U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

DOT HS 809 438 **April 2002**

Technical Report

Characteristics of Fatal Rollover Crashes

Published By:

**National Center for Statistics and Analysis
Research and Development**

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 809 438		

4. Title and Subtitle	5. Report Date
Characteristics of Fatal Rollover Crashes	April 2002
	6. Performing Organization Code: NRD-31

7. Author(s)	8. Performing Organization Report No.
Deutermann, William	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Mathematical Analysis Division, National Center for Statistics and Analysis National Highway Traffic Safety Administration U.S. Department of Transportation NRD-31, 400 Seventh Street, S.W. Washington, D.C. 20590	11. Contract or Grant No.

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Mathematical Analysis Division, National Center for Statistics and Analysis National Highway Traffic Safety Administration U.S. Department of Transportation NRD-31, 400 Seventh Street, S.W. Washington, D.C. 20590	NHTSA Technical Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Umesh Shankar of the Mathematical Analysis Division contributed in the review and preparation of this report.

Abstract

The objective of this study by the National Center for Statistics and Analysis (NCSA) was to examine the characteristics of passenger vehicles and their drivers involved in fatal rollover crashes. Using data from the 1991 through 2000 NCSA's Fatality Analysis Reporting System (FARS), the Federal Highway Administration, and the US Census Bureau trends were examined and rates of fatal rollovers per registered vehicle and vehicle miles traveled (VMT) were calculated and compared.

The changing composition in the fleet of vehicles on the nation's highways has resulted in a growing number of SUVs and other light trucks relative to passenger cars. Findings show that light trucks in general, and Sport Utility Vehicles (SUV) in particular, are a rapidly increasing component of the total number of fatal rollover crashes. Most of the characteristics of vehicle and drivers involved have remained fairly constant over time both for passenger cars and light trucks. While occupant fatalities due to passenger car rollovers have been declining, the greater propensity toward rollovers in some classes of light trucks has maintained the aggregate level of passenger vehicle occupant fatalities in crashes about 32,000 annually.

17. Key Words	18. Distribution Statement
rollover, passenger vehicles, light trucks, fatalities	Document is available to the public through the National Technical Information Service, Springfield, VA 22161 http//:www.ntis.gov

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	54	

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1. EXECUTIVE SUMMARY

This report by the National Center for Statistics and Analysis (NCSA) was written to shed some light on increases that have been observed in the numbers of passenger vehicles involved in fatal rollover crashes. The analysis is based on 1991 through 2000 data from three sources: the Fatality Analysis Reporting System (FARS), an annual census of all fatal motor vehicle crashes occurring in the United States; Federal Highway Administration data on vehicle registrations and Vehicle Miles Traveled (VMT); and general population data from the United States Census Bureau. While the report contains background information from 1991-2000, most of the analysis centers on the period 1995 through 2000, owing to limitations in the availability of some of the data. The analysis focuses on rollover crashes involving passenger vehicles, defined as passenger cars and light trucks, including sport utility vehicles (SUVs), vans, and pickup trucks.

The annual number of fatalities resulting from traffic crashes has been relatively stable at about 42,000 between 1991 and 2000. Approximately three-fourths of these deaths represent passenger vehicle occupant fatalities. However, over the same period there has been a noticeable shift in the effect of passenger vehicle rollover crashes on this total. In the years since 1991, the number of passenger vehicle occupant deaths has varied from a low of 29,485 in 1992 to a high of 32,127 in 1999, an overall increase of about 9 percent. During this same period, however, the number of passenger vehicle occupants killed in rollover crashes increased by 6 percent. Within the category of passenger vehicles, passenger car occupant rollover deaths fell by 15 percent while occupant deaths in light truck rollover crashes increased by 35 percent. The increasing popularity of this type of vehicle suggests that the growing numbers of light truck fatalities are replacing passenger car fatalities, particularly in rollover crashes.

1.1 Purpose

The purpose of this report is to:

- Analyze passenger vehicle rollover crashes using selected data from FARS;
- Use exposure data such as vehicle registration and Vehicle Miles Traveled from the Federal Highway Administration, and data on the resident population from the US Census Bureau to explore the impact of rollover crashes;
- Form conclusions based on this analysis concerning the effect of rollover crashes on continuing trends in motor vehicle traffic crash fatalities.

