The Increasing Role of SUVs in Crash Involvement in Germany

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IRCOBI

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GDV

Literature

- Canada: Increased risk of serious injury or death for car drivers when opponent was an SUV or pick-up (Fredette et al., 2008)
- USA: Increased fatality risk for SUV occupants in roll-overs (Subramanian, 2006)
- USA: 3.4 times higher fatality risk for pedestrians when struck by LTV (incl. SUV) front than by passenger car front (Roudsari et al., 2004)
- Europe: Higher injury risk for car occupants and motorcyclists in collisions with SUV, higher risk of roll-over for SUVs, varying results regarding injury risk for pedestrians (EU project IMPROVER, 2006)

Definition of SUV

- EU project IMPROVER: SUV is a passenger vehicle (M1 class) with
  - approach angle > 25°
  - departure and ramp angle > 20°
  - ground clearance under front and rear axle > 180 mm
  - ground clearance between axles > 200 mm
  - vehicle height > 1600 mm
  - 4x4 drive not required

- Definition for own study: SUV is a passenger vehicle (M1 class) with
  - ground clearance ≥ 170 mm
  - vehicle height ≥ 1590 mm
  - 4x4 drive not required

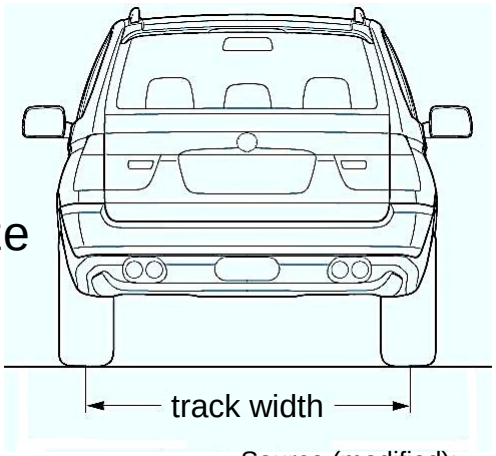
Study Methodology

- Based on geometrical SUV criteria, 83 models identified (current and out-of-production), representing large majority of German SUV fleet
- Special analysis of German national accident statistics (all police-registered injury accidents) with involvement of these models
  - 1997 – 2008 injury accidents, general data
  - 2008 injury accidents for detailed analysis
- Detailed analysis of 361 injury accidents from insurer claim files (min. 15,000 € claim costs) with involvement of respective SUV models
- Analysis of two vehicle user surveys including SUV owners

SUV Definition for Study

SUV models differentiated by

- **Size**: vehicle track width used as indicator for SUV size
  - „small“ if track width ≤ 1550 mm
  - „large“ if track width > 1550 mm



Source (modified): BMW.de



short wheelbase version

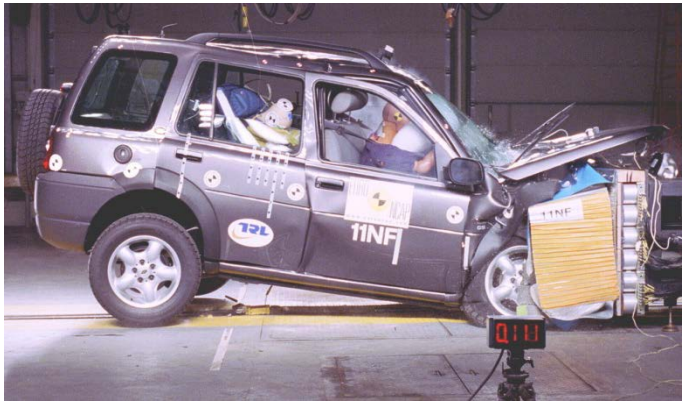


long wheelbase version

SUV Definition for Study, cont‘d

SUV models differentiated by

- **Age**: market introduction as indicator for state-of-the-art passive safety
  - „old“ if model introduced before 2003
  - „new“ if introduced in 2003 or after



Source: euroncap.com



Source: euroncap.com

SUV Definition for Study, cont‘d

SUV models differentiated by

- **Structure**: typical vehicle concept
  - SUV with „frame chassis“ design
  - SUV with „unibody“ design



Source: Daimler.com



Source: Audi.de

SUV Definition for Study, cont‘d

SUV models differentiated by

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- **Structure**: typical vehicle concept
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  - SUV with „unibody“ design

⇒ Eight SUV categories from „small / old / frame chassis“ to „large / new / unibody“ SUV model

