

Mercedes-Benz CIREN Center
The University of Alabama at Birmingham

Passenger Cars, Minivans, and SUVs An Exploratory Study in Relative Injury and Fatality Rates

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Definitions - Vehicle Categories

- LTV-Light Trucks and Vans
 - < 10,000 lb GVW
 - Pickups, Vans, Minivans
 - Truck-based station wagons
 - Sport Utility Vehicles (SUV)
- Light Vehicles
 - LTVs and Passenger Cars

Crashworthiness

- Capability of a vehicle to protect its occupants in a collision

Aggressivity

- Measured in terms of the causalities to occupants of the other vehicle involved in the collision

Issues Related to LTVs

- **Market Share**
- **Safety - Fatality & Injury Statistics**
- **Exploratory Data**
- **Vehicle Compatibility & Aggressivity**
- **Future Directions**

Top Selling Vehicles

- 1. Ford F-Series pickup
- 2. Chevrolet Silverado pickup
- 3. Honda Accord
- 4. Ford Explorer
- 5. Toyota Camry
- 6. Ford Taurus
- 7. Dodge Ram pickup
- 8. Honda Civic
- 9. Ford Ranger pickup
- 10. Dodge Caravan
- 11. Ford Focus
- 12. Chevrolet Cavalier
- 13. Toyota Corolla
- 14. Jeep Grand Cherokee
- 15. Chevrolet Impala
- 16. Chevrolet Malibu
- 17. Pontiac Grand Am
- 18. Chevrolet Tahoe
- 19. GMC Sierra pickup
- 20. Ford Windstar

Source: Reuters

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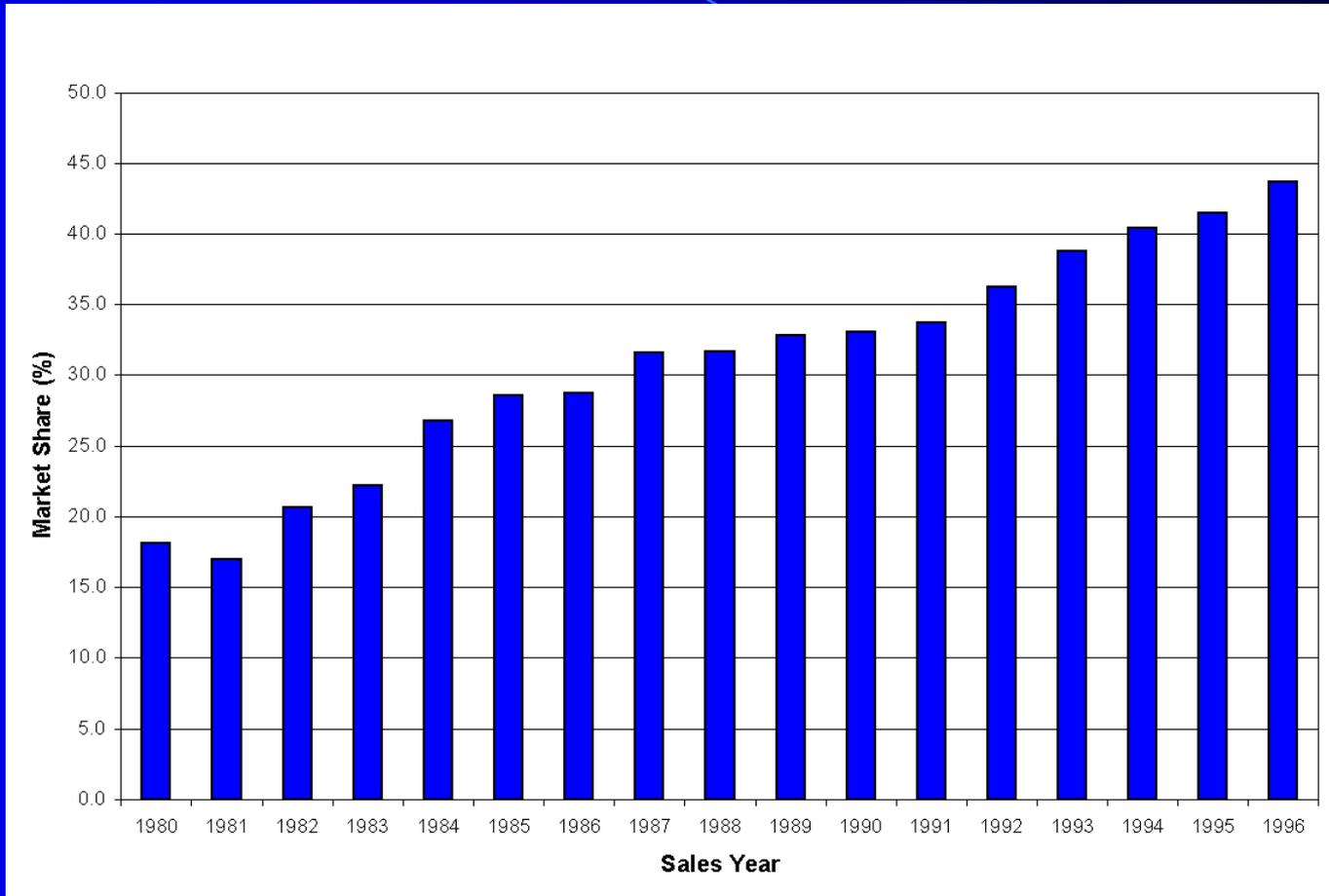
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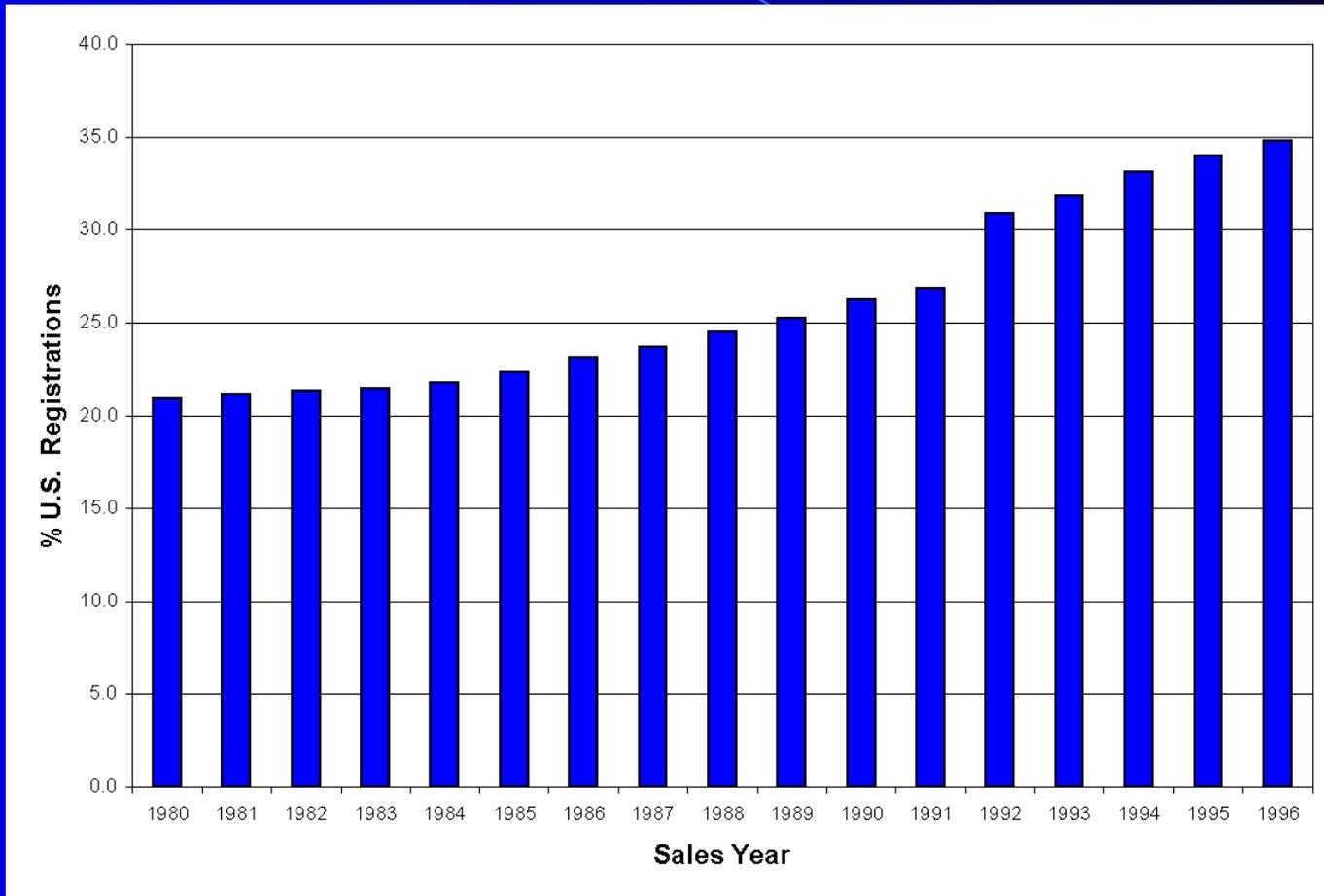
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- 

LTVs Sales as Fraction Light Vehicles Market Share



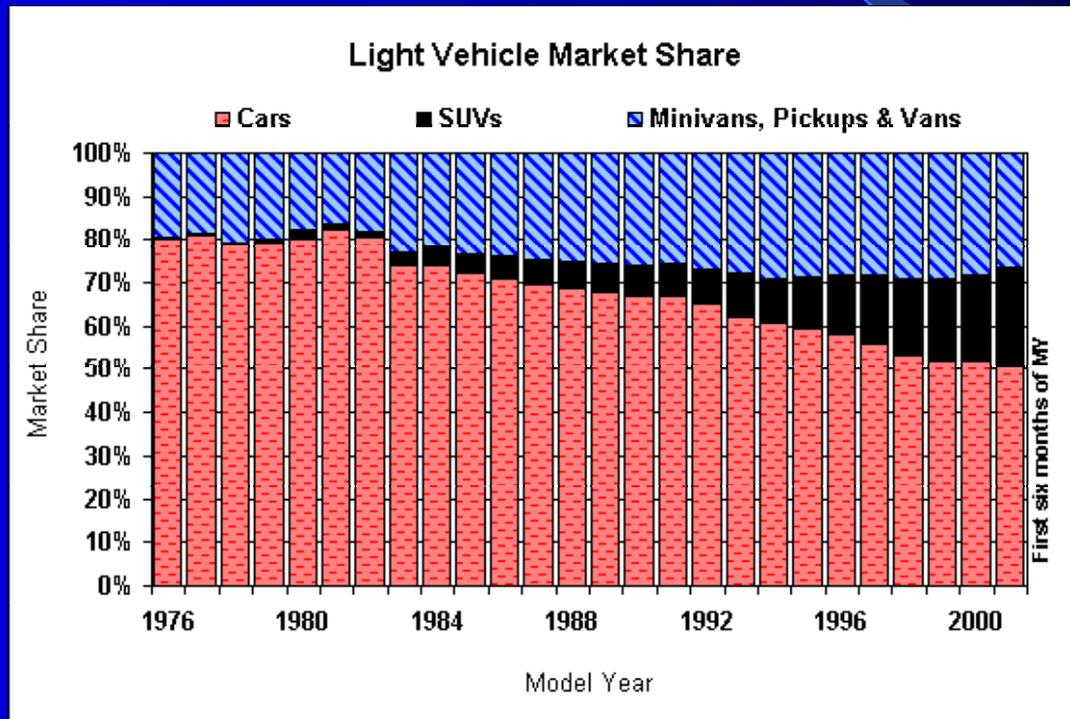
Light Truck & Van Registrations as Fraction Light Vehicle Registrations



