
 - 15-49 – Young Male
 - 50-97 – Old Male
 - 15-49 – Young Female
 - 50-97 – Old Female

Chest Injury Rates – Front Outboard Occupants Belted plus Air Bag – NASS 88-05



Objectives of the Study

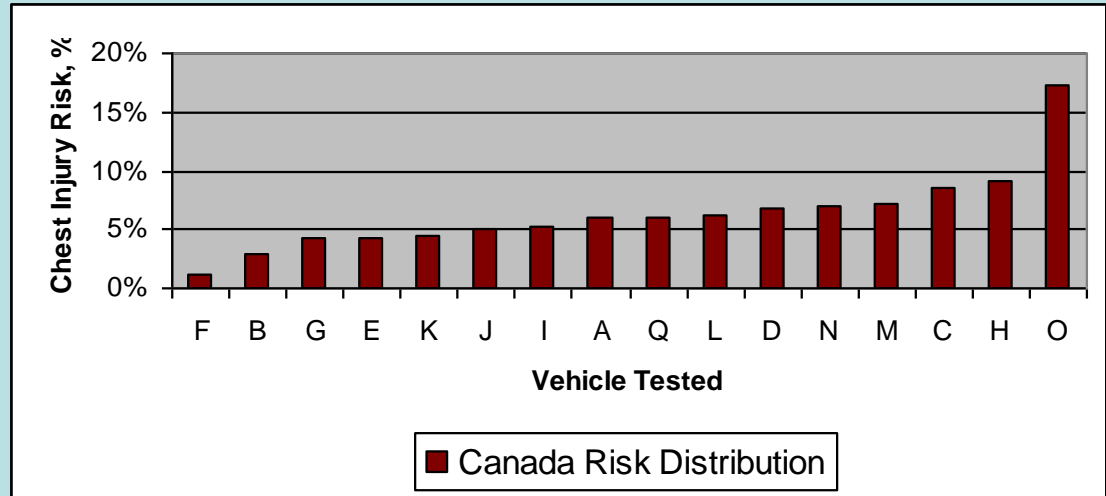
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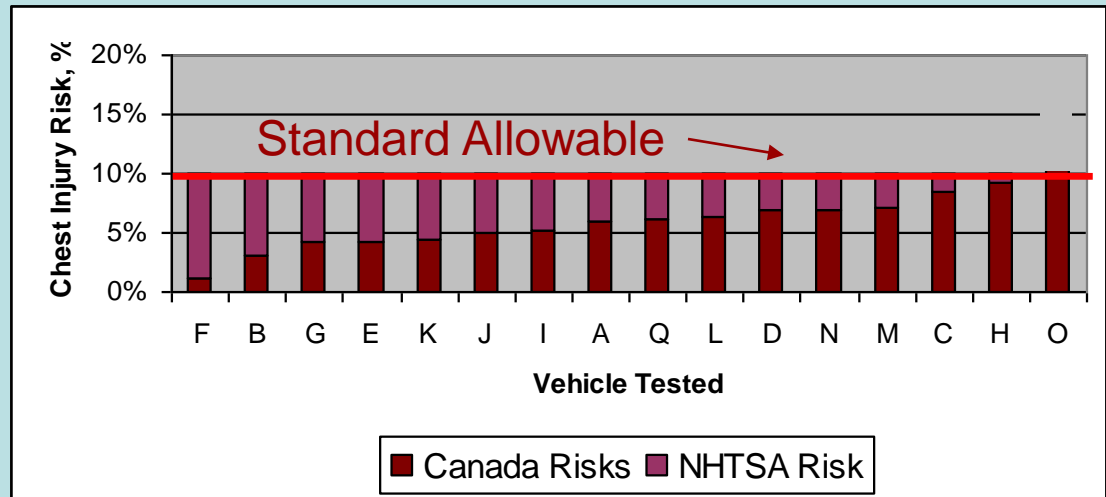