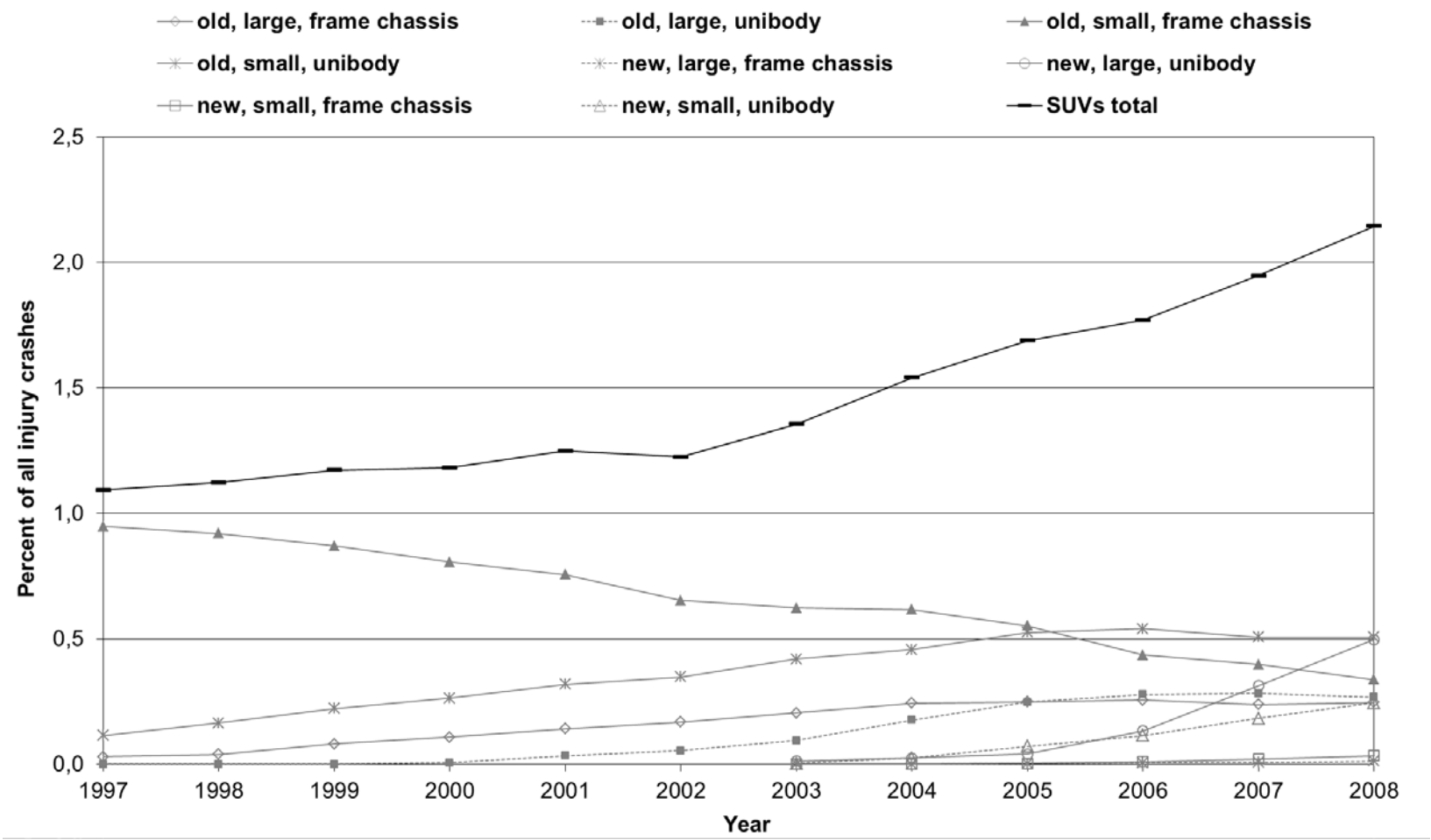


curb mass 1060 kg; length 3625 mm



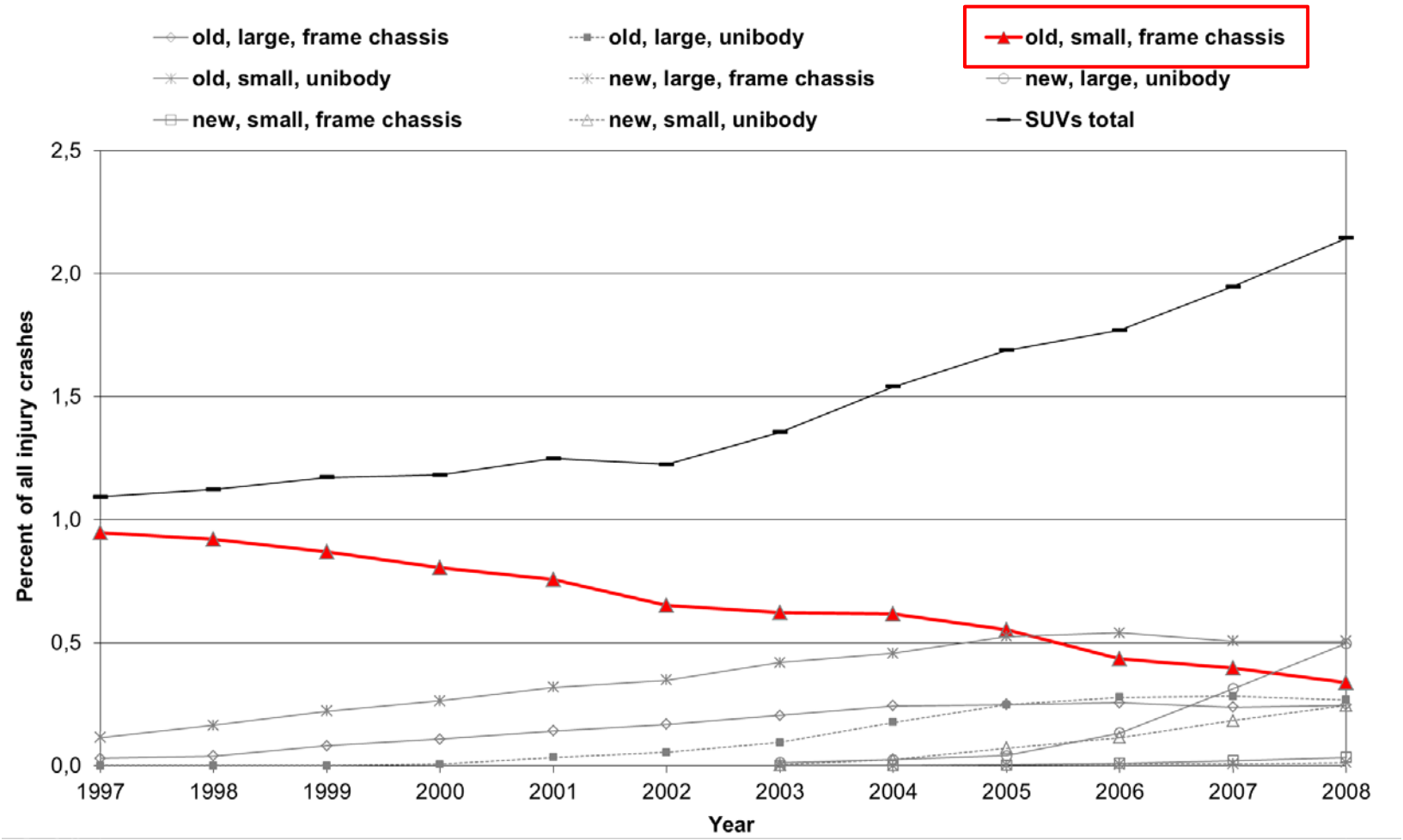
curb mass 2060 kg; length 4800 mm

National Statistics: Incidence Rate



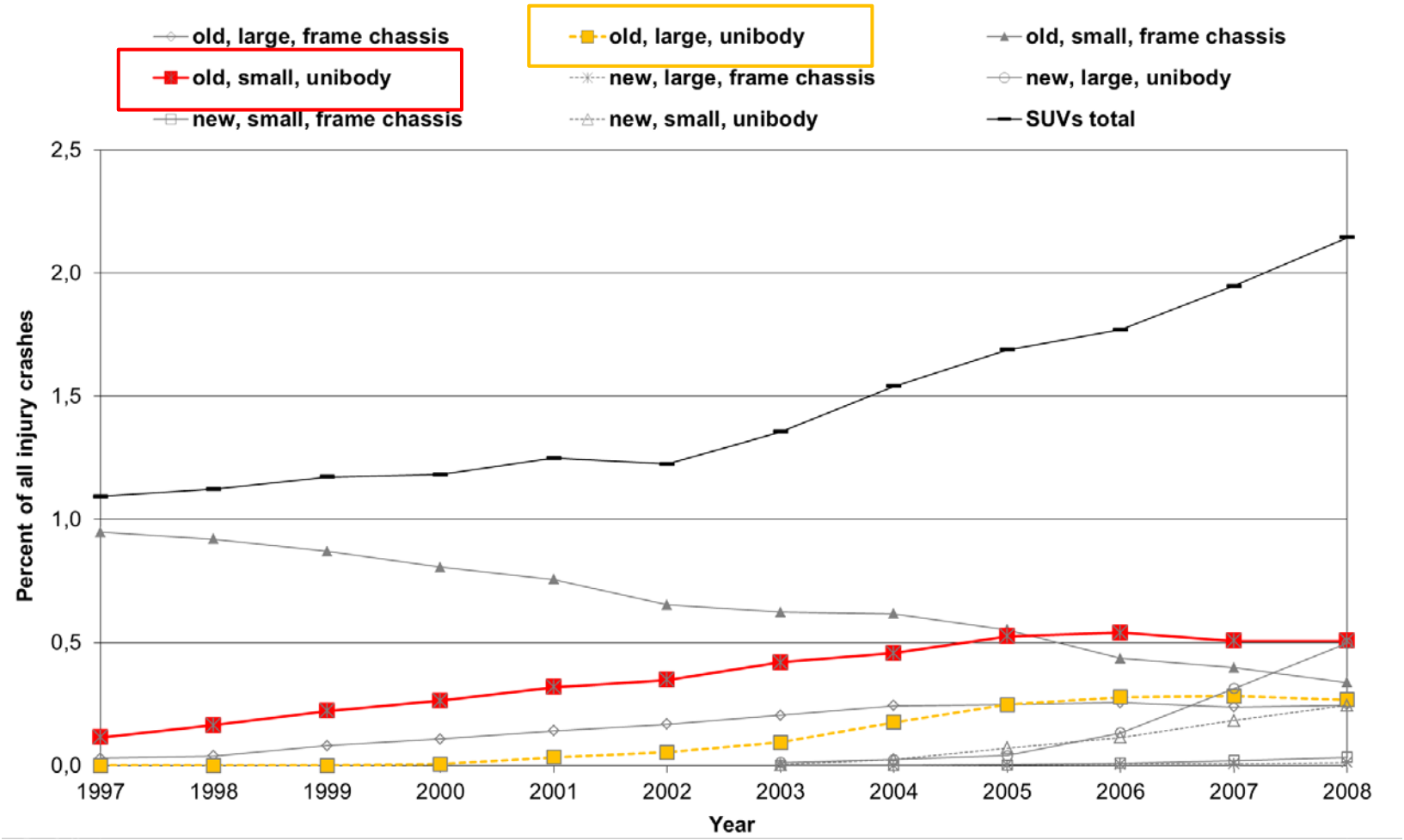