R.L. Polk Co., 1980-96

SUV Market Share

- 14.2% in 1996 to 21.0% in 2000; a 48% increase



Polk News Release

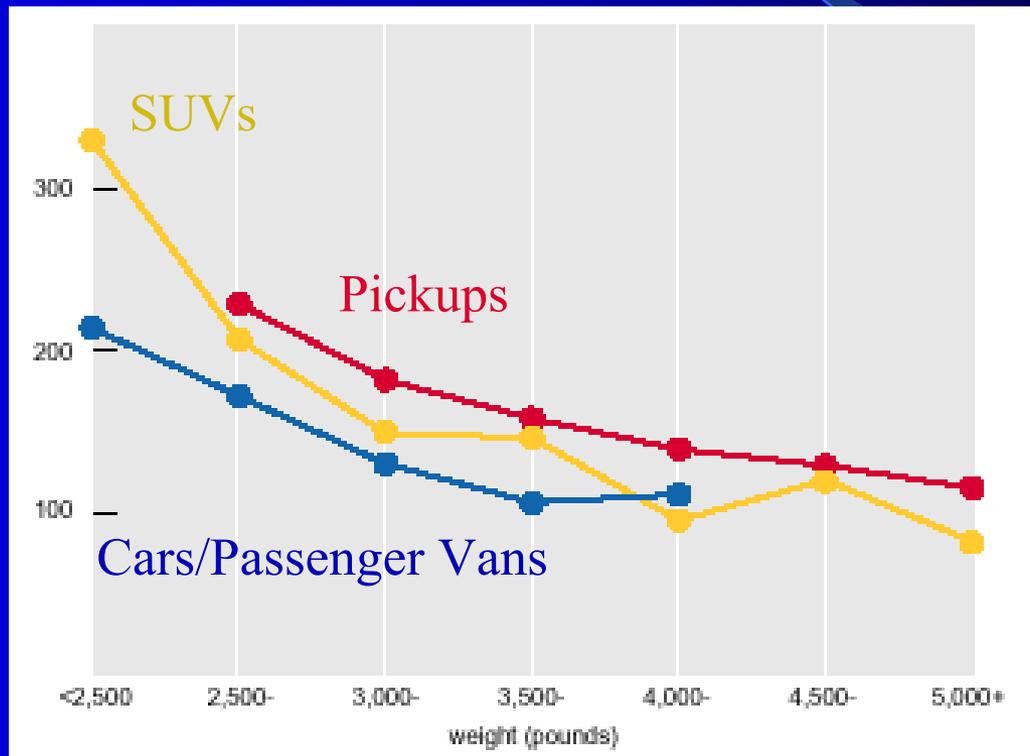
S. Davis, Oak Ridge National Laboratory, Light Vehicle MPG and Market Shares System, Oak Ridge, TN, 2001.



Crash Statistics

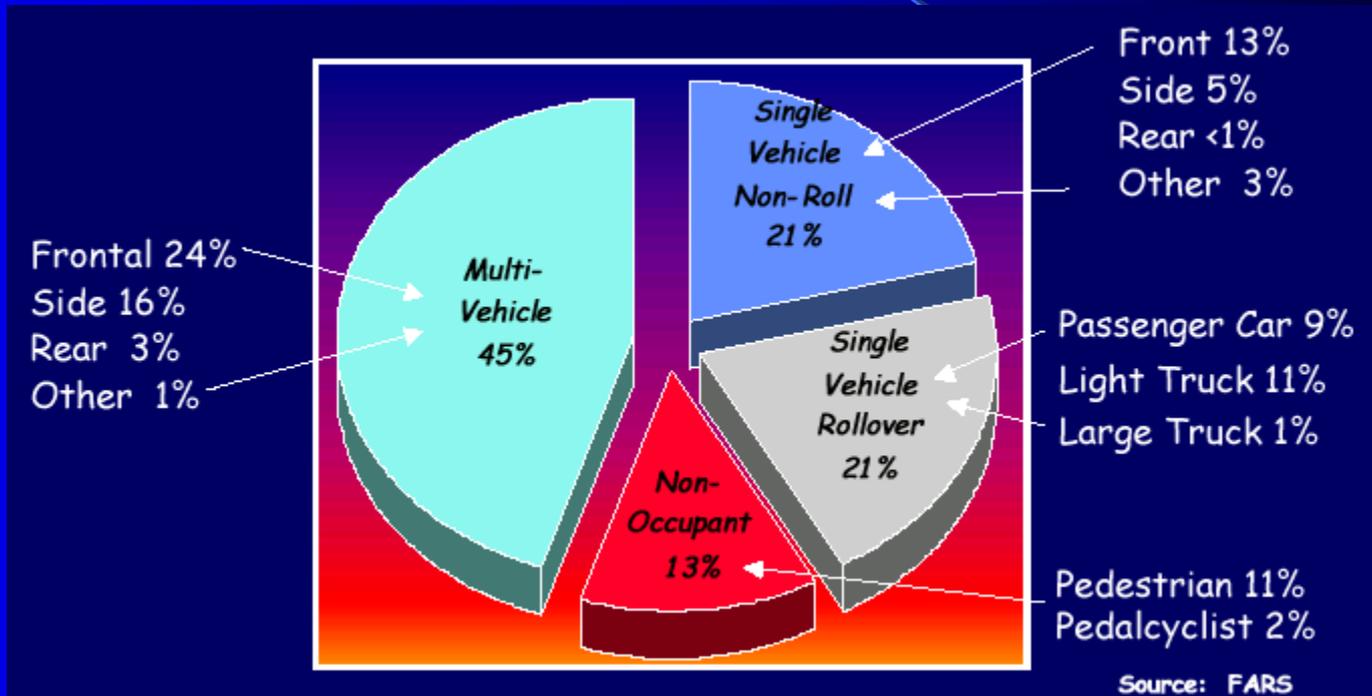
- NHTSA
- IIHS
- NASS - Exploratory Data

Occupant Death Rates per Million Vehicles per Year



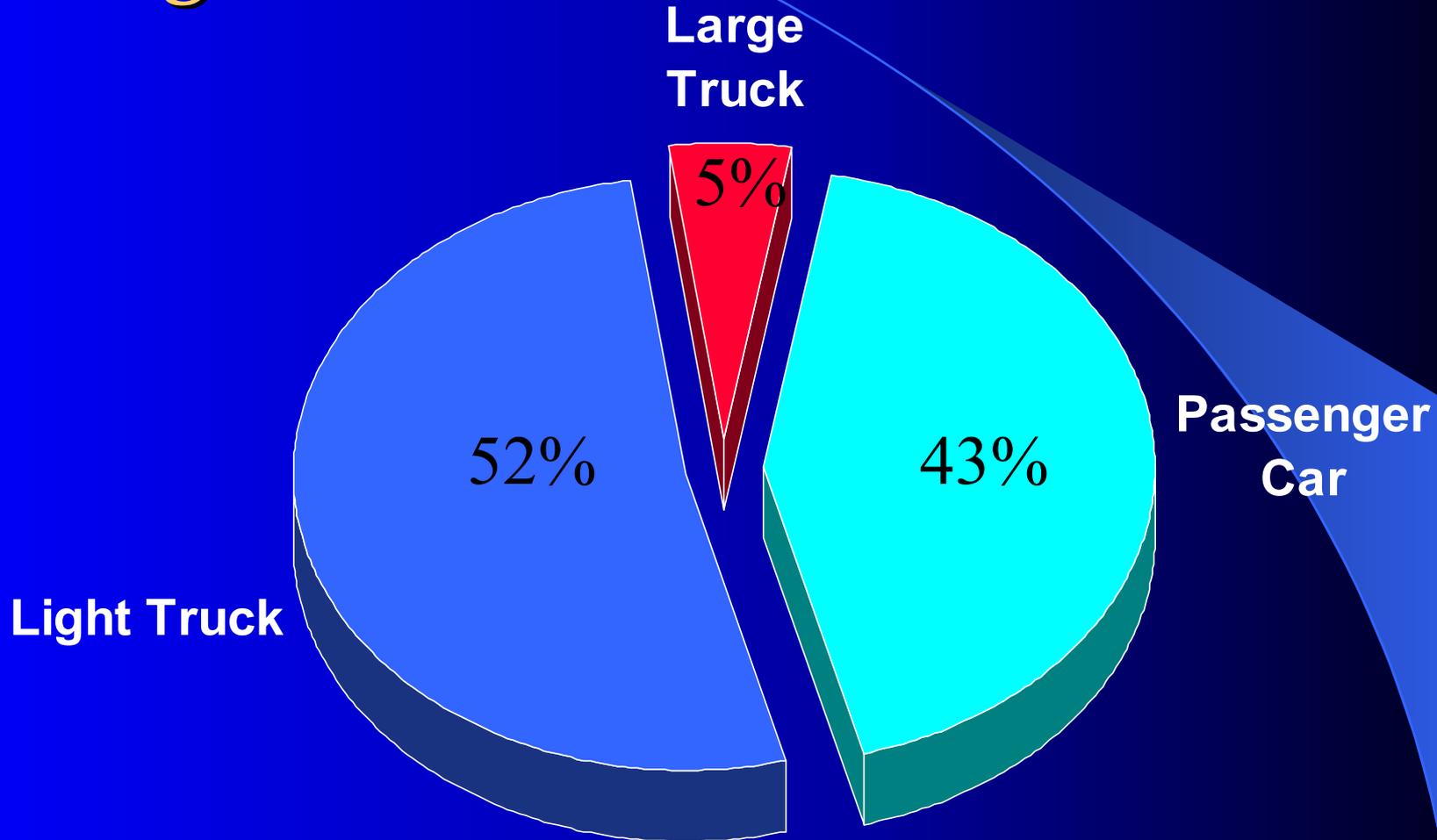
Status Report: Crash compatibility. IIHS. 1999:33(1).

Persons Killed in 2000 by Crash Type



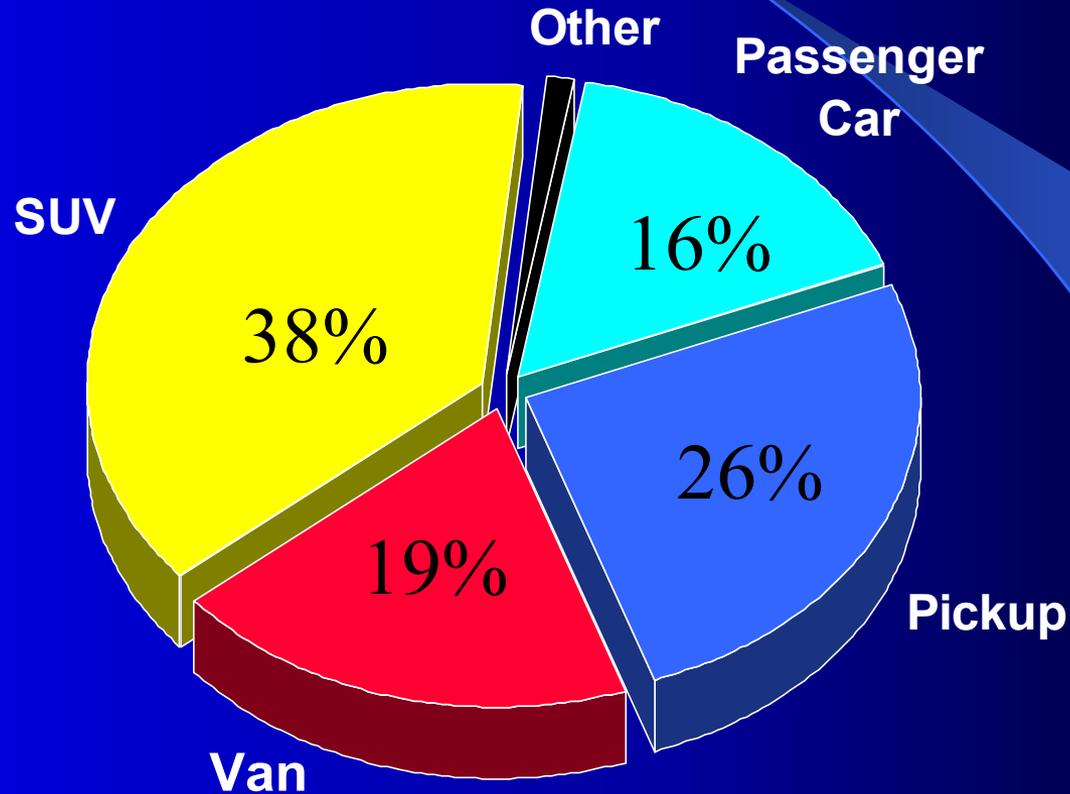
NHTSA 1999 Annual Report File & 2000 Early Assessment Files

