Statement before the Committee on Commerce, Science, and Transportation

U.S. Senate

Some aspects of the relative safety of cars and SUVs

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February 26, 2003

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The Insurance Institute for Highway Safety is a nonprofit research and communications organization that identifies ways to reduce motor vehicle crash deaths, injuries, and property damage. I am the Institute's president, and I am here to discuss some aspects of the safety of sport utility vehicles (SUVs) compared with cars.

PASSENGER VEHICLE REGISTRATIONS BY VEHICLE TYPE

Recent models (1 to 4 years old)	**Calendar years 1990-91**	**2000-01**
Cars	72%	56%
Minivans	5%	8%
Pickup trucks	17%	18%
SUVs	6%	18%
All models (all model years)	**1990-91**	**2000-01**
Cars	75%	65%
Minivans	3%	6%
Pickup trucks	17%	18%
SUVs	5%	11%

The increasing sale of SUVs in recent years is well known. They accounted for about 6 percent of all passenger vehicles 1 to 4 years old registered in 1990-91. A decade later the corresponding percentage had tripled to 18. During 2000-01, SUVs and pickups (all model years) accounted for 29 percent of total passenger vehicle registrations.

The increasing number of SUVs on the road has contributed to a growing debate about the safety of these vehicles. Many purchasers say they buy SUVs in part because they believe there is a safety advantage. But do SUVs provide better protection than cars to their occupants in crashes? Do SUVs have a rollover problem? What about other people on the road? Are SUVs particularly hazardous, or "aggressive," to people in the cars with which they collide?

Concepts of self protection and partner protection

Two kinds of occupant death rates can be used to address these questions and provide insights about the relative safety of cars and SUVs. One kind summarizes the numbers of occupants killed in particular types of vehicles (cars, SUVs, or pickup trucks), per million of that vehicle type registered. These death rates can be used to compare crashworthiness among the different vehicle types — that is, to compare the protection they provide to their own occupants. This is sometimes referred to as <u>self protection</u>.

For these comparisons of crashworthiness to be meaningful, it is necessary to isolate the effects of vehicle weight because SUVs and pickups are, on average, heavier than cars, and vehicle weight is an important determinant of occupant death rates. Everything else being equal, lighter vehicles will have higher occupant death rates.

Small and lightweight vehicles have high death rates for their own occupants in all kinds of crashes, single as well as multiple vehicle. However, in crashes between two vehicles the heavier ones can increase the deceleration forces — and the injury risks — for occupants of the lighter ones. So an issue is the extent to which occupants of vehicles such as very large and heavy SUVs have lower risks at the expense of increased risks for occupants traveling in other vehicles. To assess this concern, it is important to consider not only what happens to occupants inside particular vehicle types (self protection) but also what happens to occupants inside other passenger vehicles with which they collide. These other vehicles sometimes are referred to as "crash partners," and reducing the risks produced by particular vehicle types for the occupants of their crash partner vehicles sometimes is referred to as partner protection.