- SUV crash involvement almost parallel to increasing share in fleet

National Statistics: Incidence Rate



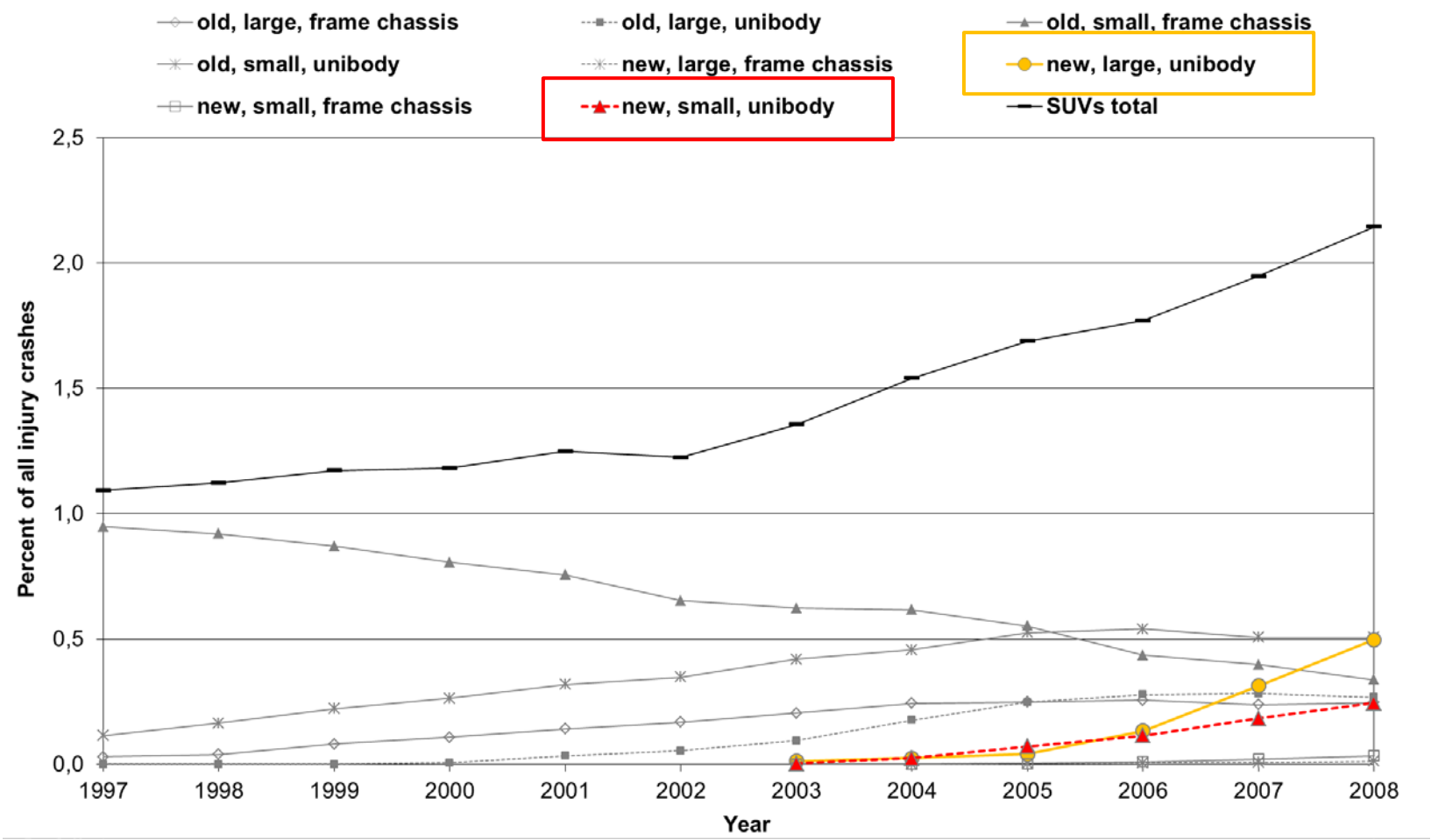
- Involvement of small, old SUVs with frame chassis decreases

