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Development of a crashworthiness evaluation program for rear-seated occupants in frontal crashes



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Summary of recent IIHS research on rear seat occupants



- ▶ Improved front restraint technologies are making the rear less safe by comparison
- ▶ High seat belt loads exceeding human tolerances – older occupants at particular risk
- ▶ Countermeasures exist but are not widespread
 - Current US regulatory and consumer information crash tests do not drive rear seat belt improvements

Current work:

- ▶ Develop rear-seat occupant test protocol in frontal crash test

2019 research testing

Development of rear-seat occupant test protocol



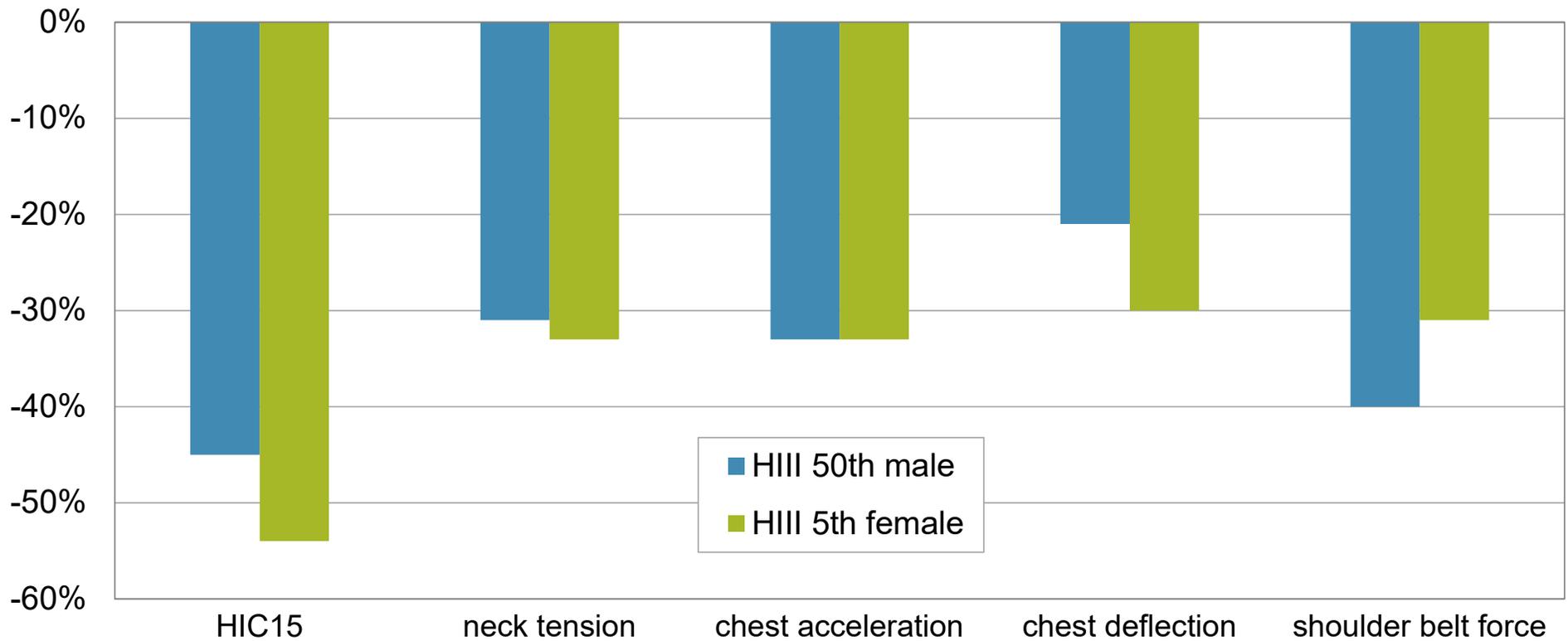
- ▶ Initial matrix of 16 tests to inform decisions on
 - Crash configuration
 - Dummy size and type
 - Seat position
 - Performance and injury metrics
- ▶ Second matrix of 11 tests with a broader set of vehicles
 - Examine whether initial findings persist across a range of vehicles
 - Focus on potential performance metrics
- ▶ Explore effect of potential countermeasures