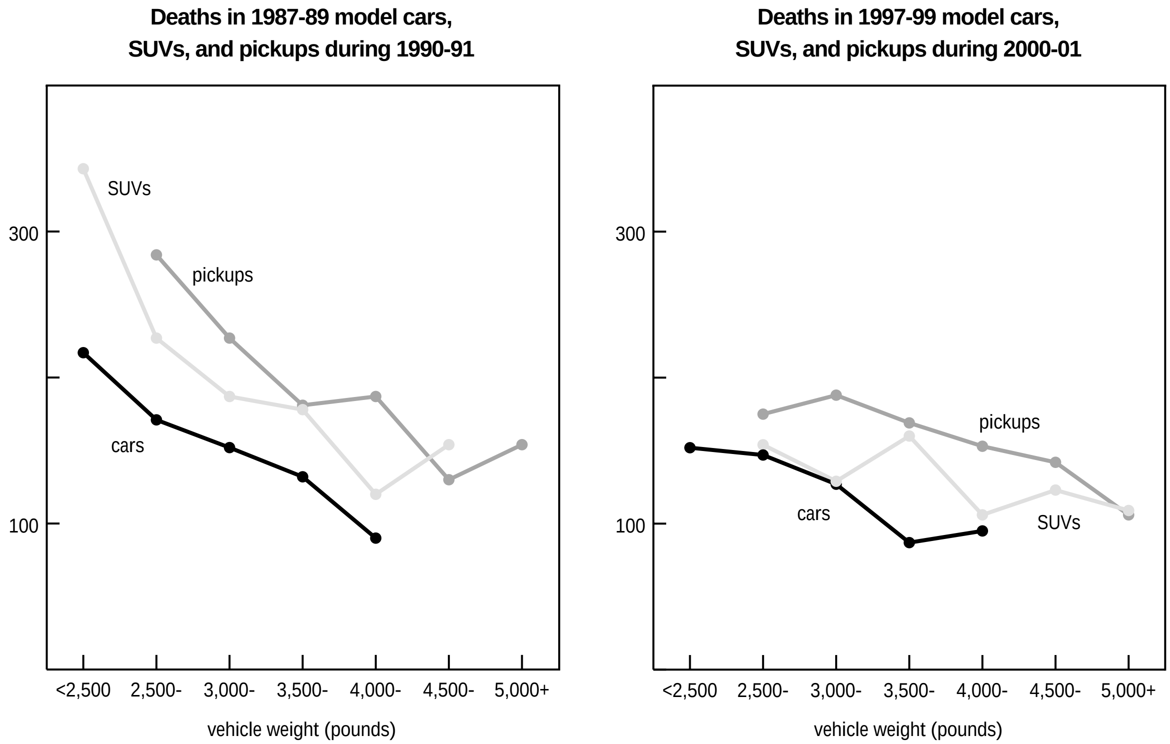
Crash partner risks can be assessed by comparing the numbers of occupant deaths in cars (all model years) in crashes with SUVs, pickups, or other cars (specific model years; per million of the SUVs, pickups, or cars registered). These death rates indicate the risks for occupants of crash partner cars resulting from collisions with different vehicle types. As with crashworthiness (or self protection) death rates, comparisons of crash partner death rates need to isolate the effects of vehicle weight. This allows comparisons of the risks to occupants of partner cars when the other vehicle is, for example, a heavy car versus a heavy SUV.

The combination of self and crash partner death rates considers both deaths inside vehicles in all crashes and deaths in partner vehicles in two-vehicle collisions. This combination provides a more complete assessment of occupant safety.

Self protection: occupant deaths in cars, SUVs, and pickups

Small and lightweight vehicles afford much less protection to their occupants in crashes than larger and heavier vehicles. This is true regardless of vehicle type (car, SUV, or pickup). During 1990-91, occupant deaths per million registered vehicles 1 to 4 years old were highest in the lightest vehicles. Occupant death rates also varied by vehicle type. In each vehicle weight category, occupant death rates in vehicles 1 to 4 years old during calendar years 1990-91 were lower in cars than in SUVs or pickups. A decade later (2000-01) the patterns had changed somewhat. Most noticeable is that occupant death rates were substantially lower across the board for cars, SUVs, and pickups in every weight category. Consider, for example, vehicles weighing 3,000 to 3,499 pounds. During 1990-91 the self-protection death rate for cars was 152 per million registered cars. The corresponding rate for

SELF PROTECTION: OCCUPANT DEATHS PER MILLION REGISTERED VEHICLES



SUVs was 187 deaths per million, and for pickups it was 227 deaths per million. By 2000-01 these rates had dropped to 127 (cars), 129 (SUVs), and 188 (pickups).