National Statistics: Incidence Rate



- Involvement of SUVs with unibody increases

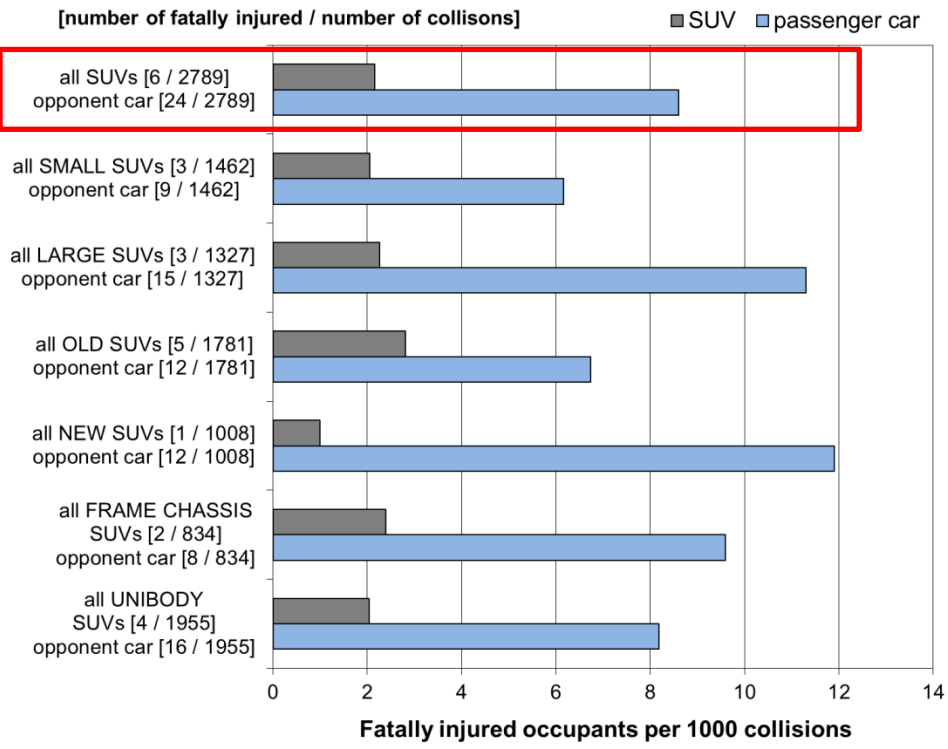
National Statistics: Incidence Rate

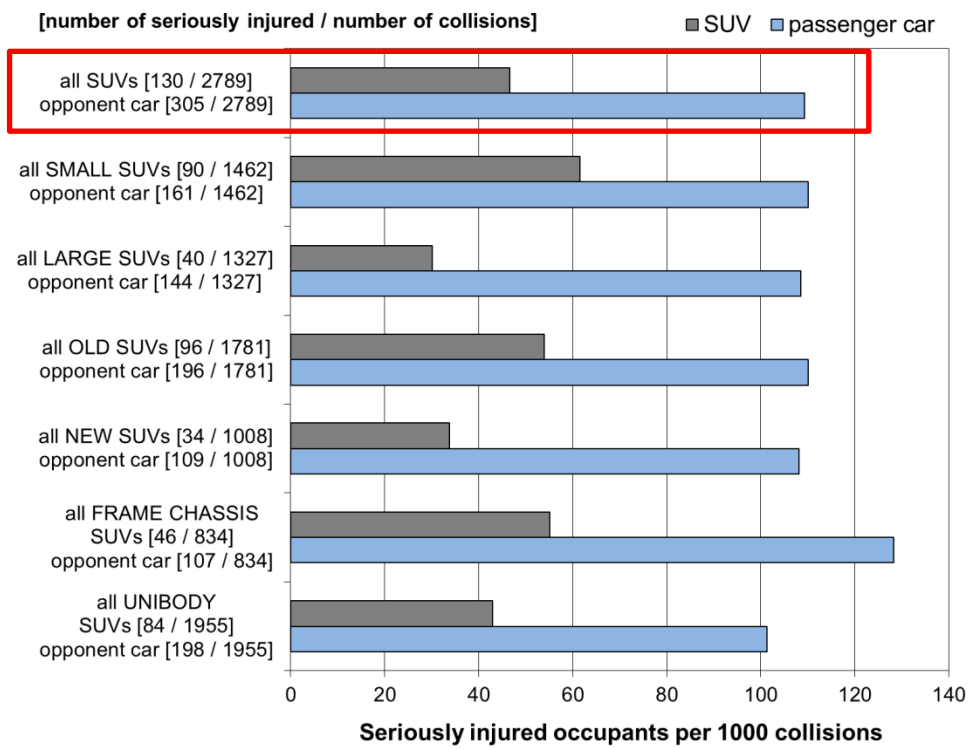


- Involvement of new, especially large, SUVs with unibody increases

SUV-Passenger Car Accidents, Crash Outcome

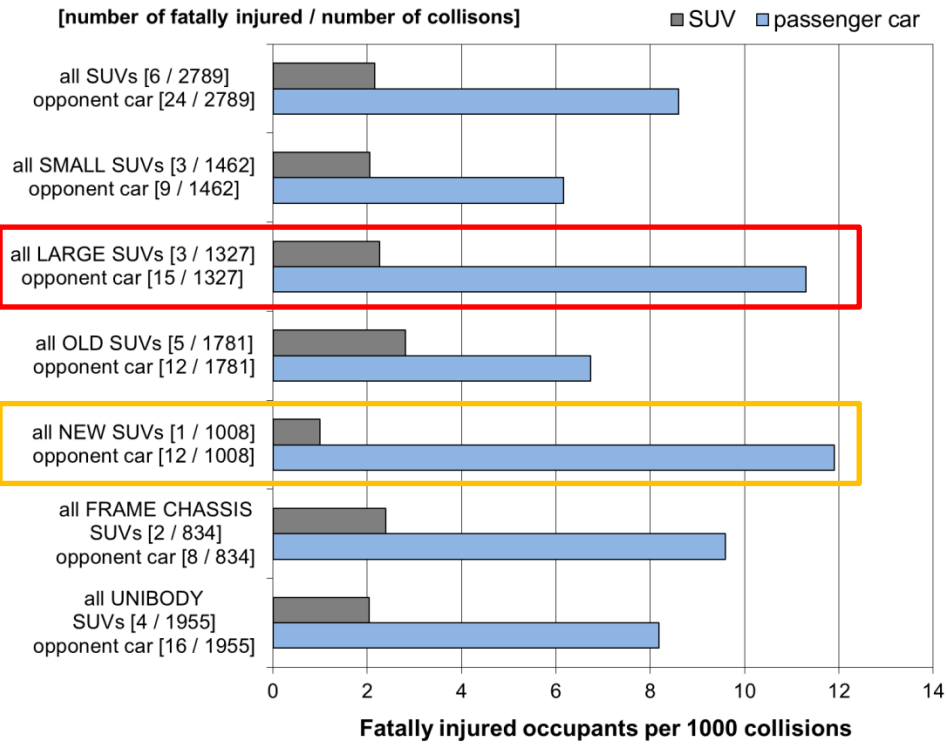
Results from National Statistics, 2008

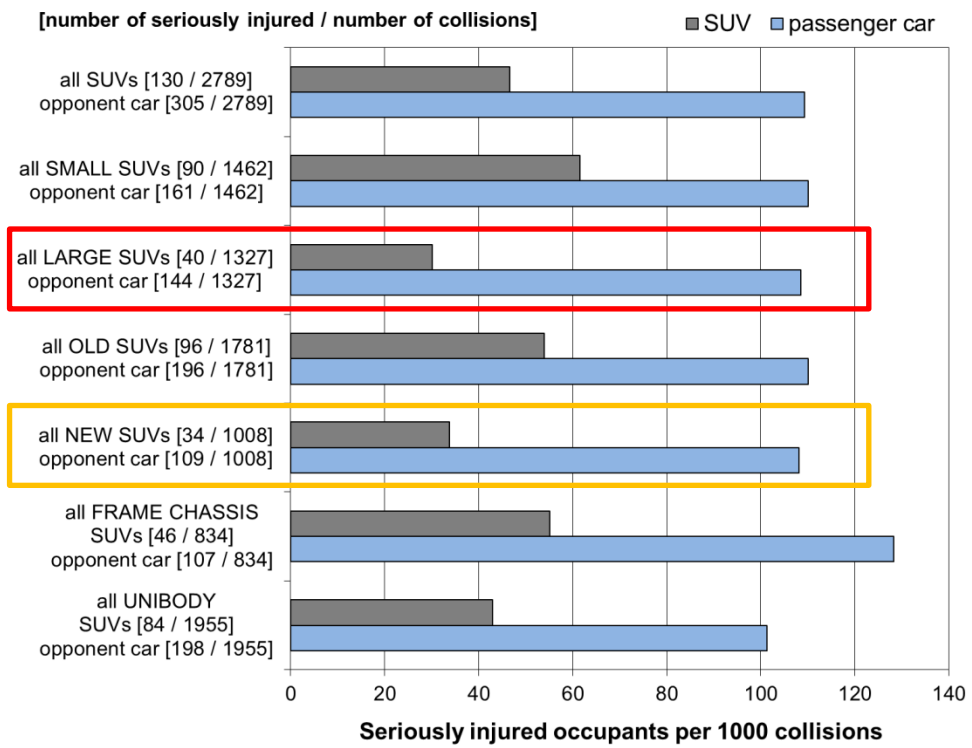