Rear seat occupant test protocol development research

crash configuration	40% overlap into deformable barrier at 64 km/h (n=19) 25% overlap into deformable barrier at 64 km/h (n=8)
dummy size and type	Hybrid III 50th male (n=12) Hybrid III 5th female (n=23) THOR 5th female (n=4) Hybrid III 10 year-old (without booster) (n=4)
seat position	2 nd row left (n=27) 2 nd row right (n=16)

Average percentage change in injury metrics with belt pretensioner and load limiter

Rear-seat occupants in frontal crash tests



Unfavorable occupant kinematics

Submerging behavior



Unfavorable occupant kinematics

Head impact on forward excursion



Rear seat occupant test protocol development research

crash configuration	Dummy injury metrics and kinematics were more challenged in the 40% overlap than 25% overlap
dummy size and type	Small female represents the broadest range of occupant sizes in the rear seat HIII 5 th female was able to discriminate between vehicles with and without advanced belt technology in the rear THOR 5 th female is not finalized for vehicle evaluations
seat position	Dummy injury metrics and kinematics were more challenged on the left side

Rear seat occupant test protocol development research

40% overlap into deformable barrier at 64 km/h

rear-seat belts	standard belts (n=9) load limiter only (n=1) pretensioner and load limiter (n=10)
vehicle type	Small car (n=1) Midsize car (n=10) Small SUV (n=3) Midsize SUV (n=4) Minivan (n=1)

Rear seat occupant test protocol development research

40% overlap into deformable barrier at 64 km/h

vehicles with
standard rear-seat belts

Honda Civic
Toyota Camry (previous generation)
Mazda 6
Chevrolet Equinox
Hyundai Santa Fe
Chrysler Pacifica

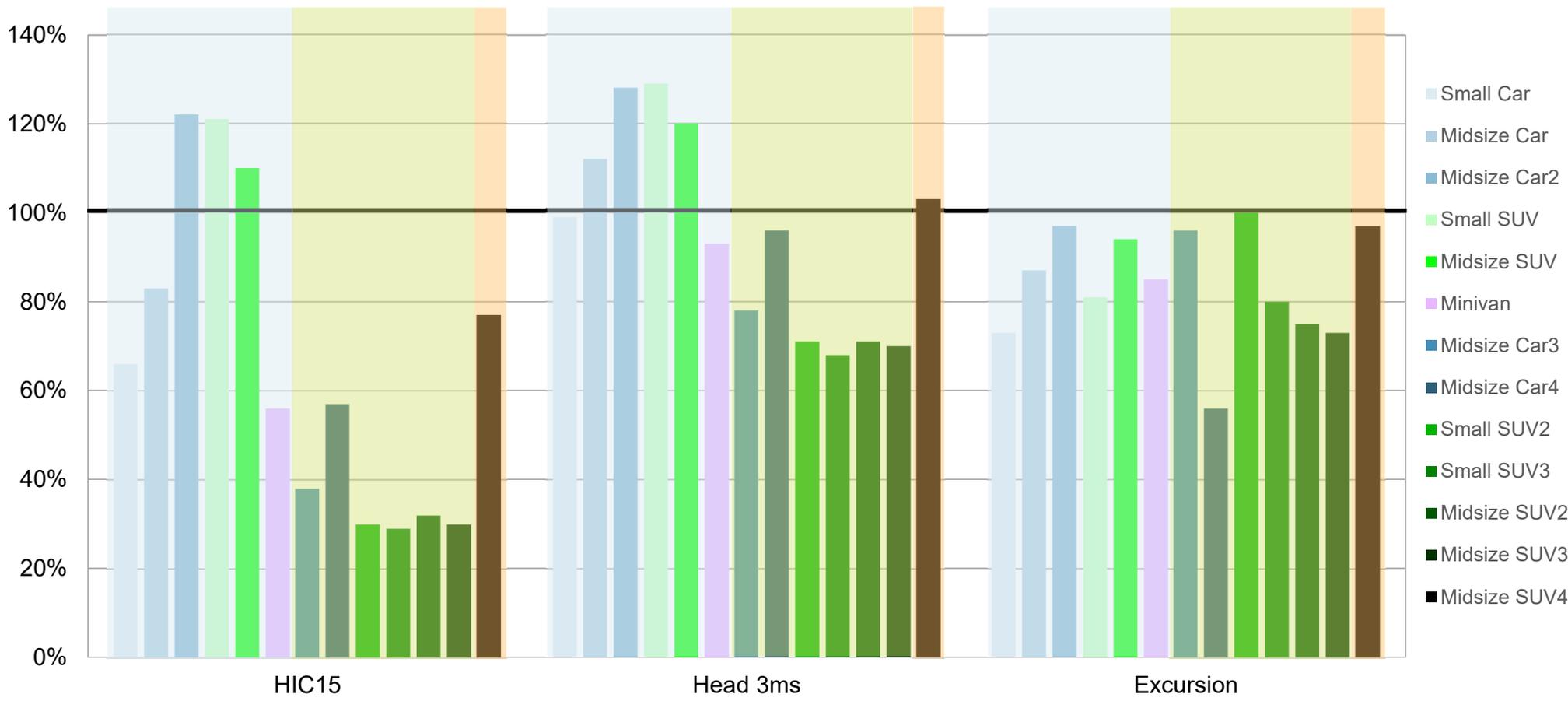
vehicles with
rear-seat load limiters and/or
pretensioners