There still were relationships between occupant death rates and vehicle weights during 2000-01, but these relationships were less pronounced than they had been a decade earlier. The biggest changes occurred in the death rates for the lightest cars (those weighing less than 2,500 pounds). This reflects in part the fact that cars in this weight category got heavier. Fifty-four percent of 1987-89 car models in the lightest group weighed less than 2,250 pounds. A decade later, fewer than 9 percent were as light.

Comparisons of death rates by vehicle type reveal other changes from 1990-91 to 2000-01. During the more recent years, cars still had lower death rates than pickups. But in the same weight categories, the death rates were similar for cars and SUVs 1 to 4 years old.

Although death rates are similar for recent model cars and SUVs, deaths in these vehicles are not occurring in the same kinds of crashes. Single-vehicle rollover crashes consistently account for about 20 percent of car occupant deaths. In contrast, the corresponding percentage of SUV occupant deaths that occurred in single-vehicle rollovers was 52 during 1990-91 and 48 a decade later. Consider 1997-99 model vehicles in the 3,000-3,499 pound weight category. Twenty-two percent of the occupant deaths in cars of this weight occurred in single-vehicle rollovers. The corresponding percentage for SUVs was 41 and for pickups 37. Thus, the risk of a fatal single-vehicle rollover crash is about twice as high for SUV occupants as it is for car occupants.

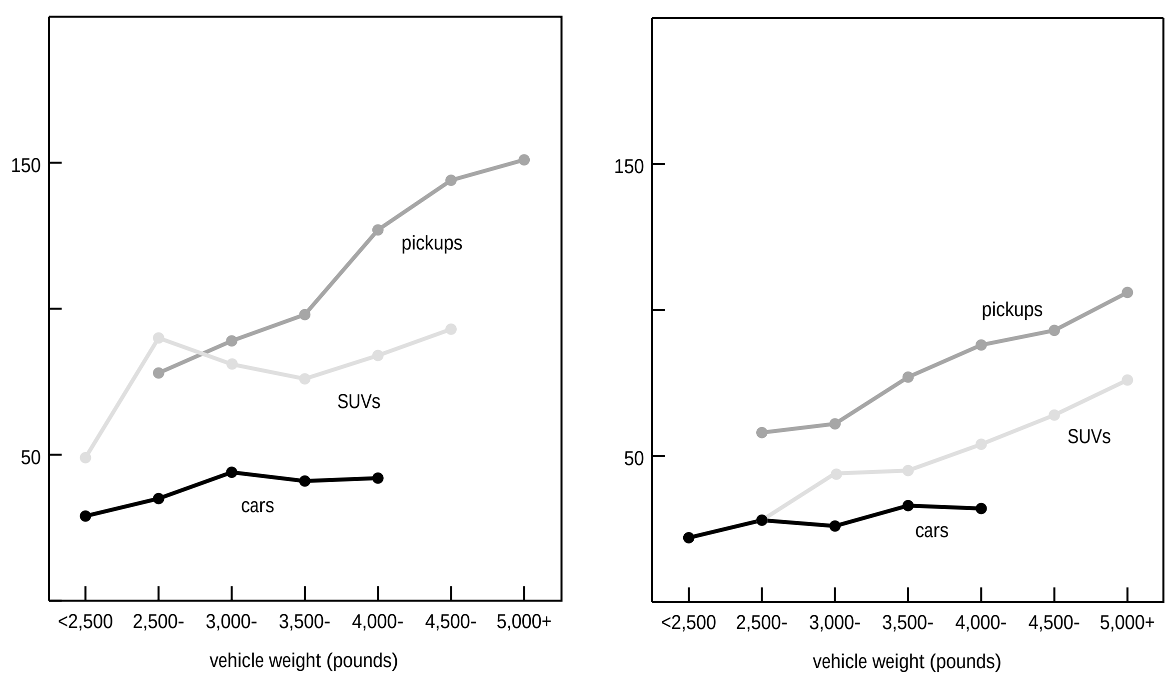
Crash partner risks: car occupant deaths in crashes with other passenger vehicles