Differences in Canadian and NHTSA Assumptions: Fleet Injury Distribution

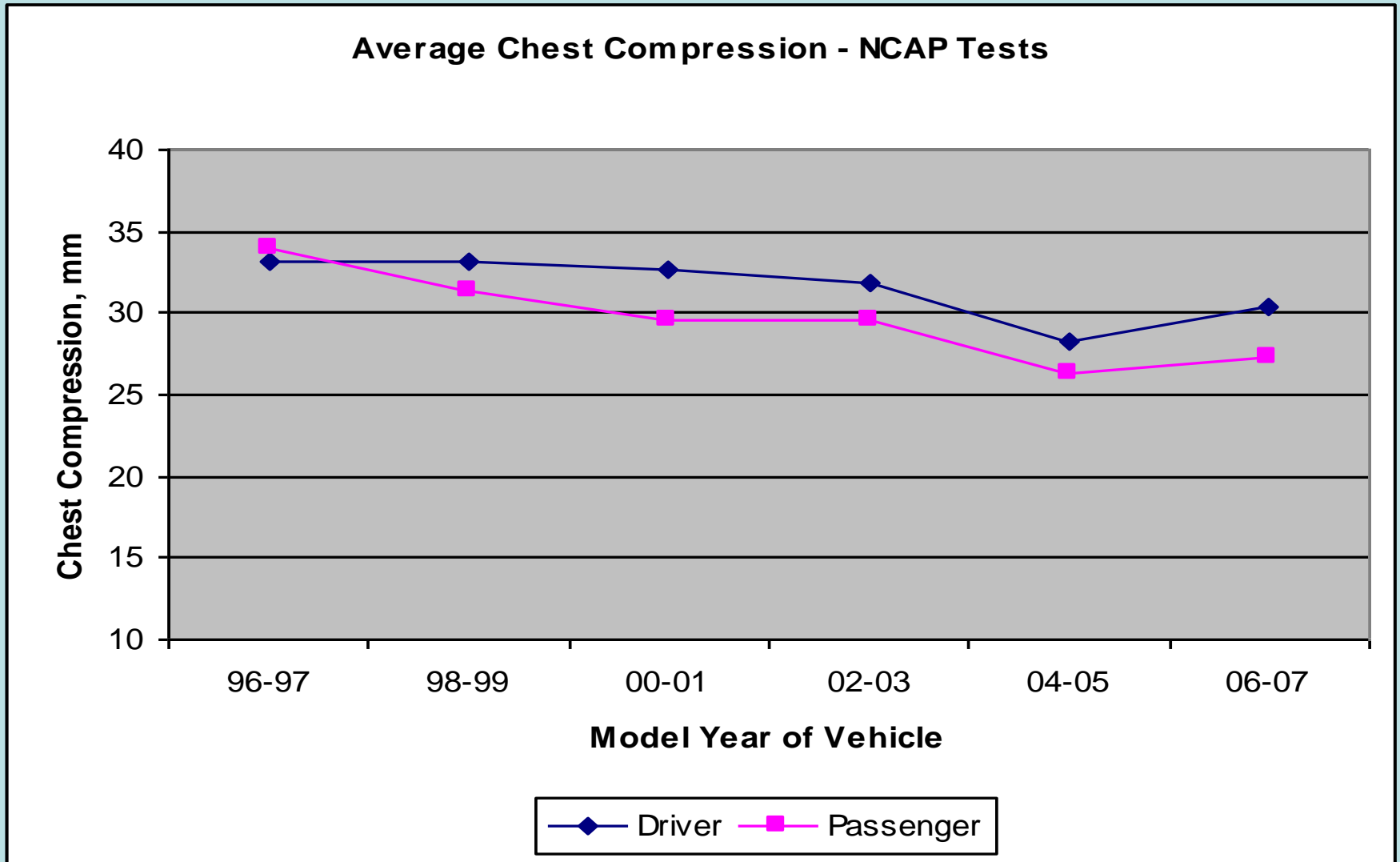
Canadian assumption:
Chest injuries in real world vehicle crashes are proportional to the injury risk measured in the crash test for similar vehicles.
(Adjusted for vehicle exposure).