Single-Vehicle Rollover Fatalities



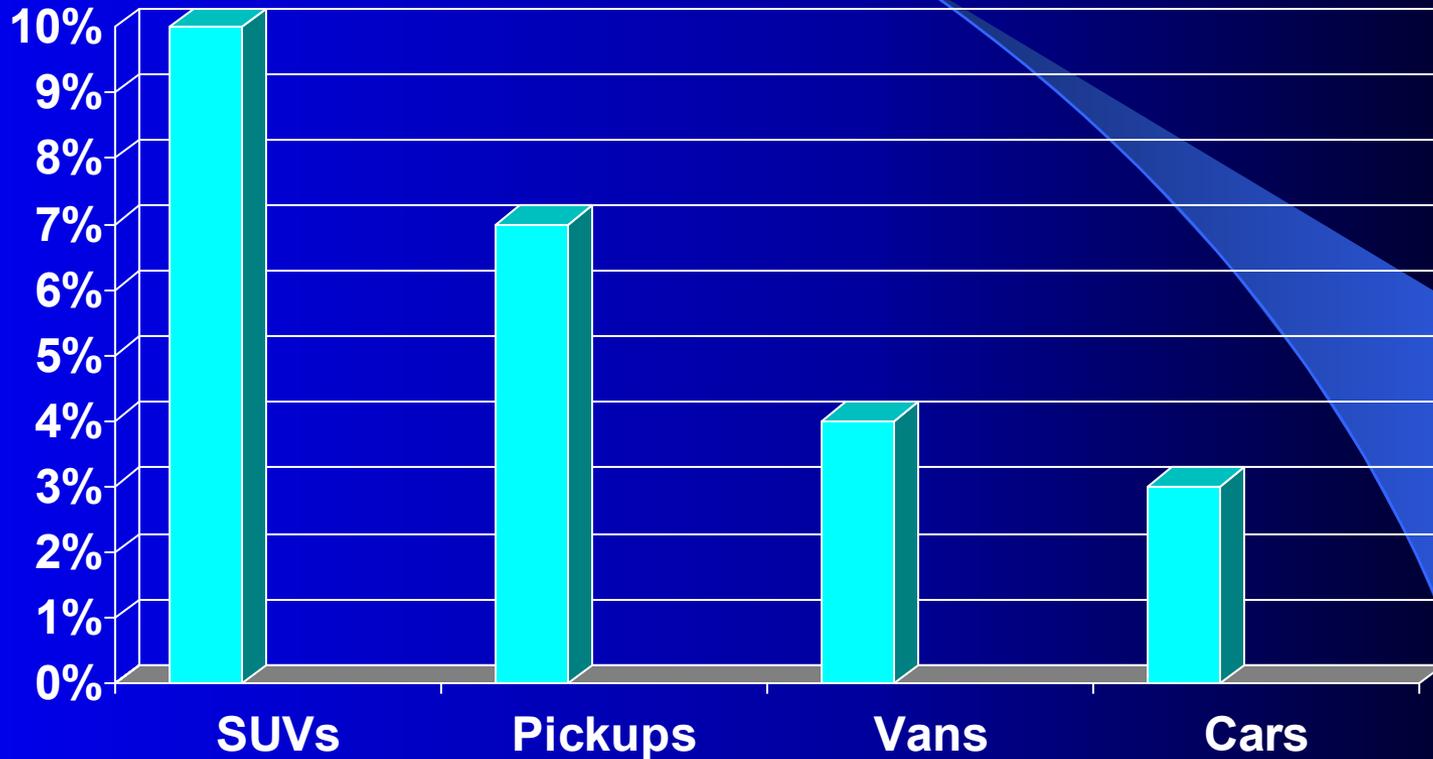
NHTSA 1999 Annual Report File & 2000 Early Assessment Files

Rollover Fatalities by Vehicle Type



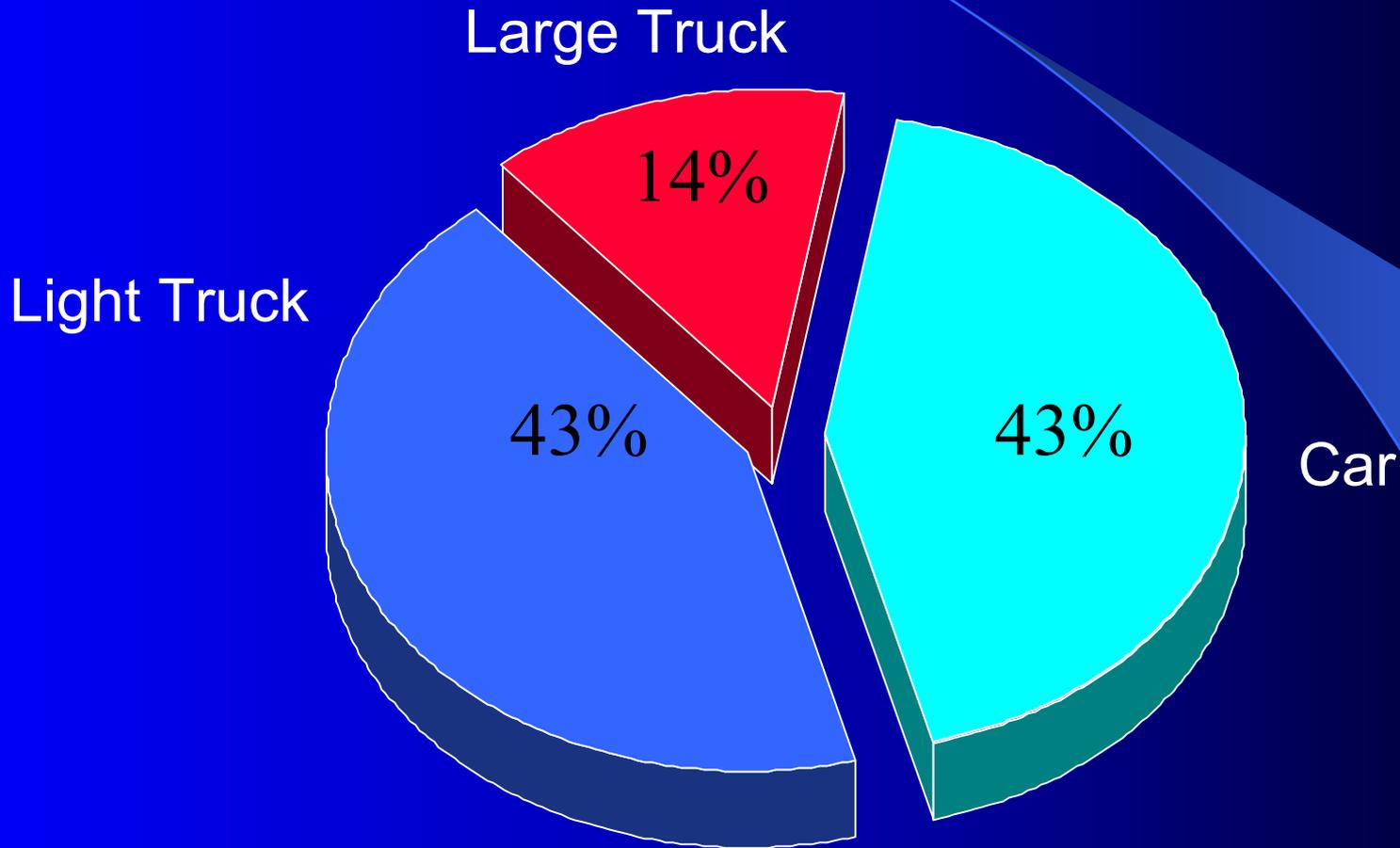
Traffic safety facts 1999. NHTSA.

Rollover Rate for Passenger Vehicles in Injury Crashes



Traffic safety facts 1999. NHTSA.

Single-Vehicle Rollover Injuries

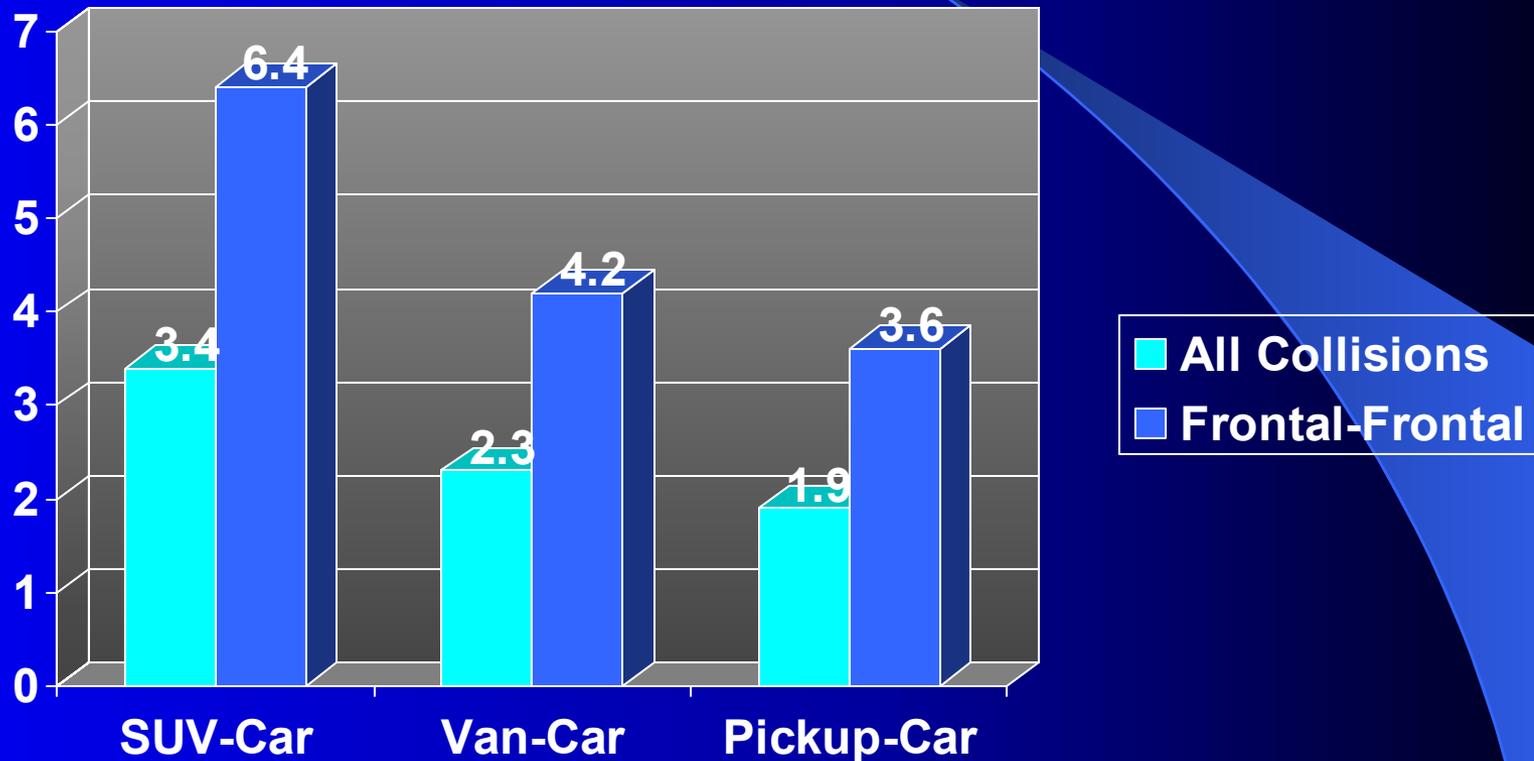


NHTSA 1999 Annual Report File & 2000 Early Assessment Files



Car Driver's Fatality Risk

Controlling for Vehicles' Weight and Impact Speed



Joksch HC. Vehicle design versus aggressivity. April, 2000. DOT HS 809 194.