Toyota Camry (current generation)
Nissan Altima
Subaru Forester
Ford Escape
Volkswagen Atlas
Volvo XC60
Volvo XC60 with integrated booster

Head injury

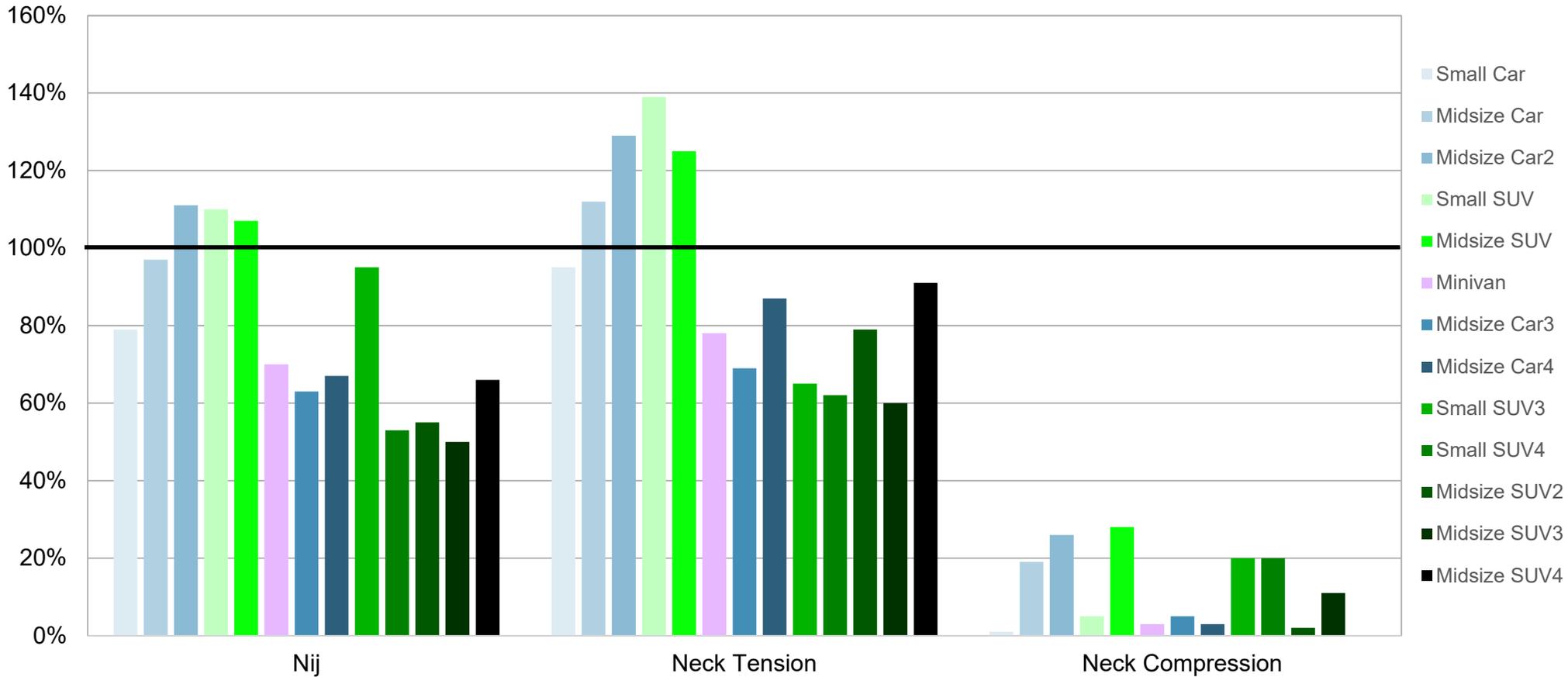
Percent of IARV

standard belt load limiter + pretensioner load limiter only