In two-vehicle crashes involving 1-to-4-year-old SUVs, pickups, or cars in which deaths occur in crash partner cars (all model years), the partner death rates vary according to the type and weight of the other vehicle. It should be noted that partner death rates are significantly lower than occupant death rates, which measure self protection, because improved crashworthiness can be effective in

CRASH PARTNER RISKS:
DEATHS IN CARS IN COLLISIONS WITH OTHER PASSENGER VEHICLES

Car occupant deaths (all model years) in crashes with 1987-89 model cars, SUVs, or pickups, per million registered, during 1990-91

Car occupant deaths (all model years) in crashes with 1997-99 model cars, SUVs, or pickups, per million registered, during 2000-01



all kinds of crashes while crash partner risks are relevant only in crashes involving two passenger vehicles. Fewer than 35 percent of all car occupant deaths occur in crashes with other passenger vehicles, including other cars.

The heavier the weights of the SUVs, pickups, or cars involved in crashes in which deaths occur in partner cars, the higher the partner car death rates. In every vehicle weight group except one, the death rate in partner cars (all model years) is lower when the other vehicle in the collision is another car than when it is an SUV or a pickup truck. This overall pattern is apparent for vehicles 1 to 4 years old during both 1990-91 and 2000-01. However, during the intervening decade the death rates in partner cars (all model years) went down, regardless of whether the other vehicles in the collisions were other cars, SUVs, or pickups. Another change during 2000-01, compared with 1990-91, was that the differences in partner car death rates were smaller when the other vehicles were cars versus SUVs.

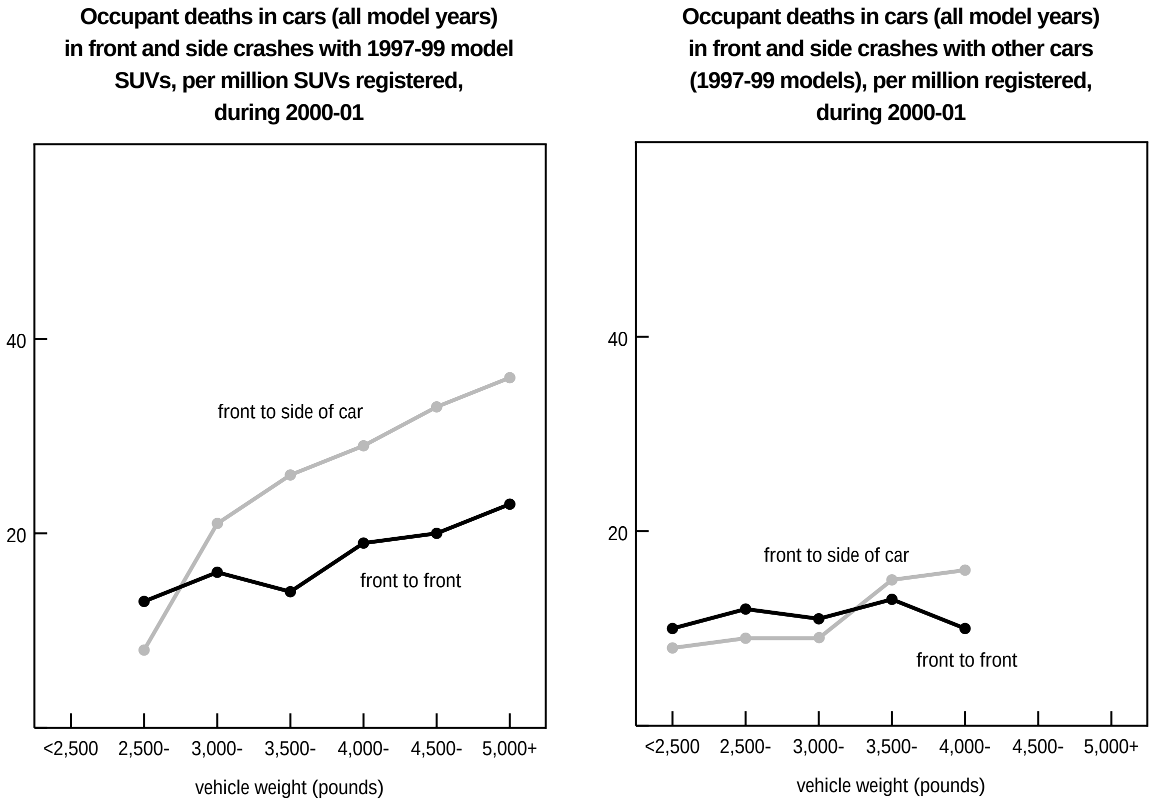
Balance between self protection and crash partner risks