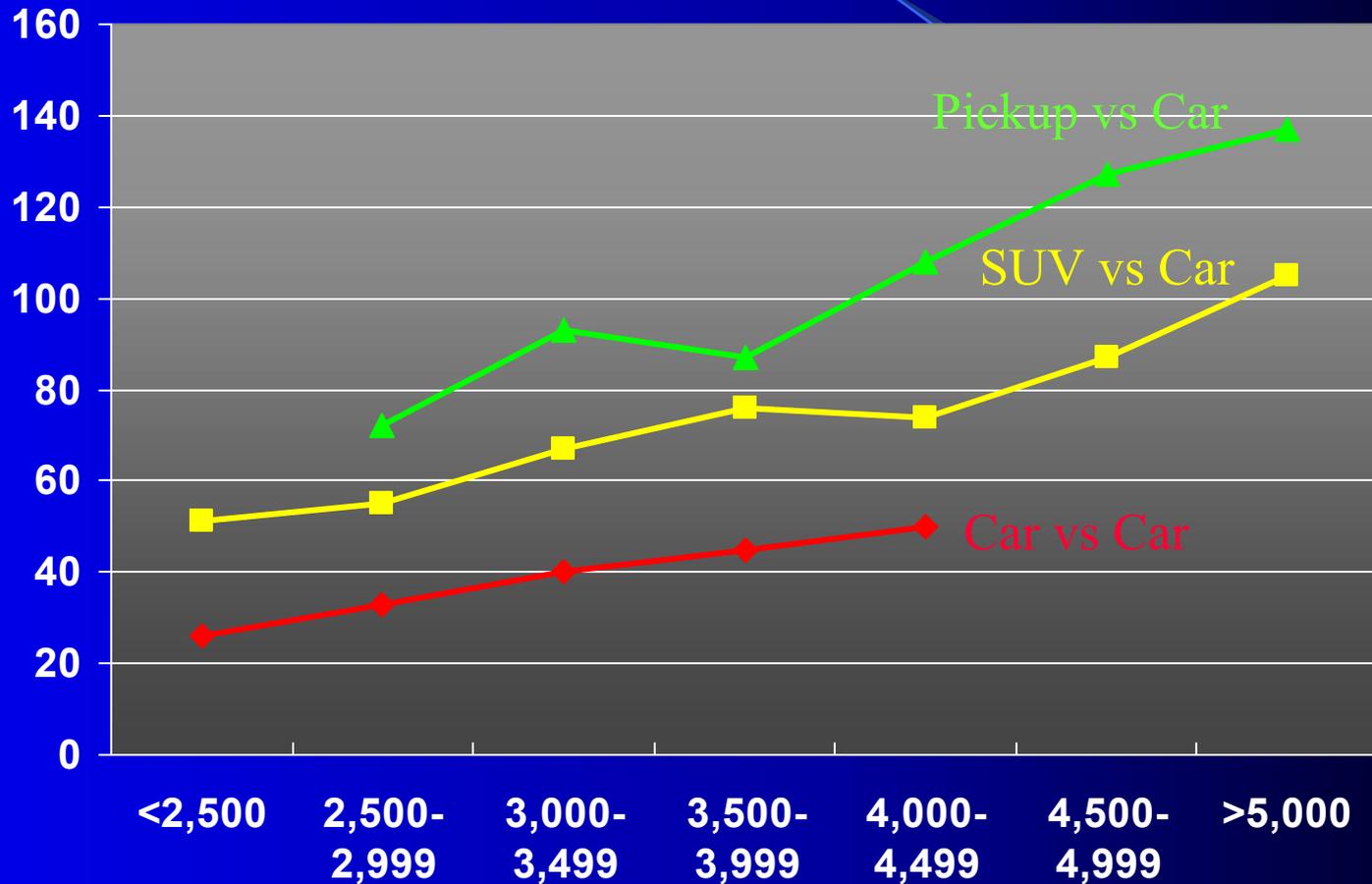
Light Vehicle-to-Vehicle Fatalities

- **LTV-Car crash**
 - 81% fatalities were car occupants
- **LTV-Car side impact**
 - 57% fatalities were car occupants
- **LTV-Car frontal impact**
 - 62% fatalities were car occupants

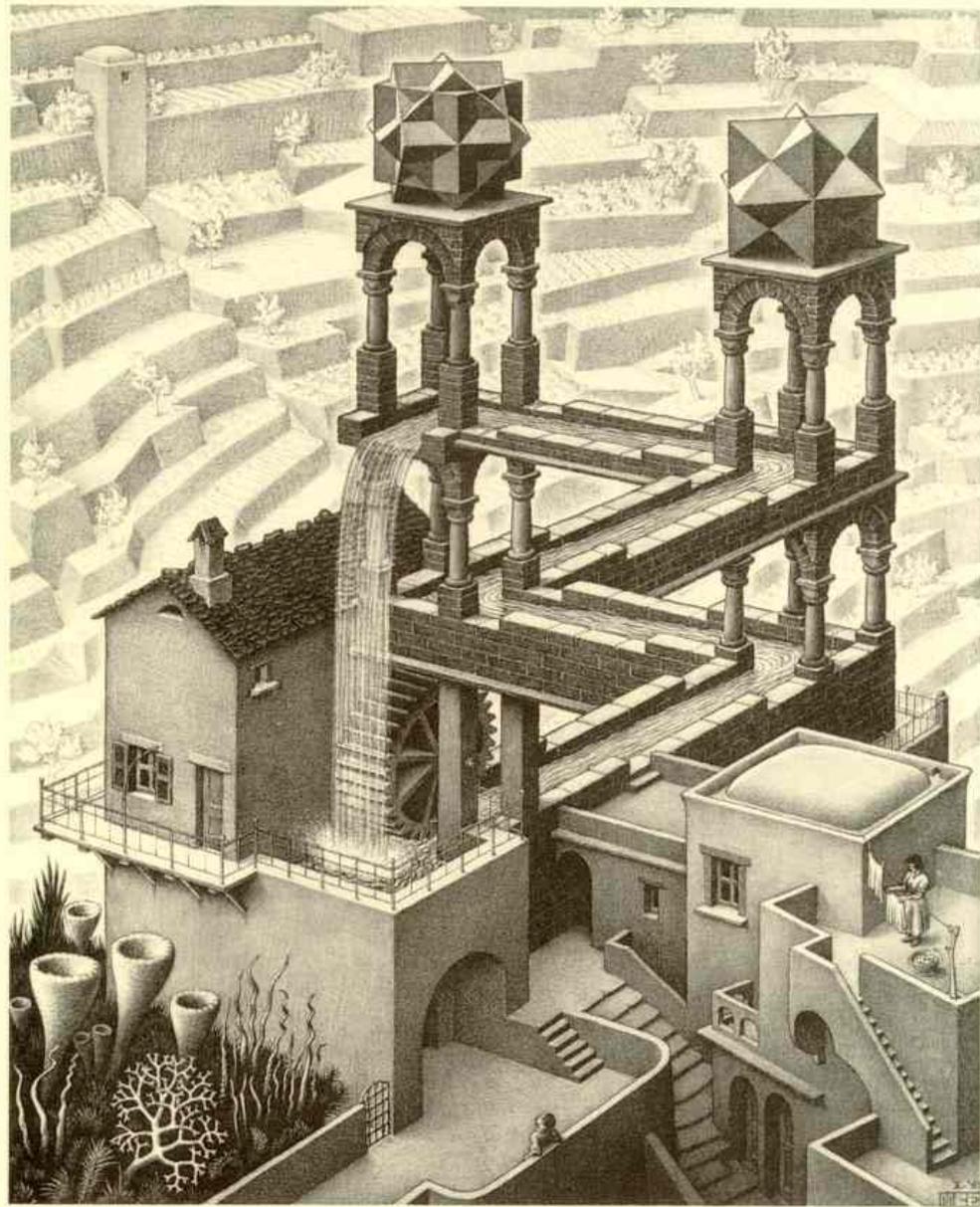
Gabler H, Hollowell WT. The crash compatibility of cars and light trucks. J Crash Prev Inj Control. 2000(1).

Car Occupant Deaths

All Car Models, 1990-96, per million registered

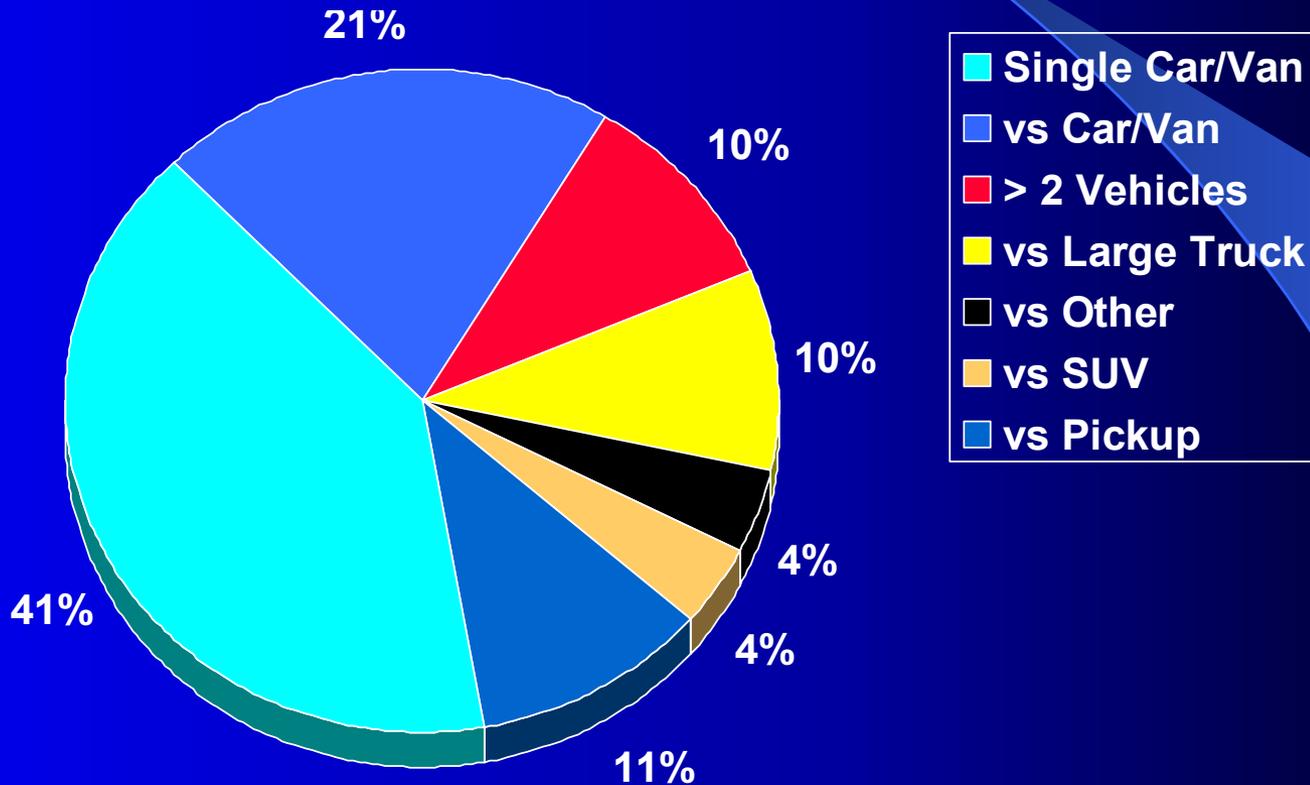


Lund AK et al. Crash compatibility issue in perspective. IIHS. SAE 2000-01-1378.