SUV-Passenger Car Accidents, Crash Outcome

Results from National Statistics, 2008

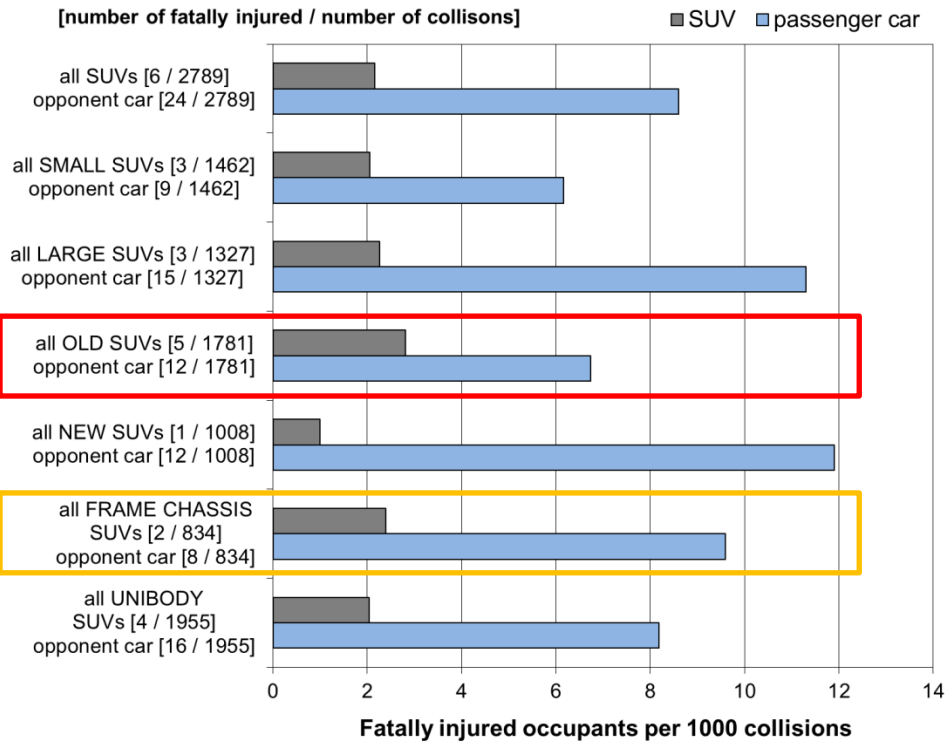


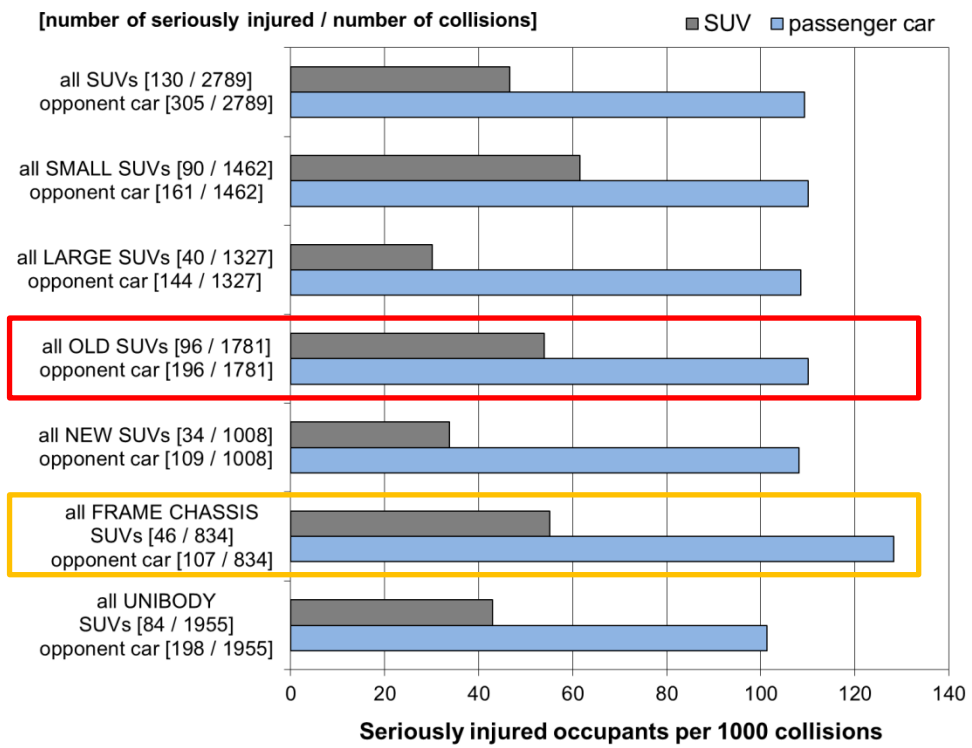


- Apparently, „large“ and „new“ SUVs present highest risk for car occupants

SUV-Passenger Car Accidents, Crash Outcome

Results from National Statistics, 2008



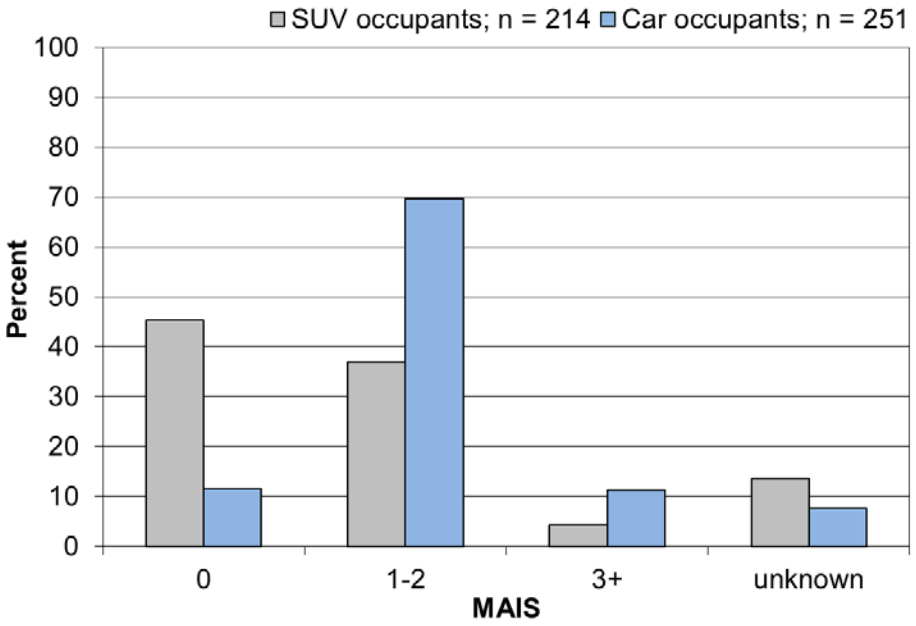


- Apparently, „large“ and „new“ SUVs present highest risk for car occupants