For overall safety, it is important to maintain an appropriate balance between self protection and risks for occupants of crash partner cars. A good example involves vehicle weight. Increasing weight generally increases self protection, but this benefit diminishes as vehicles get heavier and heavier. At the same time, the disbenefits for occupants of crash partner cars do not appear to decrease as the other vehicles get heavier and heavier. So at some point heavy vehicles cost more lives in crash partner cars than they save.

Comparing self and partner death rates for each vehicle type shows that more occupant deaths occur even in heavy SUVs and pickups than in their crash partner cars. Consider the group of SUVs weighing 4,000 to 4,500 pounds. The occupant death rate in these vehicles 1 to 4 years old during 2000-01 was 123, and their car crash partner death rate was 64. Thus there were twice as many deaths inside these relatively heavy vehicles as in their crash partner cars. Compared with cars, both SUVs and pickups have proportionately more car crash partner deaths than occupant deaths, which indicates that SUVs (and pickups) pose greater risks than cars for the occupants of their crash partner cars.

What is it about SUVs, beyond their weight, that increases the risks for occupants of their car crash partners? A clue is apparent in crash partner death rates by direction of impact. In crashes involving two cars, crash partner deaths are split about evenly between front-to-front and front-to-side impacts.

CRASH PARTNER RISKS BY CRASH CONFIGURATION: DEATHS IN CARS IN COLLISIONS WITH SUVS OR OTHER CARS



But the split is very different when the other vehicle is an SUV. In these crashes, the occupant deaths in crash partner cars are about 50 percent more likely to occur in side than in frontal impacts.

Conclusions

The self and partner death rates summarized above highlight differences between car and SUV safety, and most of the differences between these two vehicle types also apply to cars versus pickups.

It often has been claimed that overall occupant death rates are lower in SUVs than in cars. The implication is that SUVs are safer. But this results largely from the heavier weights of SUVs compared with cars. For example, only 5 percent of all 1997-99 model cars weighed more than 4,000 pounds, while the corresponding percentage for SUVs was 49. So it is disingenuous for defenders of SUVs to claim they are safer than cars. Most of their advantage in terms of self protection is simply due to mass. It also is undeniable that SUVs, as a group, have a rollover problem. They are about twice as likely as cars to be in fatal single-vehicle rollover crashes.

When it comes to occupant deaths in crash partner cars, the partner death rates are higher when the other vehicle is an SUV versus another car. The most important differences are the elevated risks to occupants of cars struck in the side by SUVs, compared with being struck in the side by other cars.

How can these findings guide us to appropriate countermeasures to improve the protection of all occupants of all passenger vehicles? First, the results presented here demonstrate that progress has been made in self protection for both cars and SUVs. Occupant death rates in 1997-99 models during 2000-01 were significantly lower than corresponding rates for 1987-89 models during 1990-91. Many factors contributed to the improvements. Belt use rates in the United States increased from 49 percent in 1990 to 71 percent in 2000. Only 3 percent of 1987-89 vehicle models were equipped with airbags, compared with 100 percent of 1997-99 models. Average car weights increased about 350 pounds, while SUVs got 650 pounds heavier. Passenger vehicle crashworthiness improved. Alcohol-impaired driving decreased. All of these changes contributed to the significant improvements in self protection, but there is more to be done.