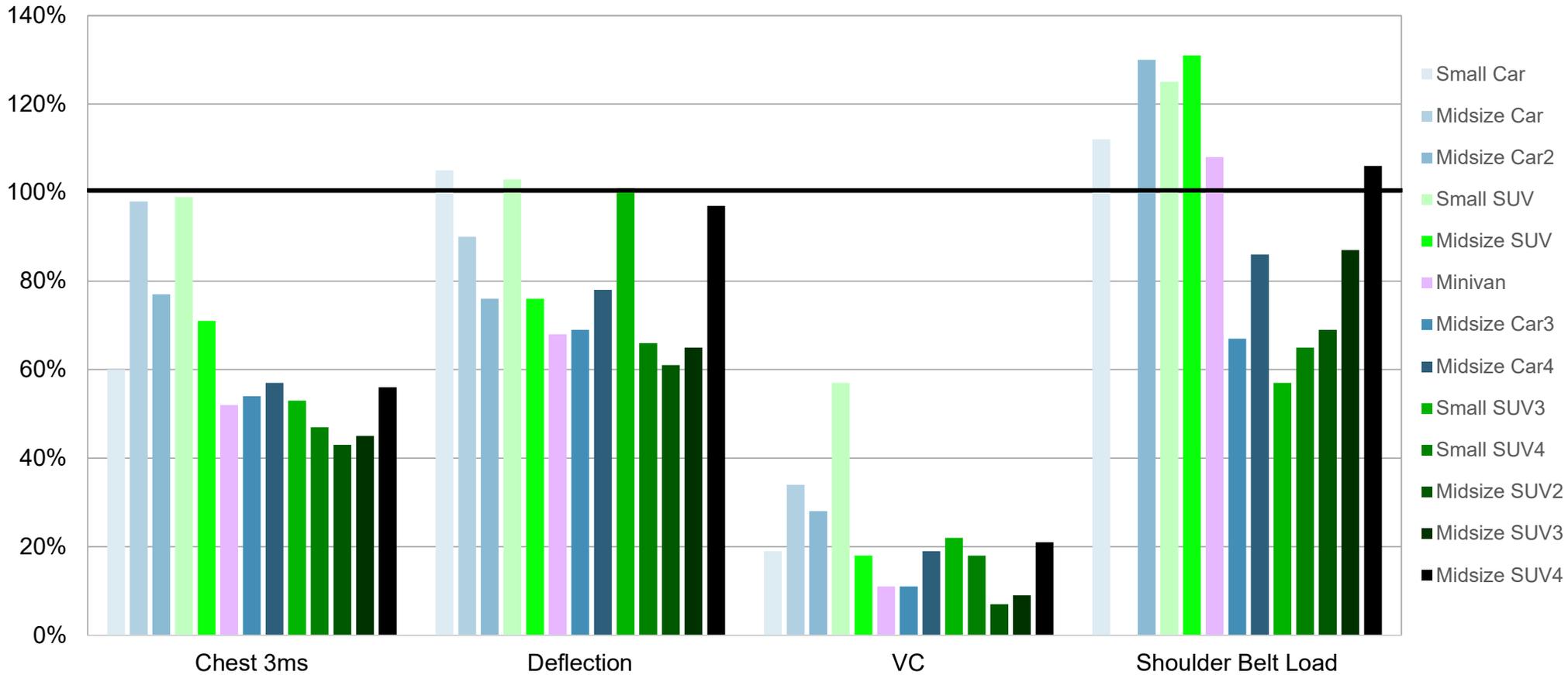
Neck injury

Percent of IARV

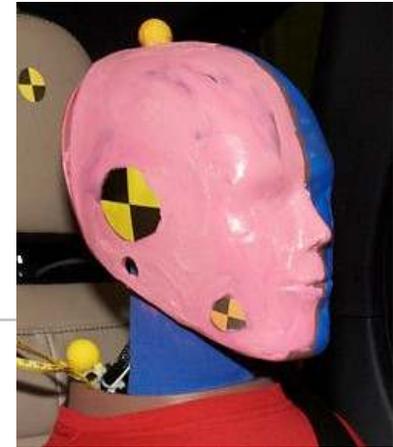
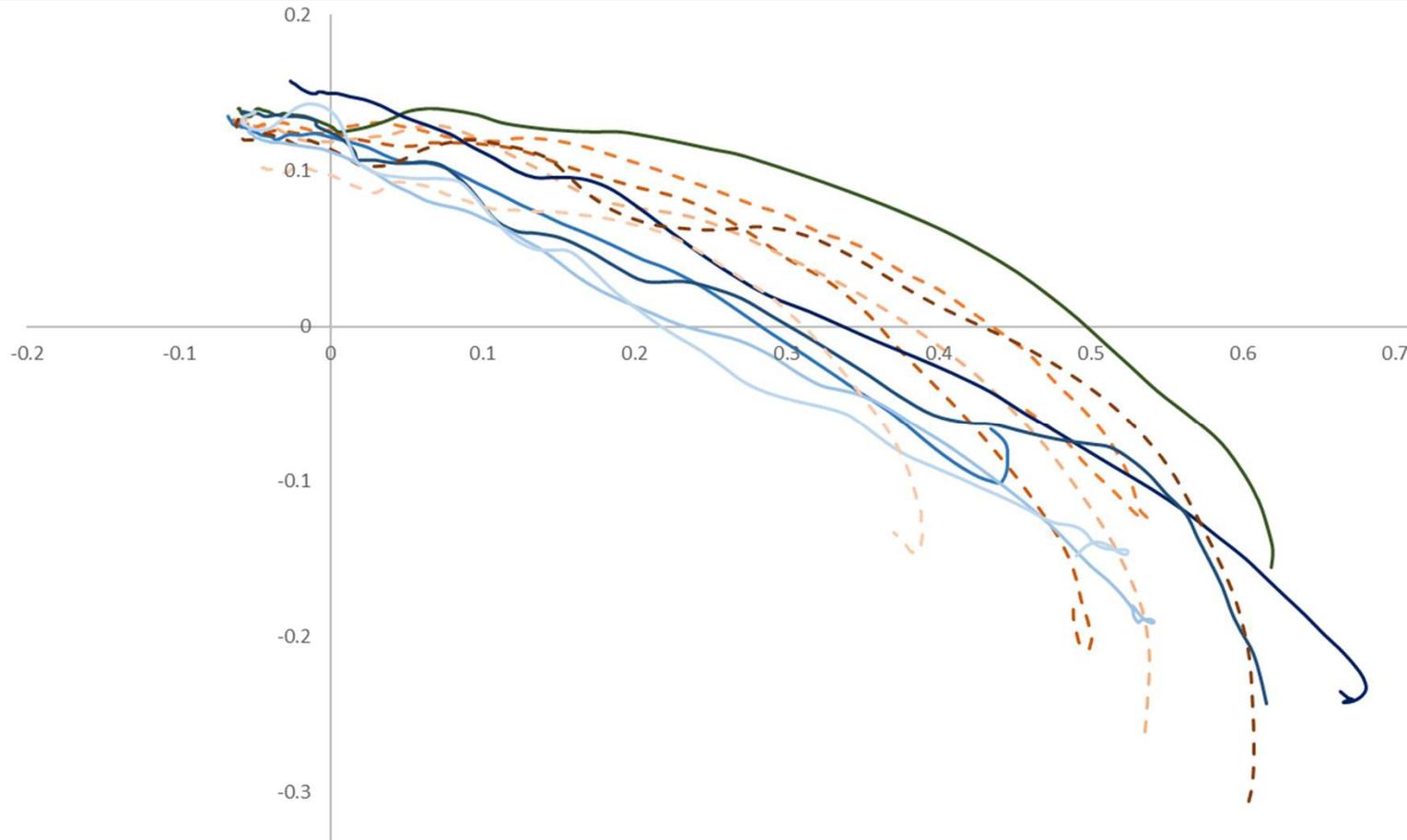