Different Perspective

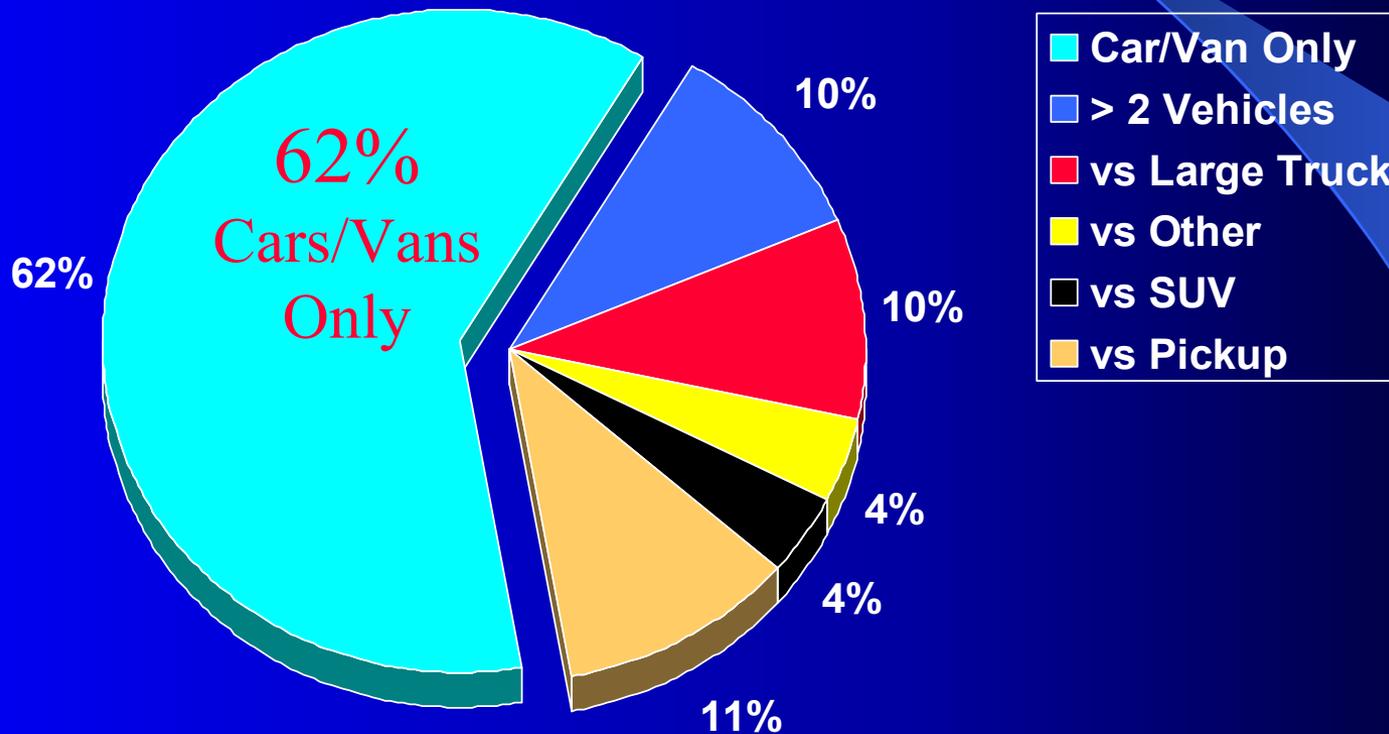
Car Occupant Deaths 1991-97 for 1990-96 Models



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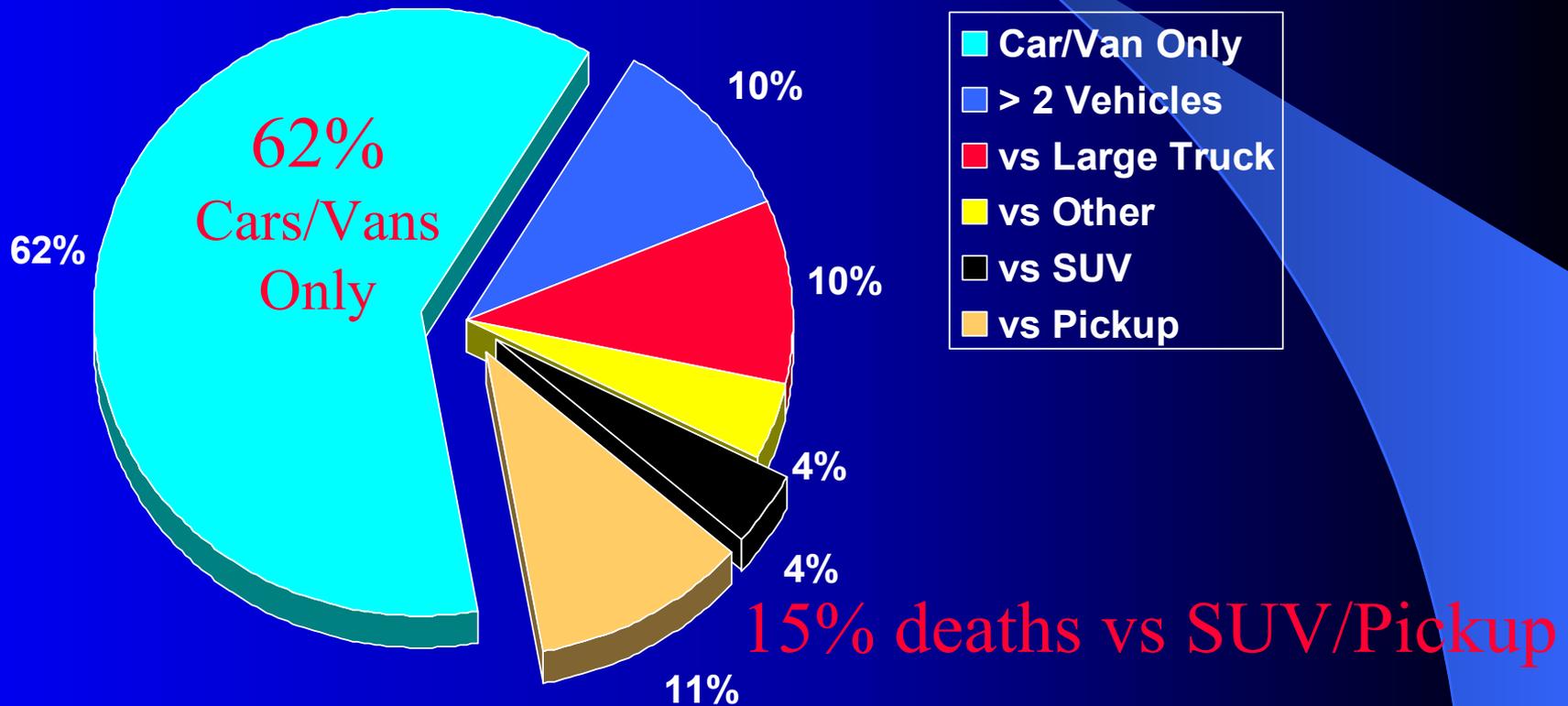
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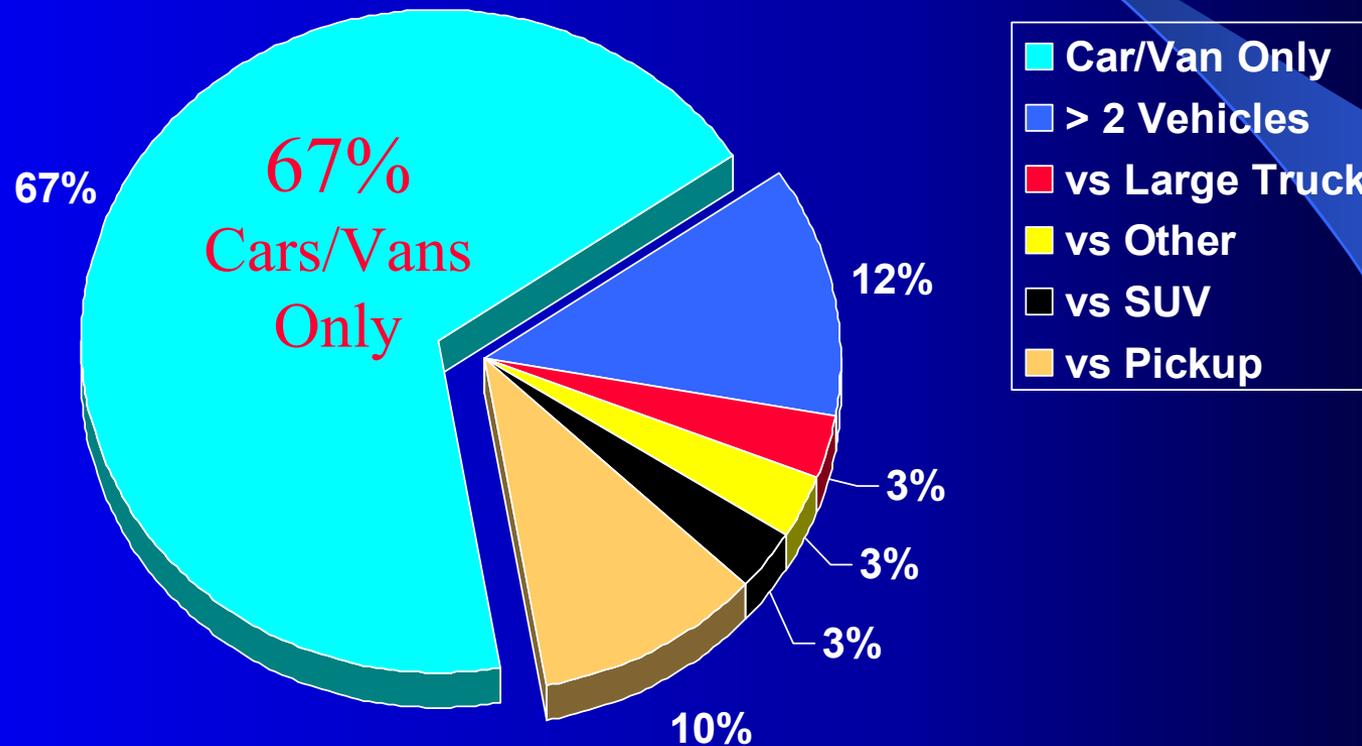
Car Occupant Deaths 1991-97 for 1990-96 Models