- „Old“ and „frame chassis“ SUVs with less protection for SUV occupants

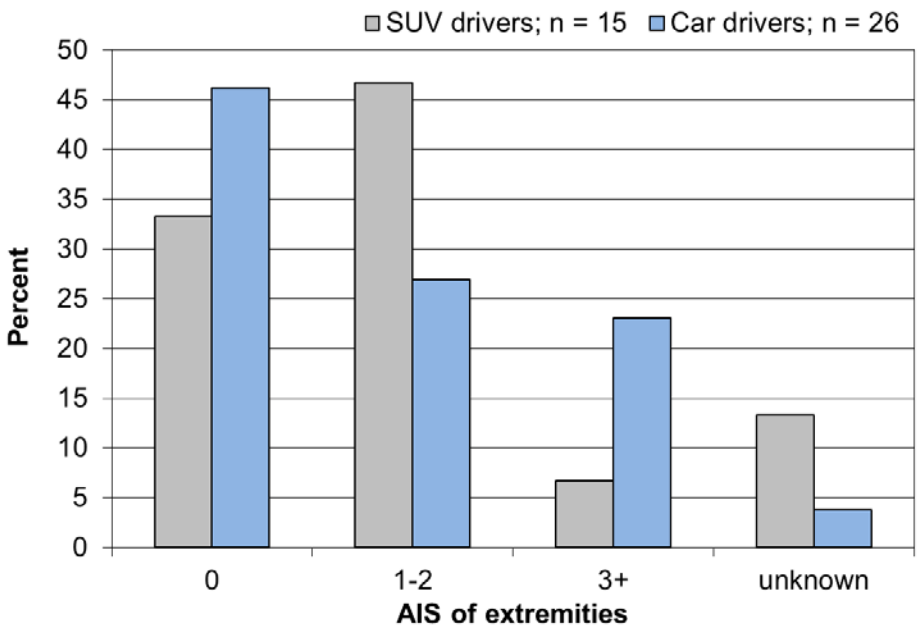
SUV against Passenger Car, Injuries

Results from Insurers Cases (n = 156 accidents)

- All SUV-vs.-car collisions
- All occupants



- Frontal collisions SUV-vs.-car
- Belted drivers

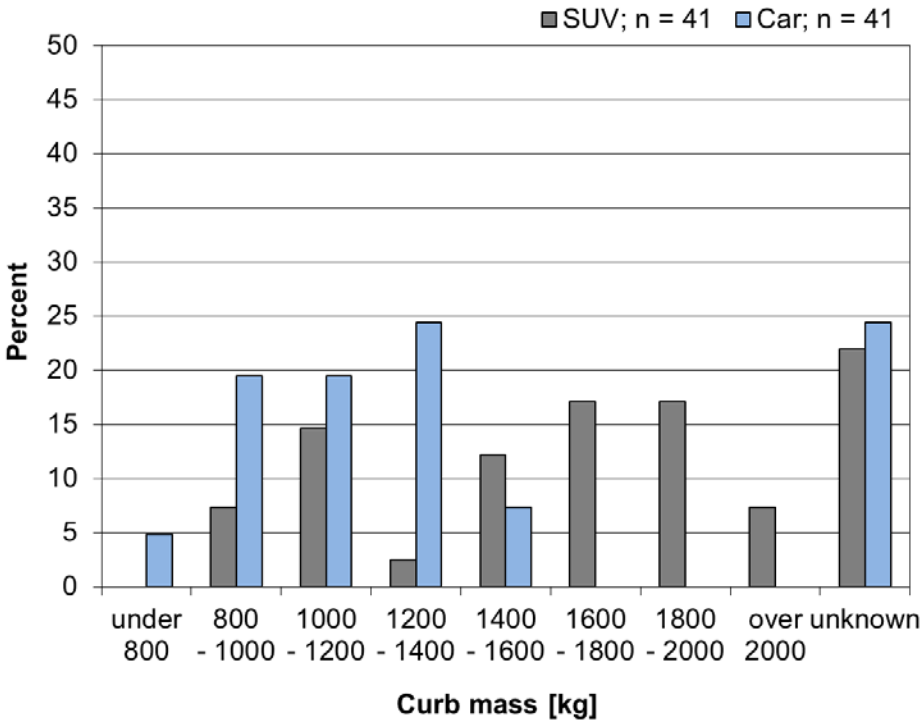


- Higher risk of serious to critical (MAIS 3+) injury for car occupants
- AIS 3+ injuries of extremities indicate intrusion of car compartment