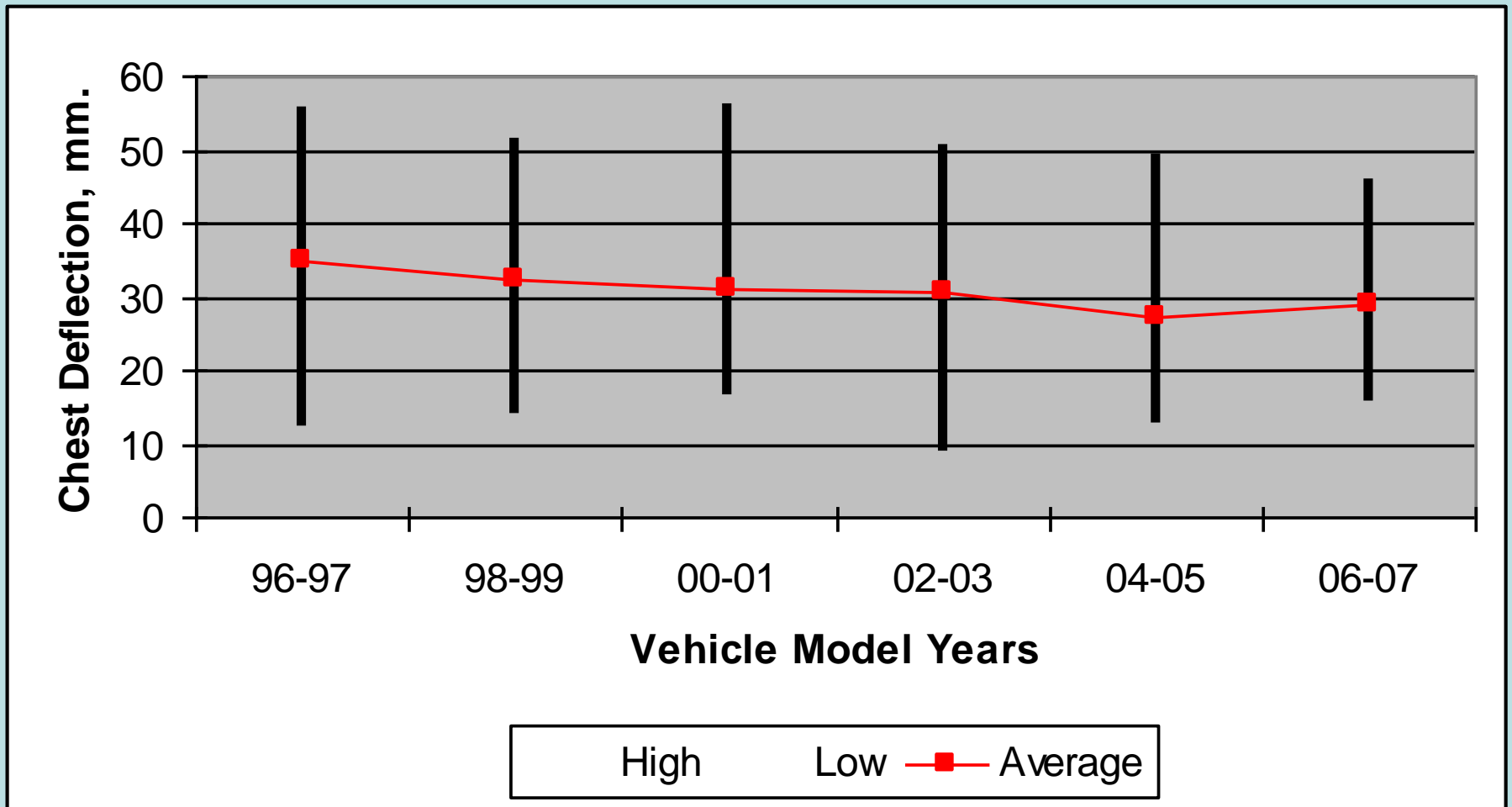
NHTSA assumption:
Chest injuries in real world vehicle crashes are distributed equally among vehicles, regardless of crash test results.
(Adjusted for vehicle exposure).