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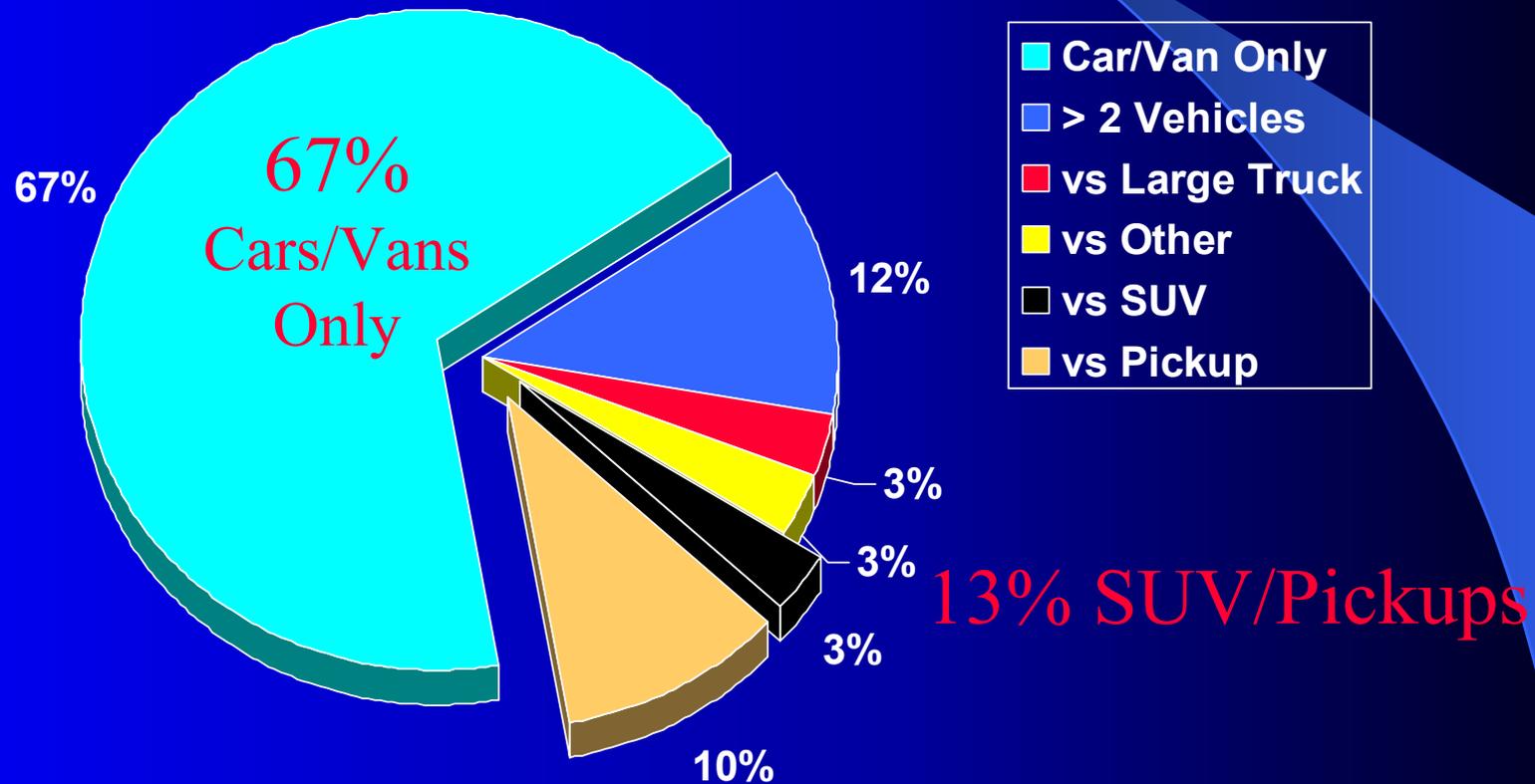
Different Perspective

Car Occupant Nonfatal Injuries



Different Perspective

Car Occupant Nonfatal Injuries



Lund AK et al. Crash compatibility issue in perspective. IIHS. SAE 2000-01-1378.

Change the Vehicle Mix?

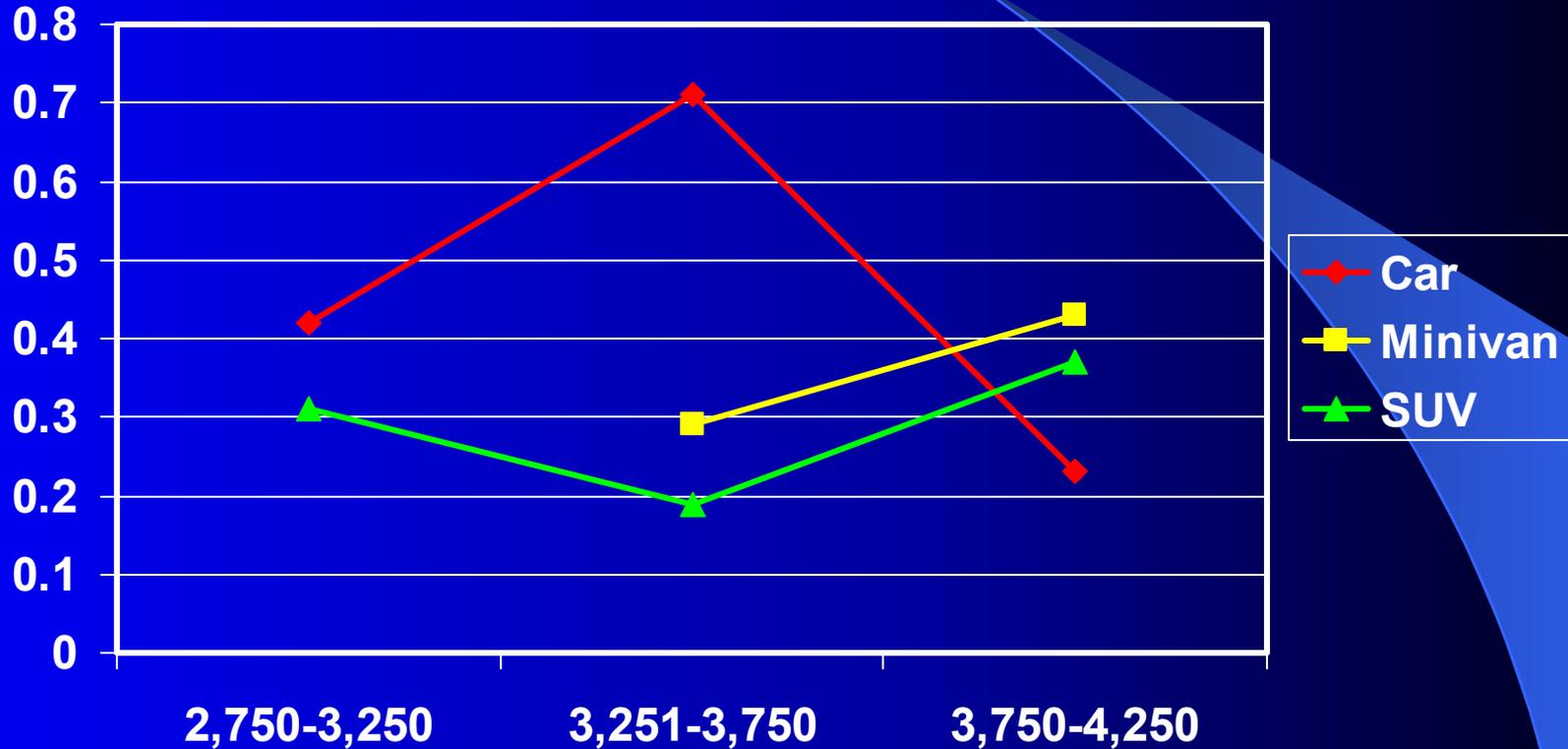
	Single Vehicle Crashes	Crash with Large Truck	Crash with Passenger Vehicle	Total
Baseline	12,675	2,723	11,032	26,429
	% Change			
Eliminate lightest cars	-1.9	-2.6	-3.7	-2.7
Eliminate lightest cars, SUV	-2.2	-2.6	-3.5	-2.8
Eliminate heaviest cars	+2.8	-0.2	+0.6	+1.6
Eliminate heaviest cars, SUVs, Pickups	+4.8	+0.2	-3.0	+1.1
Eliminate heaviest SUVs, Pickups	+2.0	+0.4	-3.7	-0.6

Lund AK et al. Crash compatibility issue in perspective. IIHS. SAE 2000-01-1378.