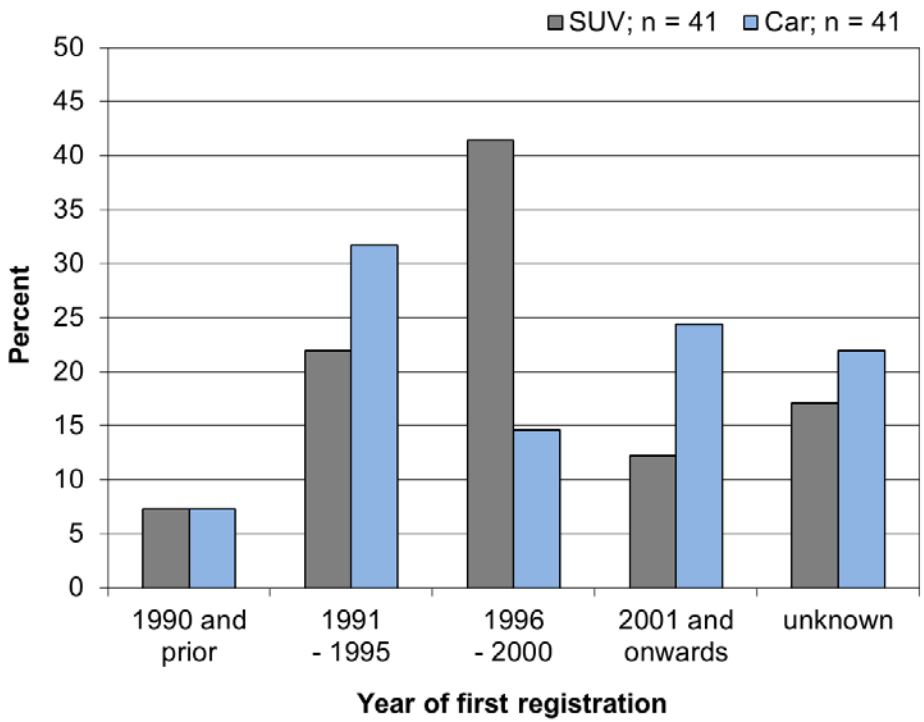
SUV against Passenger Car, Compatibility

Results from Insurers Cases (n = 156 accidents)

- Frontal collisions SUV-vs.-car



- Frontal collisions SUV-vs.-car



- Large majority of SUVs heavier than car opponent
- Difference in vehicle age less pronounced

SUV Single-Vehicle Accidents

National Statistics, 2008

- 6.4 % single-vehicle crashes in injury accidents with SUVs

  10.7 % single-vehicle crashes in injury accidents with passenger cars
- 9 SUV occupant fatalities in single-vehicle accidents, 6 in collisions with passenger cars

Insurers Cases (n = 17 accidents)

- Altogether, 4 drivers and 3 front seat passengers killed, 27 occupants seriously injured
- 3 in 4 SUVs turned or rolled over during crash



SUV-Pedestrian Accidents

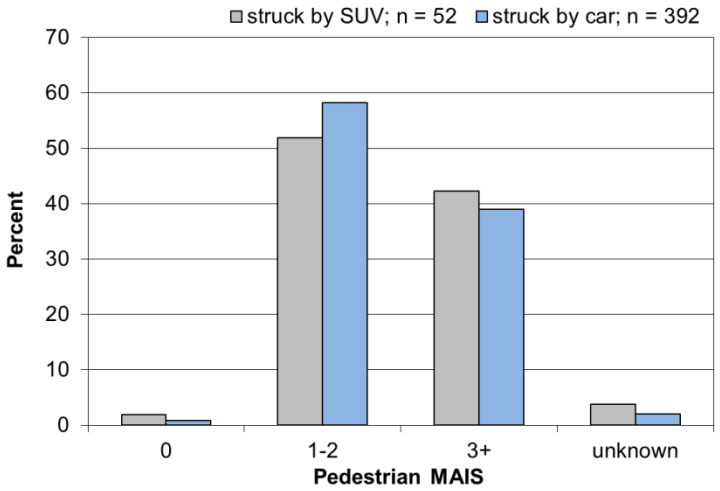
SUV-vs.-pedestrian cases compared to car-vs.-pedestrian cases

National Statistics, 2008

- No difference in injury outcome for pedestrians struck by SUVs and those struck by passenger cars
- Minor decrease in proportion of seriously and fatally injured when struck by „new“ SUV vs. „old“ SUV

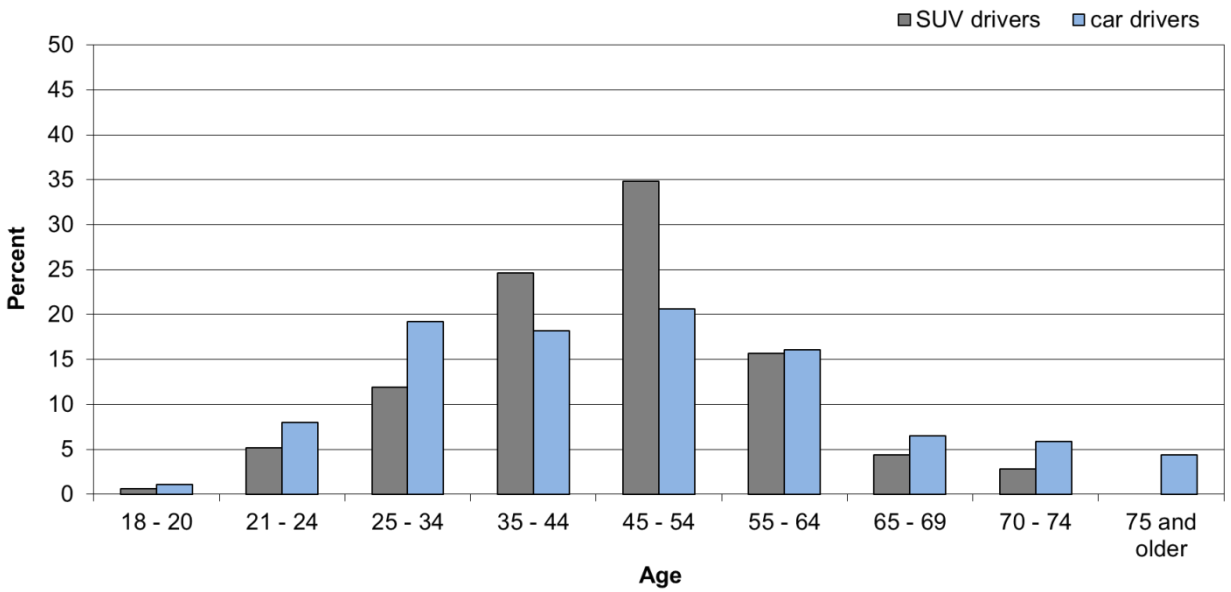
Insurers Cases (n = 52 pedestrians)

- Proportion of MAIS 3+ injuries slightly higher than in group of pedestrians struck by pass. cars
- Minor differences in severity for head, chest, legs, pelvis between those struck by SUV and those struck by pass. car (not signif.)