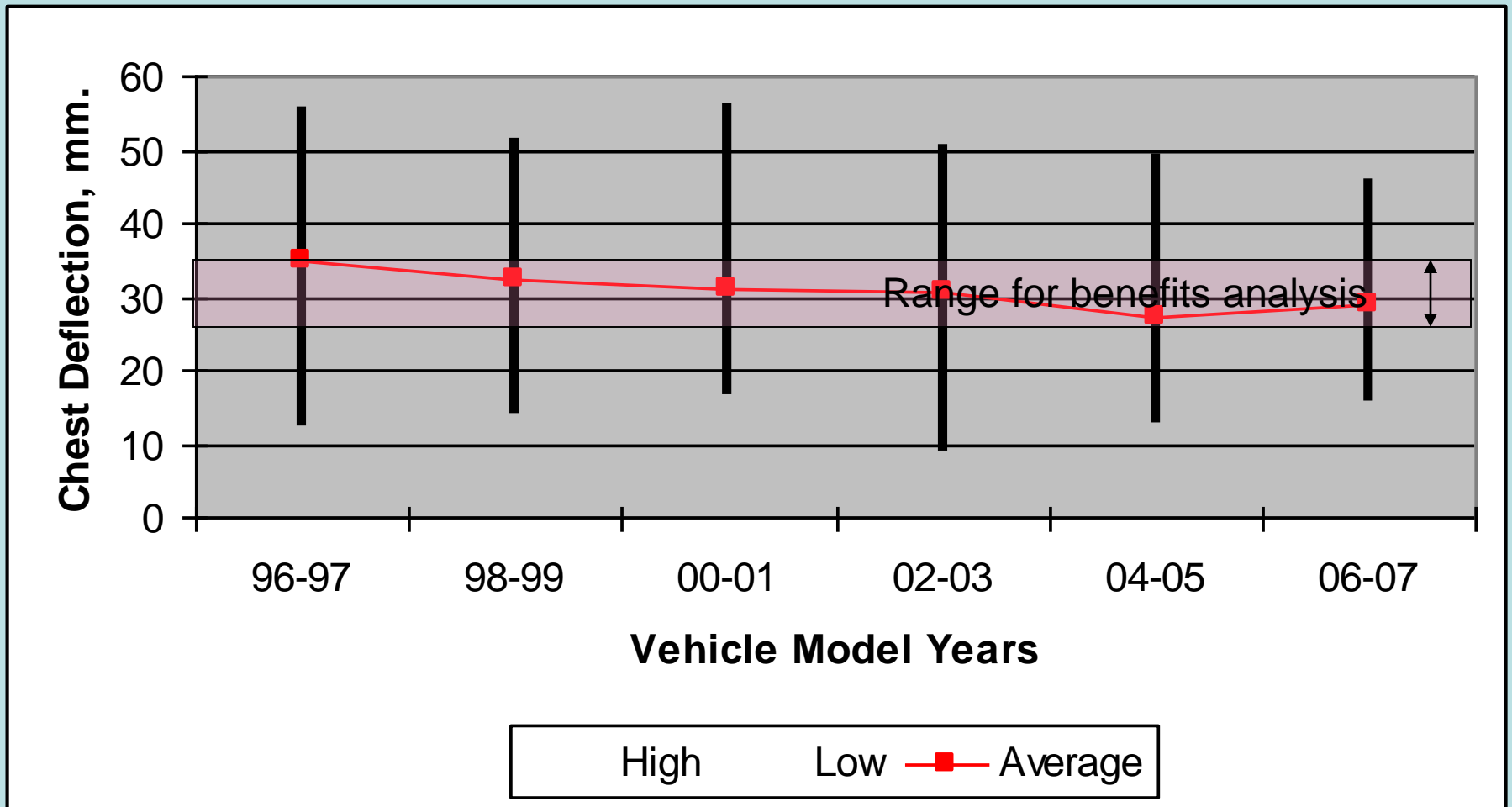
NCAP Average Chest Compression vs. Time