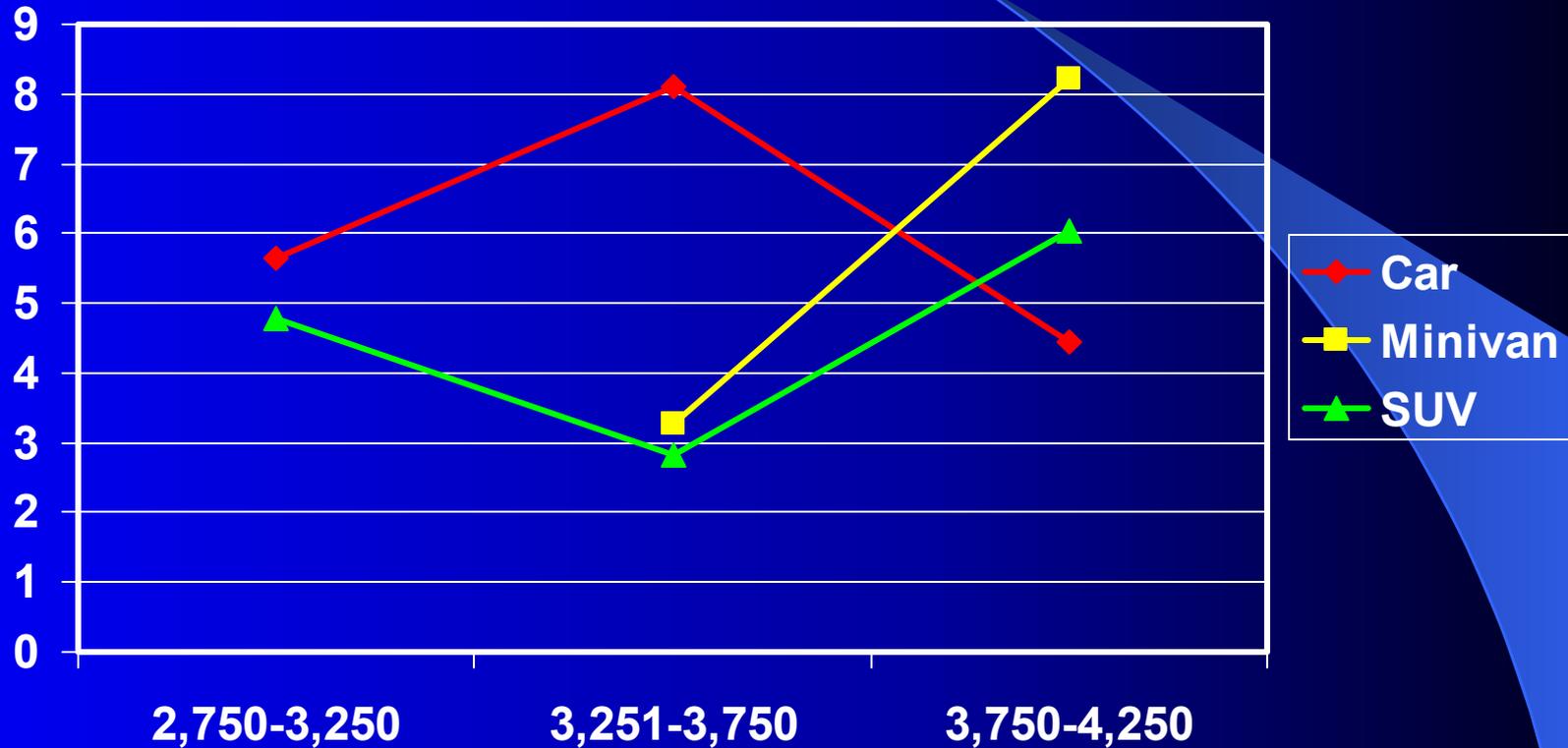
Exploratory Study

- NASS
- Fatalities and Injuries
- Stratified by weight
- Cars, Vans, SUVs

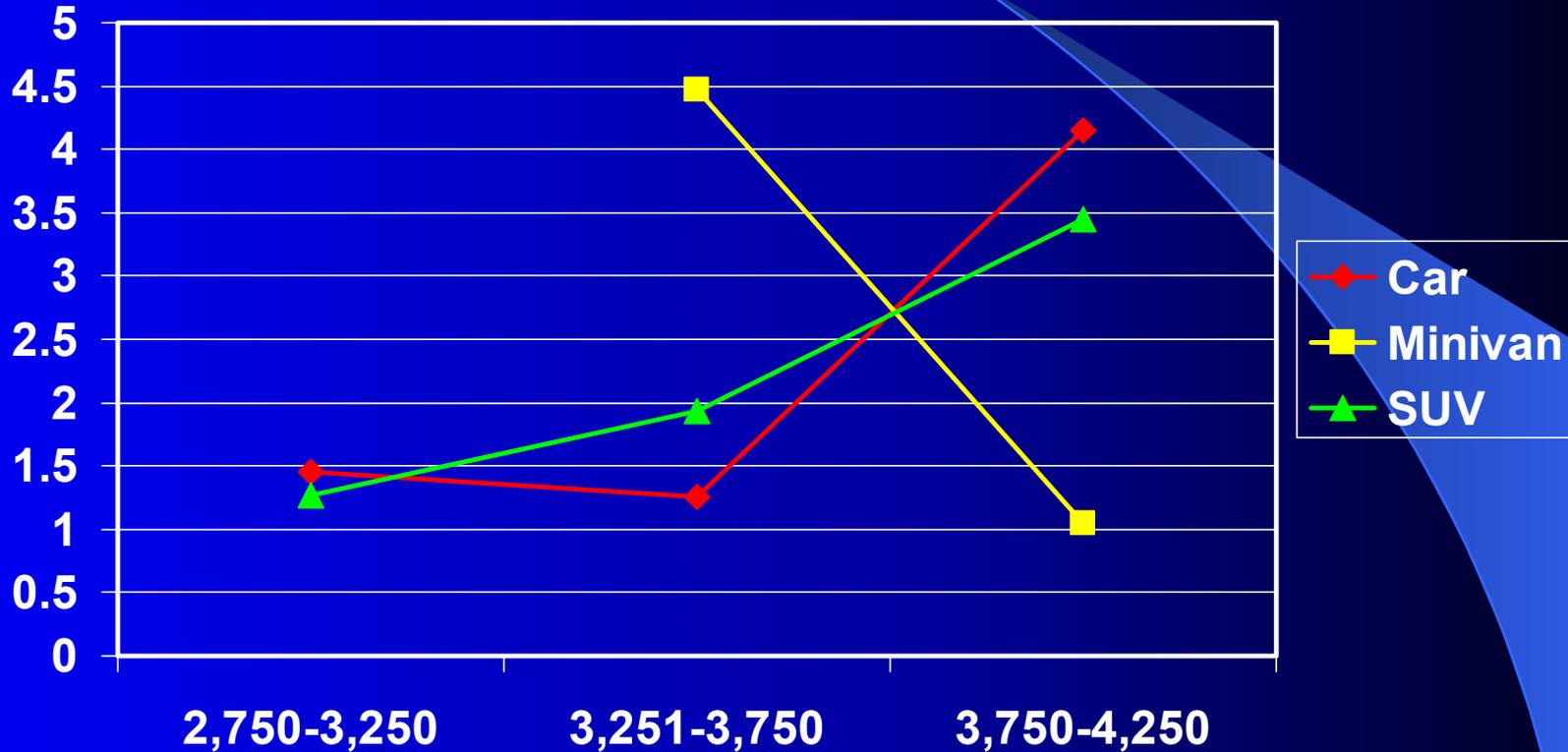
Fatality Rates, All Collisions



Injury Rates, All Collisions



Fatality Rates, Rollovers

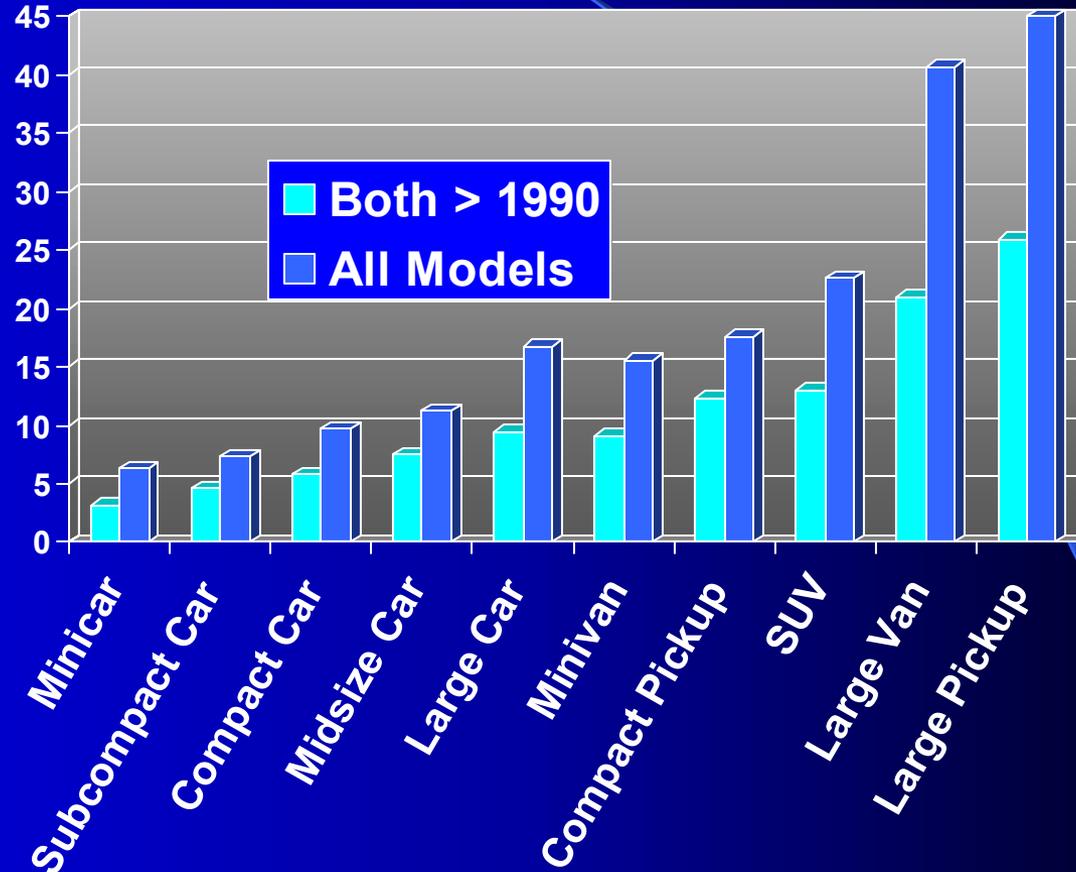


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Aggressivity by Vehicle Category Frontal-Frontal Impacts 1992-1996

Deaths other vehicle
per 1,000 Crashes



Gabler HC, Hollowell WT. The crash compatibility of cars and light trucks.
J Crash Prev Inj Control. 2000(1).

Vehicle Parameters – *Aggressivity*

- SUVs and Pickups
 - Weight
 - Height of Center of Force
 - Static Stiffness
 - Dynamic Stiffness

Joksch HC. Vehicle design versus aggressivity. April, 2000. DOT HS 809 194.

Vehicle Parameters – *Aggressivity*

- **SUVs and Pickups**
 - **Weight**
 - **Height of Center of Force**
 - **Static Stiffness**
 - **Dynamic Stiffness**

Joksch HC. Vehicle design versus aggressivity. April, 2000. DOT HS 809 194.

Vehicle Parameters – *Aggressivity*

- SUVs and **Pickups**
 - Weight
 - Height of Center of Force
 - **Static Stiffness**
 - Dynamic Stiffness

Joksch HC. Vehicle design versus aggressivity. April, 2000. DOT HS 809 194.

Vehicle Parameters – *Aggressivity*

- SUVs and Pickups
 - Weight
 - Height of Center of Force
 - Static Stiffness
 - Dynamic Stiffness
- VANS
 - No clear effect

Joksch HC. Vehicle design versus aggressivity. April, 2000. DOT HS 809 194.

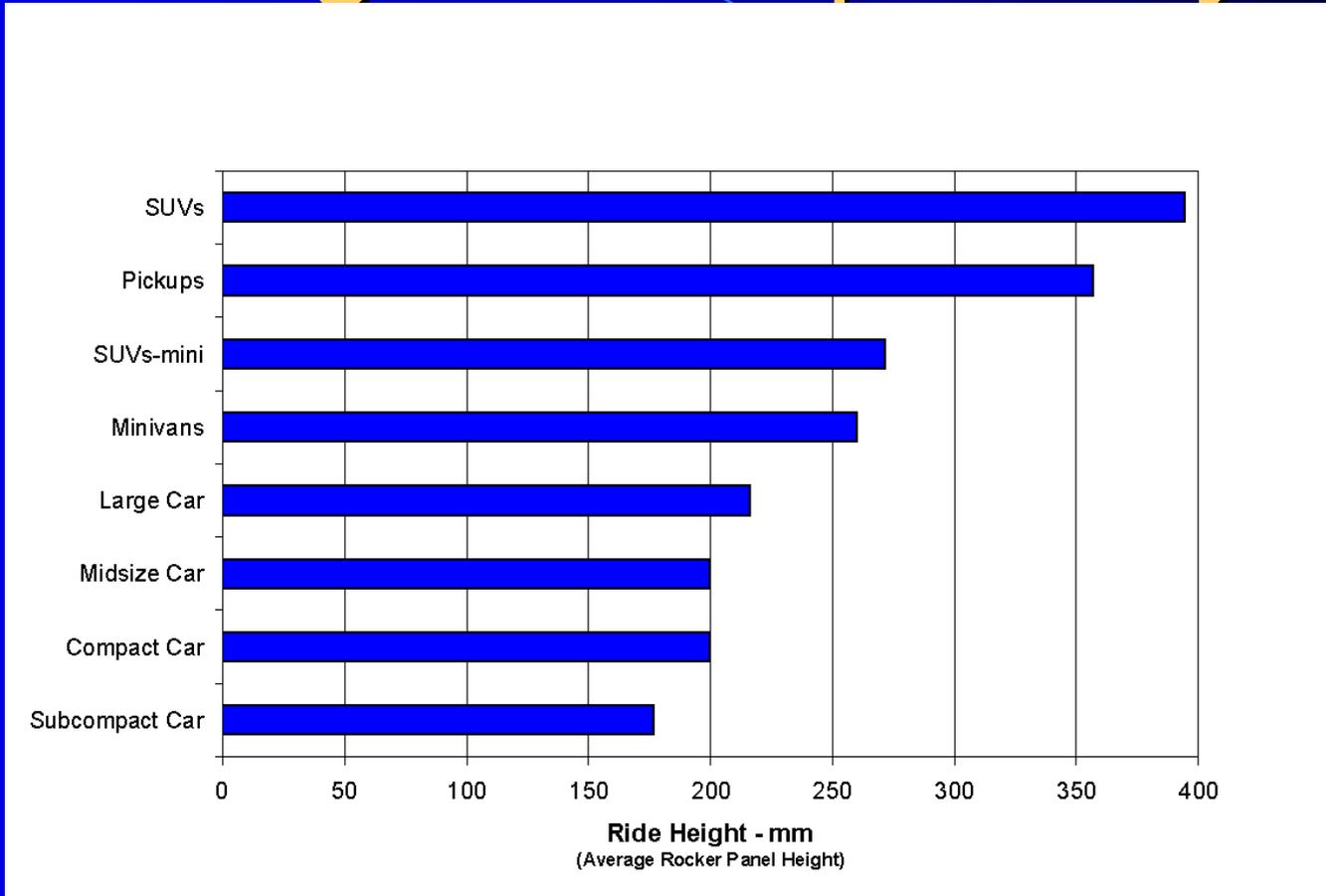
Summary of the Statistics

- SUV market share - 21% *and rising*
- Compact SUVs have the highest death rate
- Pickups, as a group, have the highest death rate
- Rollovers account for 24% of vehicle deaths
- 38% of rollover deaths occur in SUVs
- In LTV-Car crash, 81% fatalities are car occupants
- Only 15% car/van occupant deaths result from SUV/Pickup collision