Several steps were involved in the study procedure. First, the appropriate data sources were reviewed to determine the relevant variables to be used and the availability of data on registrations, population, and exposure as defined by VMT. Appropriate demographic groupings were determined to help reveal patterns in driver characteristics and data from FHWA were used, along with population data, to establish fatality rates vis-à-vis exposure.

1.2 Conclusions

- Nearly three-fourths of occupants killed in rollover crashes were not using restraints and slightly less than two-thirds of them were completely ejected from the vehicle.

- Most fatal rollover crashes are single vehicle crashes.

- Positive and elevated BACs are associated with fatal rollovers, and particularly fatal single vehicle rollovers. Involved drivers with positive BACs are more likely to have had BACs at or above the intoxication level.

- Rollover crashes are more likely to result in fatalities than other types of crashes.

- Rollover crashes constitute about one-fifth of all fatal crashes.

- The number of fatal passenger car rollover crashes has been decreasing in recent years.

- The number of fatal light truck rollover crashes is increasing, particularly among SUVs and vans.

- The number of fatal SUV rollovers has more than doubled since 1991, growing faster than any other class of light trucks.

- The increases in fatal light truck fatalities, driven by SUV crashes, have been offsetting the decreases in both fatal passenger car crashes and rollover crashes.

- Increases in fatal light truck rollovers may be a result of their growing proportion of the vehicle mix rather than deterioration in the design and construction of the vehicles involved.

- Slightly less than one-half of single vehicle rollovers were reported by the investigating police officer to be preceded by an attempt to avoid the crash by a steering maneuver, compared with one-third of rollovers in multi-vehicle crashes.

- In about 40 percent of fatal single vehicle rollovers and 57 percent of multi-vehicle rollovers, investigating officers reported that no crash avoidance maneuvers preceded the crash.

- Drivers of rollover vehicles tend to be males, under 40 years old, driving on two-way roads without dividing barriers.

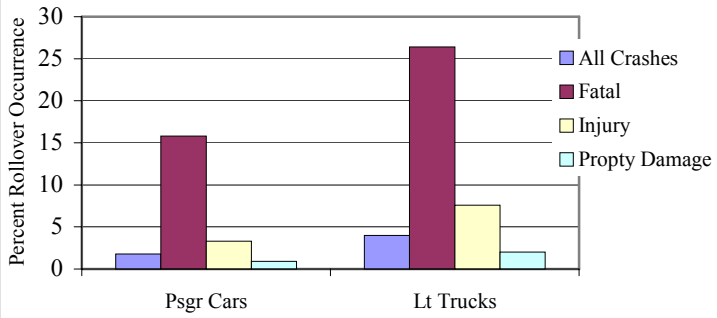
- Speed was an important factor in fatal rollovers, with most crashes occurring on roads where speed limits were 55 miles an hour or greater.

2. INTRODUCTION

Traffic crashes are recognized as a major cause of death in the United States, claiming approximately 42,000 lives annually. Some 41,821 traffic crash fatalities occurred in 2000, with occupants of passenger vehicles (passenger cars and light trucks) accounting for 31,910, about 76 percent of the total.

Rollover crashes are a significant and growing contributor to this statistic. A rollover crash is particularly violent in nature. Unrestrained occupants of a vehicle that rolls are subjected to a variety of forces and impacts that can result in severe injuries or death. In 2000, rollover crashes killed 9,873 occupants of passenger cars and light trucks, almost one-third of the total deaths of occupants of these types of vehicles.

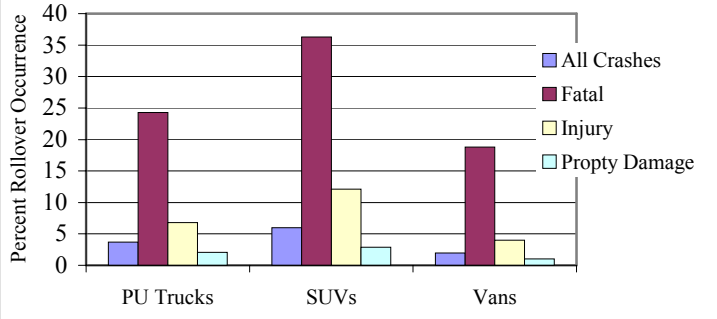
Figure 1
Passenger Vehicle Rollovers by Crash Severity



Source: NCSA, NHTSA, FARS 2000 and NASS/GES 2000

A rollover crash is far more likely to result in fatalities than are non-rollover crashes. In 2000, only 3 percent of all passenger vehicles involved in crashes were rollovers, but rollovers accounted for 20 percent of passenger vehicles involved in fatal crashes.