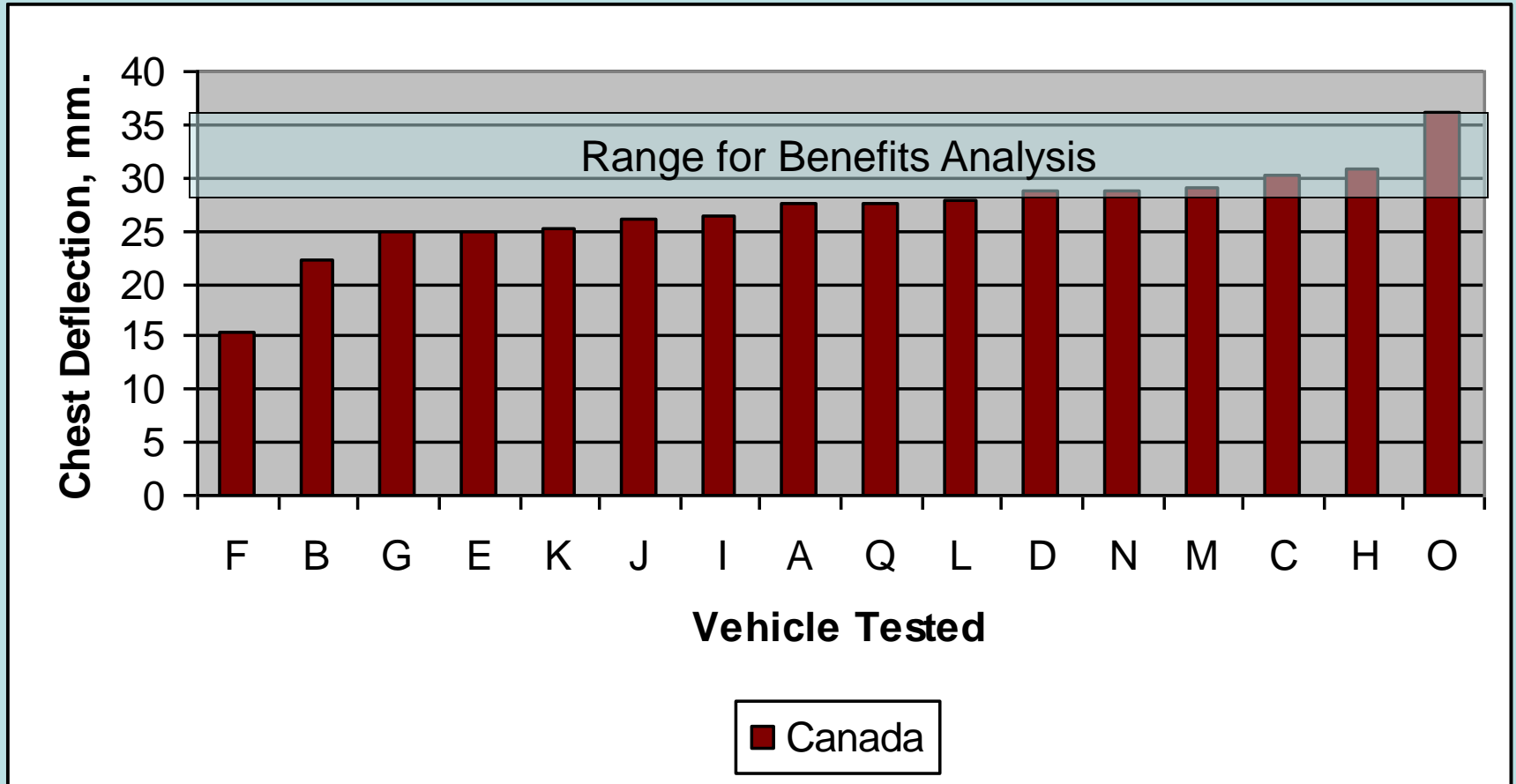
Range of Driver Chest Deflection Measured in NCAP Tests