Future Directions

- **Light Vehicle Classification**
 - Pickup Trucks
 - SUVs
 - Minivans
 - Vans (Truck based)
 - Cars
- **Improve Overall Fleet Safety**
 - Uniform Bumper Standard

Ride Height Incompatibility



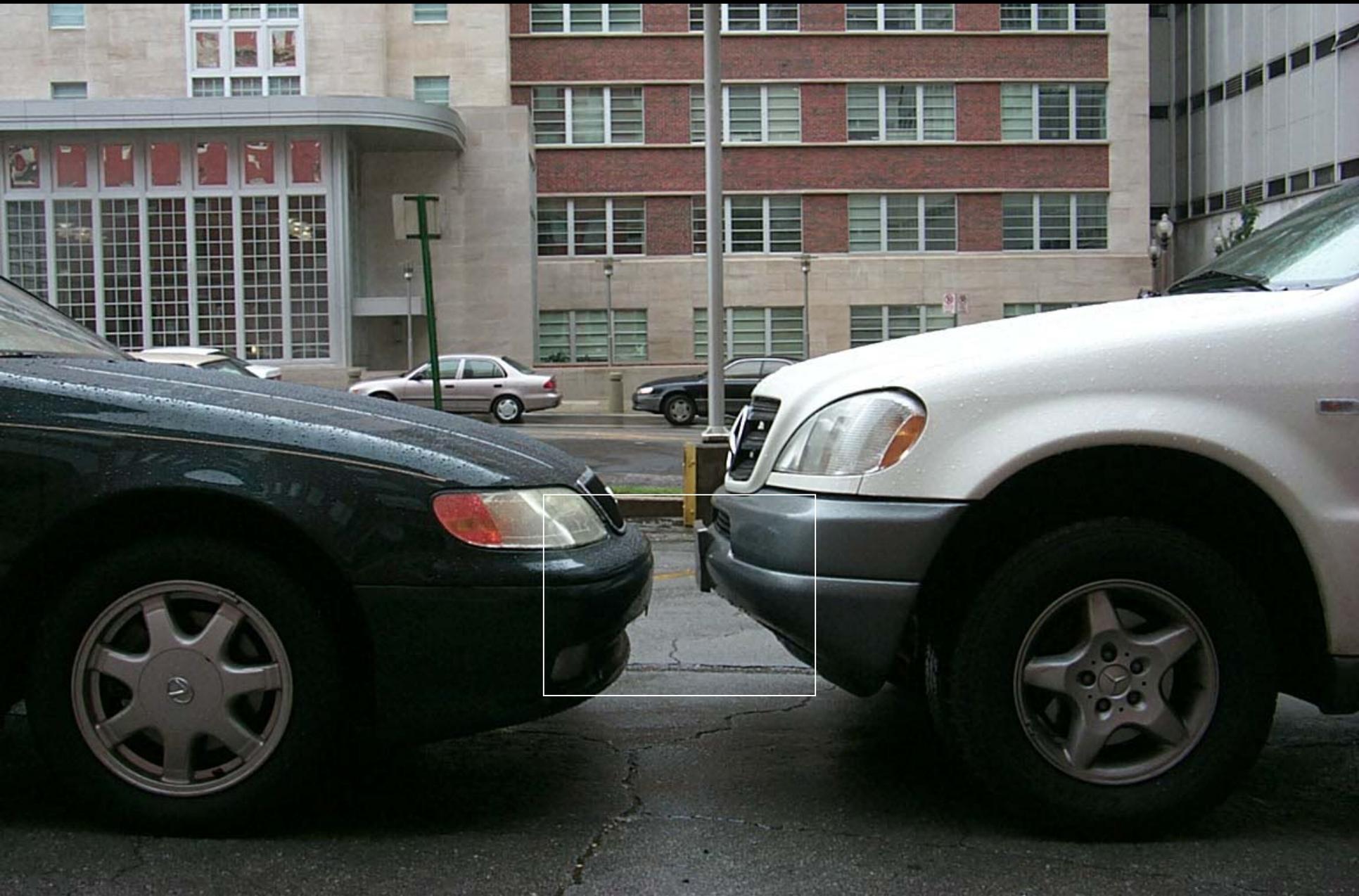
Gabler H, Hollowell WT. The aggressivity of light trucks and vans in traffic crashes. NHTSA. 980908.



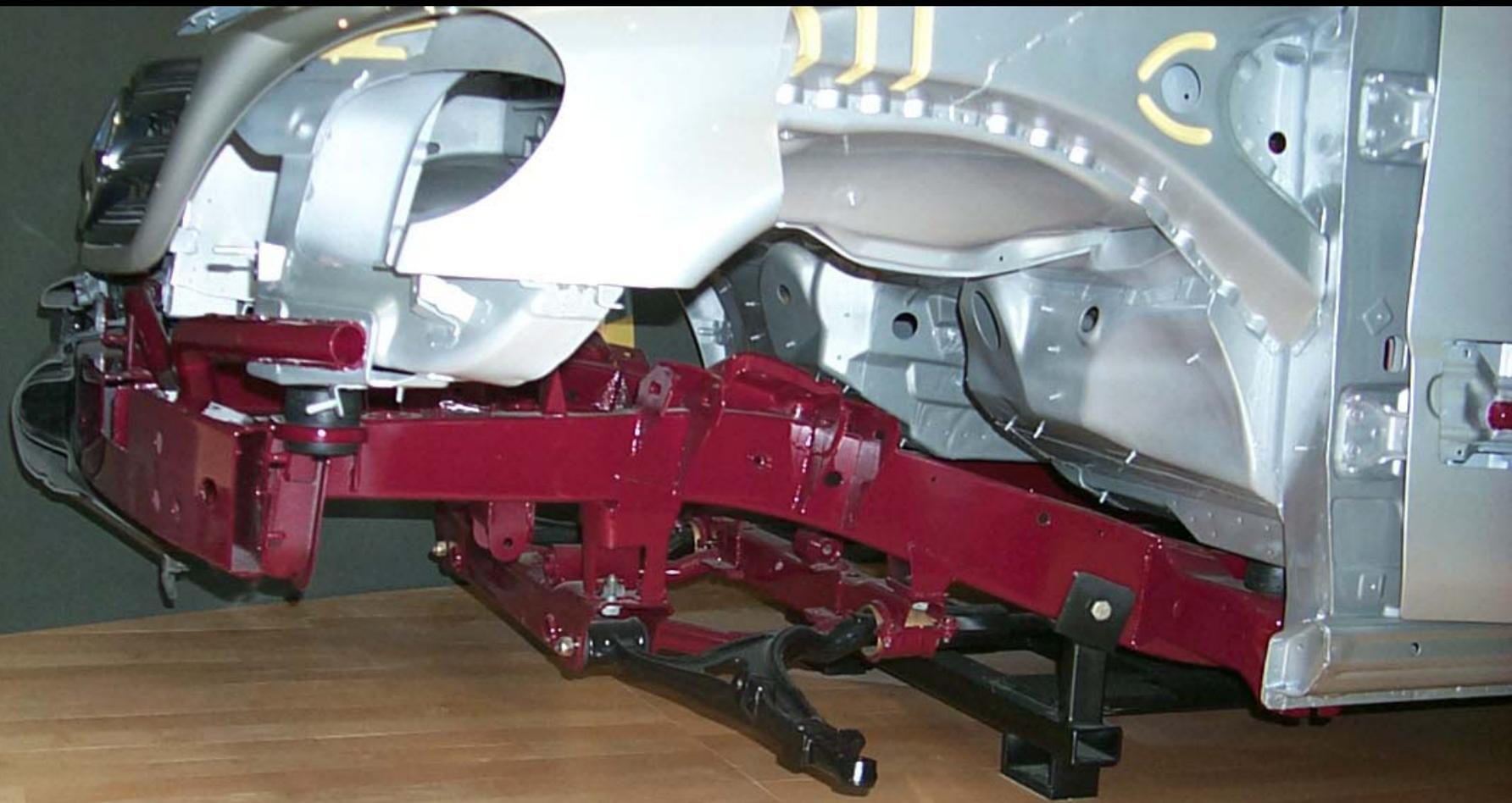
LYONS-HARRIS
RESEARCH BUIL

DODGE
RAM













Future Directions

- **Light Vehicle Classification**
 - Pickup Trucks
 - SUVs
 - Minivans
 - Vans (Truck based)
 - Cars
- **Improve Overall Fleet Safety**
 - Uniform Bumper Standard
- **Injury Patterns Associated with Vehicle Type in Single Vehicle Collisions**
- **Injury Patterns Associated with Aggressivity of Bullet Vehicle**
- **Prehospital Notification Based on Vehicles in Collision**



CRASH DATA

- CASE VEHICLE 1994 Jeep Cherokee
- OTHER VEHICLE 1986 Oldsmobile 98
- TIME OF CRASH 4:10 am / Dark
- ROAD CONDITIONS Dry Asphalt
- SPEED 60 - 65 mph
- AVOIDANCE Steering Right
- RESTRAINTS None

VEHICLE SPECIFICATIONS

- WHEELBASE 101 in. / 258 cm.
- OVERALL LENGTH 169 in. / 429 cm.
- OVERALL WIDTH 68 in. / 172 cm
- CURB WEIGHT 3028 lbs. / 1373 kgs.
- PDOF (PRINCIPAL DIRECTION OF FORCE) -20 degrees
- CDC (COLLISION DEFORMATION CLASS.) 11FDEW6
- DELTA V 71 mph / 115 km

INTRUSIONS

- LEFT

– TOE PAN	22 in. / 55 cm.	Longitudinal
– LF SEATBACK	6 in. / 15 cm.	Longitudinal
– GEAR SHIFT LEVER	4 in. / 10 cm.	Lateral
– GAS PEDAL	6 in. / 16 cm.	Lateral

- CENTER

– INSTRUMENT PANEL	14 in. / 35 cm.	Longitudinal
– LF SEATBACK	6 in. / 15 cm.	Longitudinal
– ROOF	7 in. / 19 cm.	Vertical
– TOEPAN	22 in. / 55 cm.	Longitudinal
– FRONT HEADER	2 in. / 5 cm.	Longitudinal

INTRUSIONS

- RIGHT

– INSTRUMENT PANEL	21 in. / 53 cm.	Longitudinal
– RF SEATBACK	3 in. / 7 cm.	Longitudinal
– ROOF	12 in. / 30 cm.	Vertical
– ROOF SIDE RAIL	9 in. / 22 cm.	Vertical
– ‘A’ PILLAR	19 in. / 47 cm.	Longitudinal
– FRONT HEADER	6 in. / 16 cm.	Longitudinal
– TOEPAN	46 in. / 116 cm.	Longitudinal
– RF WHEEL	53 in. / 134 cm.	Longitudinal

OCCUPANT CONTACTS

- STEERING WHEEL Deformed / Collapsed
- LEFT SUNVISOR Torn / Blood
- FRONT HEADER Scuffed / Blood
- 'A' PILLAR Imbedded Glass / Blood
- LEFT WINDOW FRAME Blood
- ROOF Blood
- CONSOLE GEAR SHIFT Intruded & Cracked
- W/S WIPER LEVER Broken
- LEFT INSTR. PANEL Indented