Figure 2
Light Truck Rollovers by Crash Severity



Source: NCSA, NHTSA, FARS 2000 and NASS/GES 2000

Controlling for vehicle type shows that within the passenger vehicle category, light trucks are more likely than passenger cars to be involved in rollover crashes and when rollovers occur, the proportions of fatal and injury only type crashes that involve rollovers are also higher among light trucks than passenger cars. In 2000, 2 percent of passenger cars involved in crashes experienced rollovers and 15 percent of passenger cars involved in fatal crashes rolled over. Among light trucks, the proportions were 4 percent and 26 percent respectively (Figure 1).

Within the light trucks category, the vehicles most likely to be involved in rollovers were SUVs and pickup trucks. In 2000, 6 percent of SUVs involved in crashes rolled over,

compared with 4 percent of pickup trucks and 2 percent of vans. The proportion that rolled over in fatal crashes was 36 percent, compared with 24 percent of pickup trucks and 19 percent of vans (Figure 2).

This report focuses on rollover crashes and recent trends in fatal rollover crash statistics. The analysis is limited to passenger vehicles, a category that includes passenger cars and light trucks (SUVs, pickup trucks and vans).

Following a decline from 1988 through 1992, the number of passenger vehicle occupant deaths rose to 32,437 in 1996, and has remained at a level of about 32,000 through 2000, the latest year for which data are available. Breaking down the number of fatalities by type of vehicle involved shows that while passenger car fatalities declined by about 9 percent between 1996 and 2000, light truck fatalities steadily increased by 41 percent between 1992 and 2000.

Annually, rollover crashes account for approximately 30 percent of passenger vehicle occupant fatalities. The proportion of fatalities that are attributable to rollovers is highest among the light trucks, 47 percent compared with 22 percent of passenger car occupant fatalities.

These facts raise the following questions relating to rollover crashes and fatalities:

- What are some of distinguishing characteristics of the vehicles that are involved in rollover crashes?
- What are the characteristics of the drivers and occupants of the vehicles involved?
- What are some of the factors contributing to fatal rollover crashes?
- What steps can be taken to reduce rollover crashes and fatal injuries resulting from them?

In the sections that follow, data from the Fatality Analysis Reporting System (FARS) are analyzed in the effort to address these questions. The analysis is primarily based on cross tabulations of variables from the FARS data base, controlling on factors such as vehicle types, characteristics of drivers, use of restraint systems, environmental factors, and factors related to the operation of the vehicles involved at the time of the crash. The objective of the report is to identify some of the characteristics of rollover crashes and to draw conclusions concerning the prevention of rollover crashes and their related fatalities.

The Fatality Analysis Reporting System (FARS) data used for this report can be accessed through the NHTSA web site at http://www-fars.nhtsa.dot.gov/. Federal Highway Administration data can be obtained through the FHWA web site at http://wwwcf.fhwa.dot.gov/, and population data are available at the Census Bureau web site at http://www.census.gov.

3. ANALYTICAL APPROACH

The analytical approach taken in this report involved the following steps:

- Review of the appropriate data sources to determine the relevant variables to be used and the availability of data on registrations, population, and exposure as defined by VMT.

- Determination of appropriate demographic and other groupings to help reveal underlying patterns in driver, vehicle, and other characteristics.

- Selection of appropriate data from FHWA and the US Census Bureau to establish fatality rates vis-à-vis exposure.

3.1 Data Sources

Three data sources were used in this analysis:

- The Fatality Analysis Reporting System (FARS) database of fatal traffic crashes.

- Federal Highway Administration data relating to vehicle registrations and Vehicle Miles Traveled (VMT).

- Resident US population data from the Commerce Department's US Census Bureau.