Chest injury

Percent of IARV



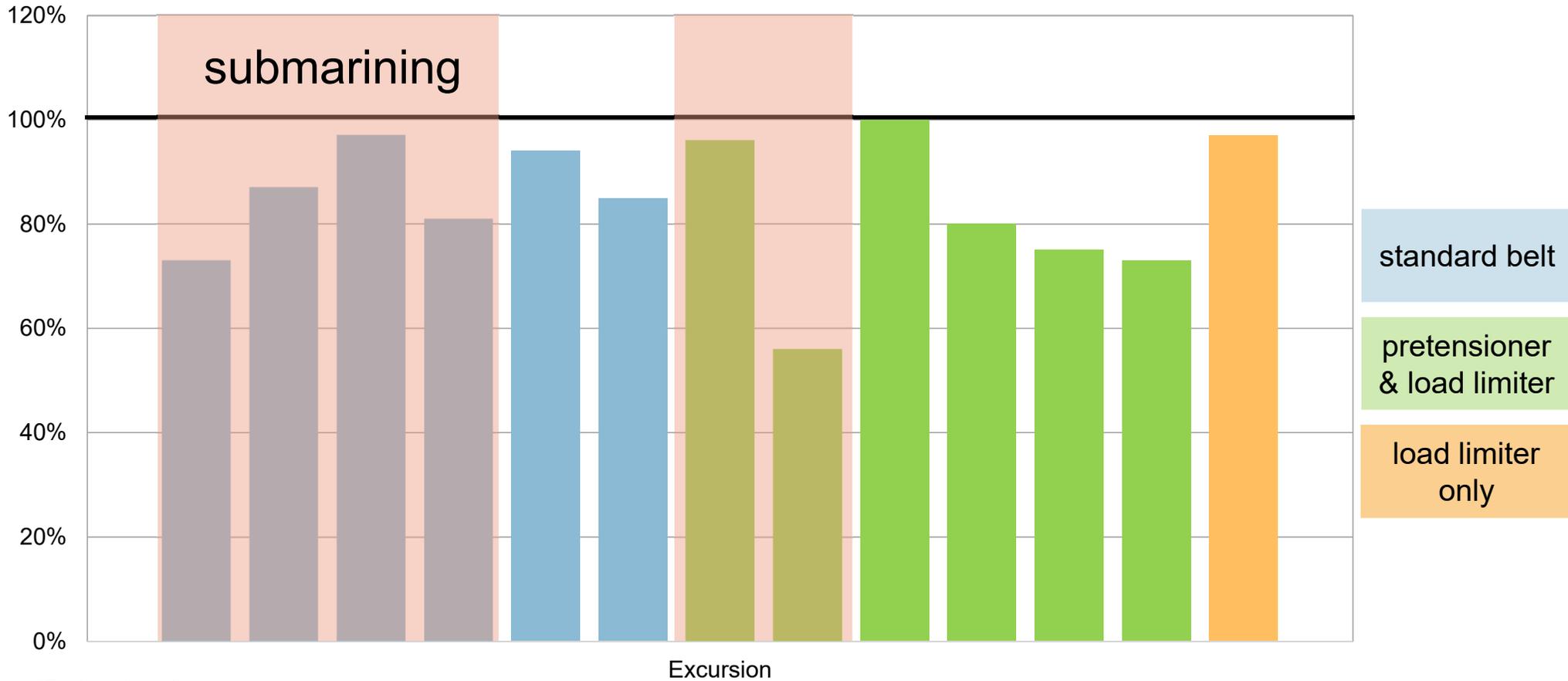
Head excursion



- standard belt
- pretensioner and load limiter
- load limiter only

Head excursion and submarining behavior

Percent of IARV



Submarining in vehicles with pretensioners



Next steps

Development of rear-seat occupant test protocol



- ▶ Recent crash test data still under review
- ▶ Draft protocols expected by early 2020
 - ▶ Seating protocol
 - ▶ Crash test protocol
- ▶ Next round of research tests (early 2020) will focus on potential performance metrics
- ▶ Ratings guidelines and first vehicle ratings targeted for 2021

Don't forget the diversity in rear seat occupants



Thank you

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