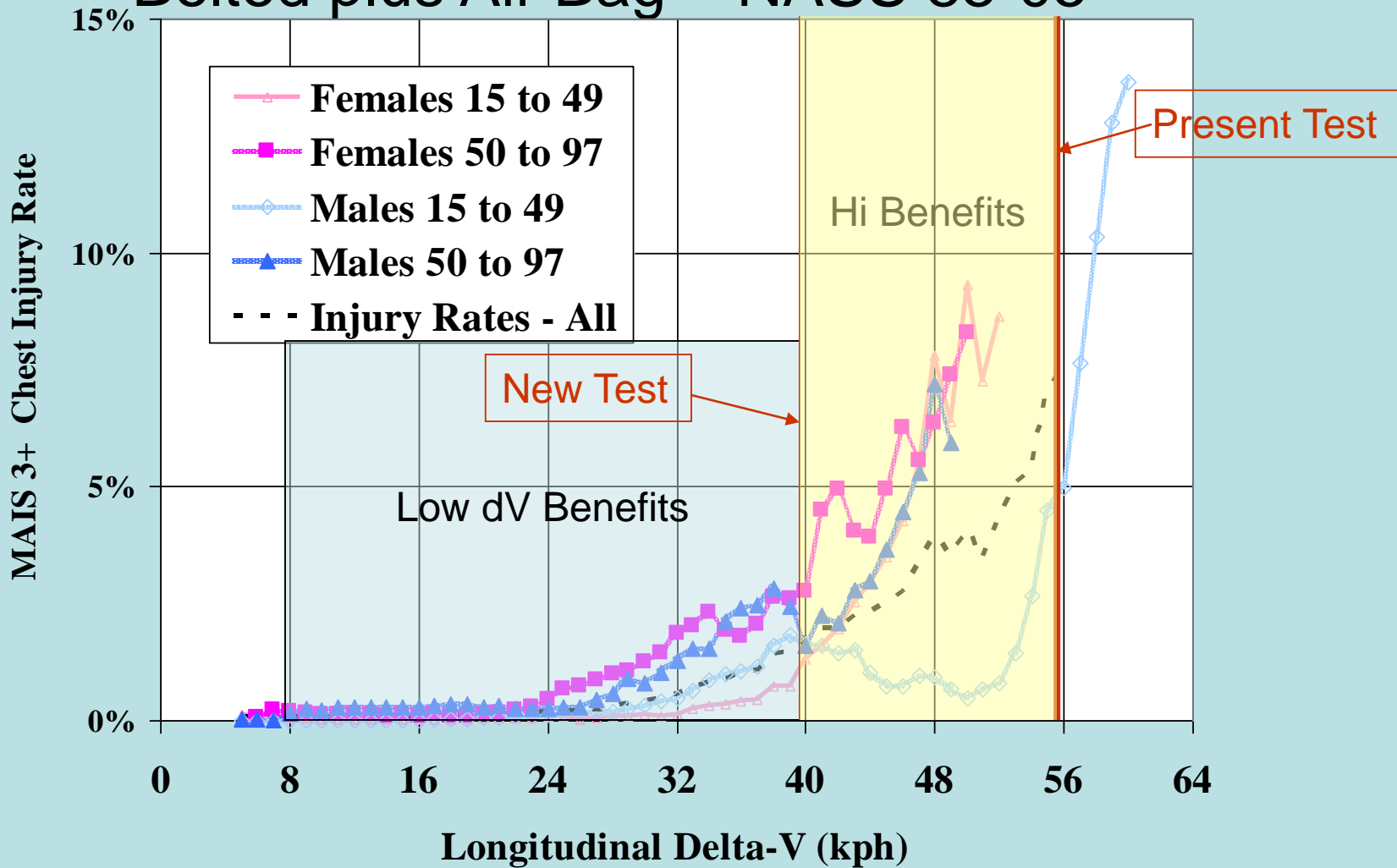
Range of Chest Deflection Allowables in Benefits Analysis