Vehicle User Surveys

- Automotive supplier customer panel (incl. 686 SUV owners)
- 2010 survey „Traffic climate in Germany“ (incl. 306 SUV drivers)



- Similar gender distribution (male drivers: 56 % in SUV; 51 % pass. car)
- On average, similar age of SUV (mean: 45 yrs.) and pass. car drivers (mean: 50 yrs.), but smaller share of young and elderly drivers in SUVs
- SUV drivers reported ca. 30 % higher annual mileage

Summary / Conclusions: Driver Behavior

- SUVs not prominent in injury accidents in Germany
- Causes of SUV accidents not different from car accidents
- SUV drivers feel safer in traffic, perform distracting tasks more often during driving (e.g., cell phone use)
- No indication of directly unsafe behavior of SUV drivers (e.g., speeding)
- Typical age groups at risk clearly underrepresented
- However, young SUV drivers prominent in single-vehicle accidents
- Advantages partly compensated by higher exposure (i.e., mileage)

Summary / Conclusions: SUV Characteristics

- If collision with SUV occurs, higher injury risk in opponent car
- On average, SUVs 4.5 yrs. old, cars are 8.1 yrs. old in German fleet
- Change in SUV fleet towards larger unibody vehicles reflected in accident involvement
- Protection for SUV occupants improved, protection of crash opponents still insufficient
- Tendency for SUVs to roll over
- SUV-pedestrian accidents show slightly lower injury risk for head, slightly higher injury risk for leg and pelvis
- SUV crash compatibility remains an issue; possible countermeasures: larger area of energy-absorbing structure, emergency braking systems.

Thank you for your attention!

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SUV crash test

videos and results on

www.udv.de

Thank you for your attention!

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„Let‘s see, what great adventures Dad is going to experience today on the way to the office!“



Definition of SUV

- USA: Fatal Accident Reporting System (FARS) refers to ANSI D16.1 (American National Standard)
  „Utility Vehicle“ is multi-purpose vehicle, generally with 4x4 drive and increased ground clearance, with max. permissible mass ≤ 4,500 kg
- USA: CFR 49 Part 523
  Light trucks include SUVs, pick-up trucks, minivans and vans
  „Light truck“ is … designed for off-highway operation and has 4x4 drive

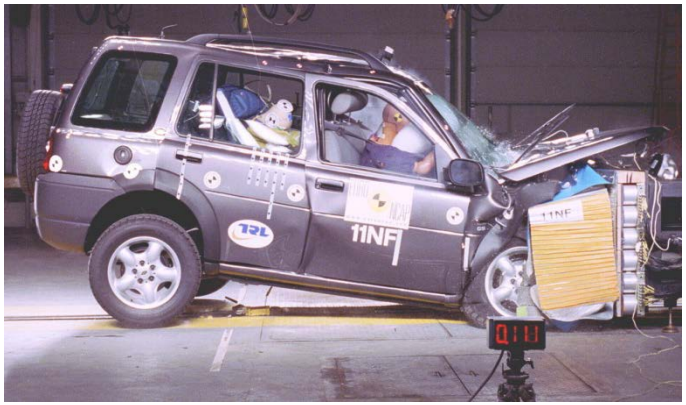
  or

  … fulfills certain geometrical requirements (e.g., min. approach and departure angle, min. ground clearance)
- CFR 49 Part 523 pertains also to average fuel economy standards.
  May become more stringent ⇒ re-classification of models

SUV Definition for Study, cont‘d

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Source: Daimler.com



Source: Audi.de

SUV Single-Vehicle Accidents

National Statistics

- 6.4 % single-vehicle crashes among SUV injury accidents

  10.7 % single-vehicle crashes among passenger car injury accidents
- In 2008, 9 SUV occupant fatalities in single-vehicle accidents, 6 in collisions with passenger cars

USA (IIHS Fatality Facts, 2009)

- 64 % of killed SUV occupants in single-vehicle crashes
- 46 % of killed car occupants in single-vehicle crashes

Insurers Cases

- 17 cases of single-vehicle crashes among SUV accidents
- Altogether, 4 drivers and 3 front seat passengers killed, 27 occupants seriously injured
- 3 in 4 SUVs turned or rolled over during crash

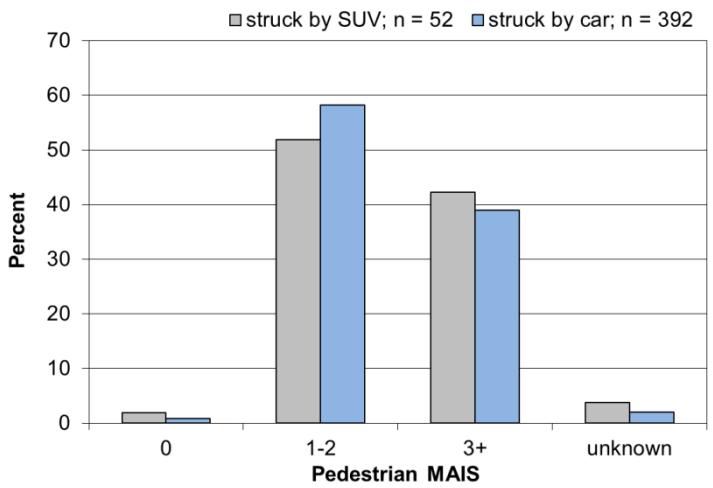


SUV-Pedestrian Accidents

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National Statistics

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- Minor decrease in proportion of seriously and fatally injured when struck by „new“ SUV vs. „old“ SUV



Insurers Cases

- 52 cases of collisions between SUVs and pedestrians
- Proportion of MAIS 3+ injuries slightly higher than in group of pedestrians struck by pass. cars
- Minor differences in injury severity for head, chest, legs, pelvis when struck by SUV or struck by passenger car

Discussion / Conclusions, Driver Behavior

- SUVs not prominent in injury accidents in Germany
- Causes of SUV accidents not different from car accidents
- SUV drivers tend to feel generally safer in road traffic, operate navigation devices or cell phone more often during driving
- No indication of directly unsafe behavior of SUV drivers
- Typical SUV driver does not belong to age groups at risk
- In single-vehicle accidents, young SUV driver population prominent
- Low risk driver behavior partly compensated by higher accident exposure

Discussion / Conclusions, SUV characteristics

- If collision with SUV occurs, higher injury risk in opponent car
- SUVs in German fleet 4.5 yrs. old, the average German car is 8.1 yrs.
- Change in SUV fleet towards larger unibody vehicles reflected in accident involvement
- Protection for SUV occupants improved, protection of crash opponents still insufficient, despite change from frame chassis to unibody, partly due to growth in SUV mass
- Higher tendency to roll over also visible in Germany
- Pedestrian accidents show slightly lower risk for serious head injury, slightly higher risk for serious leg and pelvis injury, but not significant
- Some deficiencies in crash compatibility remain and should be addressed with larger energy-absorbing front areas, but also with emergency braking systems.