The issue of SUV rollover crashes needs to be addressed. Some of the newer SUV designs have lower centers of gravity and wider track widths, so they should be more stable than the older designs. Dynamic rollover rating systems being developed by the National Highway Traffic Safety Administration should help prospective SUV buyers choose models with a lower risk of rolling over. (The ratings might even — dare I say it? — persuade some consumers that SUVs are not the wisest choice.) Electronic stability systems now available on some SUVs, and likely to become more prevalent, should reduce the likelihood that SUV drivers will lose control and spin sideways, which often precedes rolling over. Volvo has introduced something even newer. Rollover sensors on the new Volvo SUV are designed to deploy inflatable curtains that cover side windows when a rollover begins and remain inflated throughout the rollover to help prevent full or partial occupant ejection.

Just as self protection is improving, crash partner death rates also are coming down. But in this regard it is important to recognize that the risks to car occupants in crashes with SUVs can be influenced by changes to both cars and SUVs. The reductions in partner death rates that occurred between 1990-91 and 2000-01 demonstrate this. They occurred as the numbers and weights of SUVs in the fleet were increasing, and they were due mainly to the many improvements in self protection for car occupants — not to design changes to SUVs to reduce risks to occupants of their crash partners.

What more can be done to improve the safety of occupants of cars in collisions with SUVs? A high priority should be to address the problem of SUVs striking the sides of cars. The risks are much greater to occupants of cars that are struck in the side by SUVs, compared with being struck in the side by another car, even when the other car and SUV weigh the same. This indicates that the problem relates to differences in the configurations of the two vehicle types. The higher ride heights of SUVs mean their front ends strike cars' relatively weak doors in side impacts. Plus the higher hoods of SUVs put car occupants' heads at great risk.

In the short term, the increased risks to car occupants struck in the sides by SUVs should be addressed by improving self protection in cars — specifically by adding inflatable head protection systems like curtains or side airbags that protect both the head and thorax. These should be added to new cars as standard equipment as soon as possible. Improving side airbags that protect the thorax and improving vehicle side structures around the B-pillar also would reduce the risks in side impacts. To promote such improvements, the Institute recently began a crashworthiness evaluation program that will provide consumer information on the relative safety of new vehicles in side impacts. For the first time in any crash test program conducted for regulatory or consumer information purposes, the impactor that hits the sides of vehicles in these tests simulates the front end of an SUV.

Finally, what can be done to the front ends of vehicles to make them more compatible in two-vehicle crashes? In many collisions between cars and SUVs (and in some collisions between two cars) the structures of the two vehicles designed to manage crash forces override or underride, thus negating their crash energy management designs. So a fundamental need is to ensure that such structures interact in crashes. Ford's introduction of so-called blocker-beams on some of its SUVs may signal the beginning of efforts to ensure such interaction. Plus some of the newer car-based SUV designs, often called "crossovers," offer opportunities for improved structural interaction in crashes. Other designs that might reduce structural mismatches in on-the-road crashes are adjustable suspensions that automatically lower ride heights on the highways but allow for upward adjustment and greater clearance off road or, for example, in low-speed driving through deep snow.

These SUV design innovations are promising. However, changes also will be needed to car designs to improve crash compatibility. The occupant compartments of both cars and SUVs need to be strong so they will remain intact in a wide range of serious crashes (frontal offset crash testing is helping to accomplish this). And in the longer term, test procedures and criteria need to be developed to ensure that vehicle front-end stiffnesses match. Future designs should be driven by good data from research and testing as well as real-world crash experience. The evidence tells us that crash compatibility and partner protection improvements are needed, but the highest priority in the short and even medium term should continue to be self protection for people in both cars and SUVs.