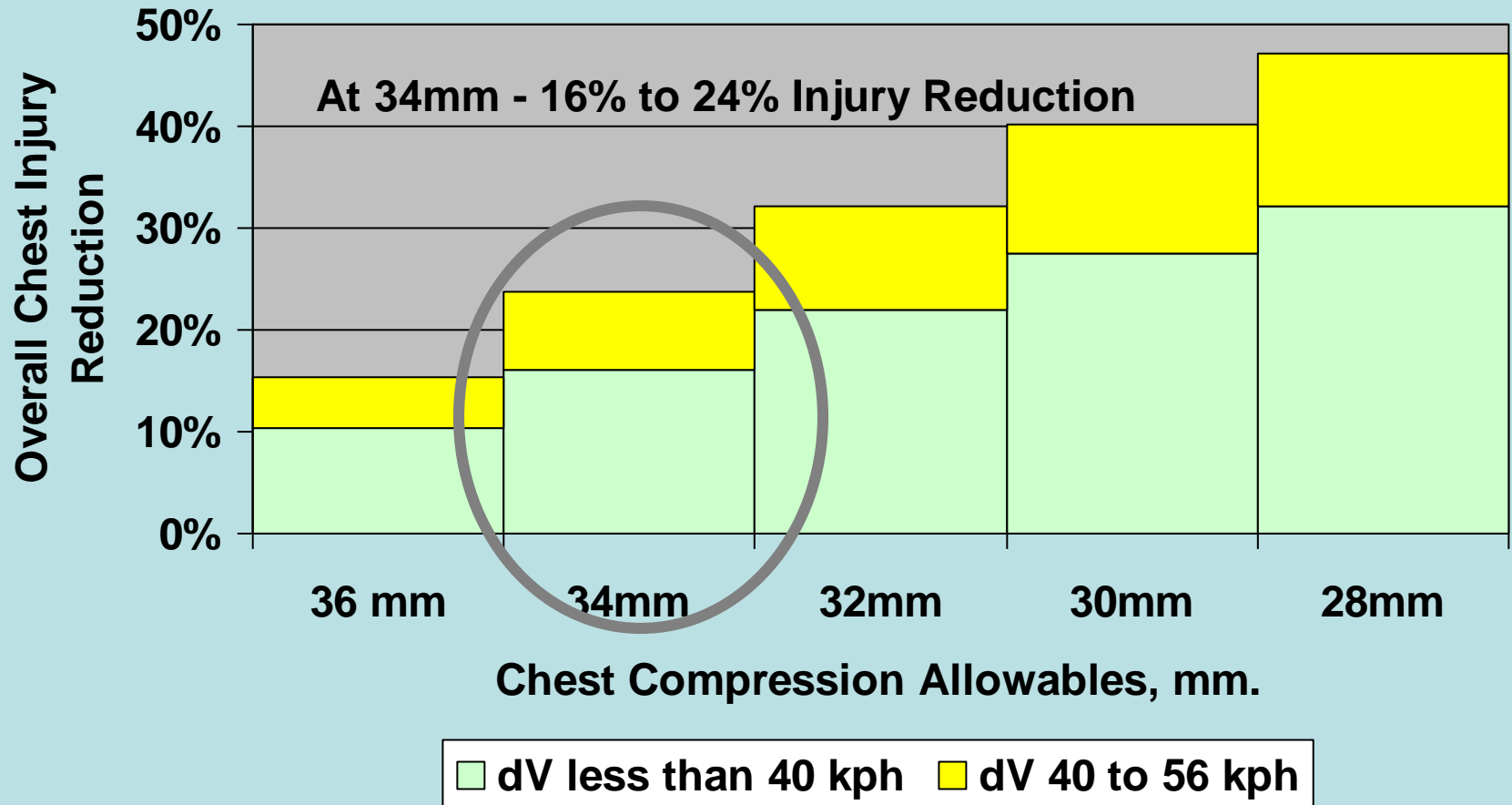
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Chest Injury Rates – Front Outboard Occupants Belted plus Air Bag – NASS 88-05



Overall Chest Injury Reduction for Different Levels of Chest Compression Allowed



Assumptions that may Require Adjustments in Benefits

- Degree to which the tested vehicles represent the fleet in service
- Degree to which the test condition represents injury producing real-world crashes of similar severity
- Degree to which the dummy represents the population being injured
- Degree to which chest injuries are caused by factors not mitigated by the restraint system

Discussion

- Older occupants have lower injury tolerance than younger occupants
- Older occupants are more frequently injured in low severity crashes than younger occupants
- Older occupants are more likely to die from an AIS 3+ injury than younger occupants
- Chest injuries are the most frequent among older occupants
- Safety systems should adjust to provide lower forces on the body in lower severity crashes
- Present systems are optimized for 56 k/hr and the technology may not be effective at lower speeds

Conclusion

Reduction of chest injury through softer belts and air-bags in low severity crashes should be a priority for reducing fatalities to the elderly

This reduction would be beneficial to all other age groups who experience a high fraction of severe chest injuries in low severity crashes

Recommendation

- The chest compression injury allowable should be more stringent in low severity crash tests (rigid barrier, 40kph)
 - New NCAP Test
 - New Regulation
- This would provide incentives for adjusting safety countermeasures in proportion to the severity of the crash and the injury tolerance of the occupants
- The largest beneficiaries for chest injury reduction would be:
 - All ages in low severity crashes –
 - Young women in low and moderate severity crashes
 - Elderly in low severity fatal crashes

Questions?