3.2 Historical Comparisons

3.2.1 Fatality Analysis Reporting System Data

The years from 1991 through 2000 have seen the number of passenger vehicles involved in fatal traffic crashes rise by 4 percent, from 46,123 to 47,791. During the same period, the number of occupants of passenger vehicles fatally injured in traffic crashes has also risen by 4 percent, from 30,776 to 31,910.

When these figures are controlled by vehicle body type, a different pattern emerges. Both in terms of the numbers of vehicles involved in fatal crashes and the numbers of occupants killed, there was a decline among passenger cars and a substantial increase among the various types of light trucks. In 2000, a total of 27,496 passenger cars were involved in fatal crashes, down 12.1 percent from 1991, while the number of light trucks involved was up 37 percent to a total of 20,295. In the light truck category, SUVs experienced the greatest increase, followed by vans. All of these vehicle body types exhibited similar increases in the numbers of rollover crashes over the ten years from 1991 to 2000 (See Table 1 below).

Table 1
Passenger Vehicles Involved in Fatal Traffic Crashes
By Year, Crash Type, and Vehicle Body Type

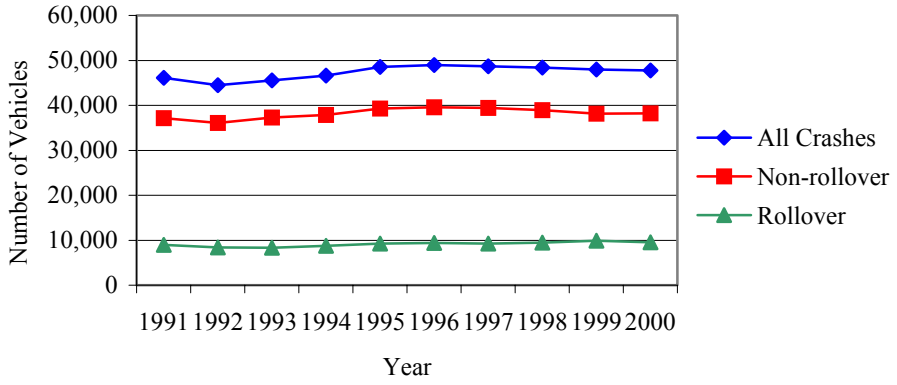
Year	Crash Type	Passenger Cars	Light Trucks				Total
			SUVs	Pickup Trucks	Vans	Other Light Trucks	
1991	Rollover	4,980	869	2,593	467	38	8,947
	No Rollover	26,311	1,526	7,128	1,966	245	37,176
	All Crashes	31,291	2,395	9,721	2,433	283	46,123
1992	Rollover	4,444	851	2,508	519	42	8,364
	No Rollover	25,373	1,517	6,941	2,047	223	36,101
	All Crashes	29,817	2,368	9,449	2,566	265	44,465
1993	Rollover	4,360	936	2,428	532	41	8,297
	No Rollover	25,873	1,723	7,217	2,266	189	37,268
	All Crashes	30,233	2,659	9,645	2,798	230	45,565
1994	Rollover	4,524	1,096	2,507	573	32	8,732
	No Rollover	25,749	1,874	7,543	2,548	180	37,894
	All Crashes	30,273	2,970	10,050	3,121	212	46,626
1995	Rollover	4,689	1,205	2,667	630	31	9,222
	No Rollover	26,251	2,131	8,093	2,700	130	39,305
	All Crashes	30,940	3,336	10,760	3,330	161	48,527
1996	Rollover	4,666	1,396	2,632	664	21	9,379
	No Rollover	26,061	2,375	8,133	2,878	147	39,594
	All Crashes	30,727	3,771	10,765	3,542	168	48,973
1997	Rollover	4,466	1,470	2,596	712	25	9,236
	No Rollover	25,626	2,671	8,053	2,921	180	39,451
	All Crashes	30,059	4,141	10,649	3,633	205	48,687
1998	Rollover	4,377	1,641	2,640	781	15	9,454
	No Rollover	24,663	2,920	8,180	3,104	82	38,949
	All Crashes	29,040	4,561	10,820	3,885	97	48,403
1999	Rollover	4,411	1,882	2,837	719	16	9,865
	No Rollover	23,616	3,098	8,212	3,134	61	38,121
	All Crashes	28,027	4,980	11,049	3,853	77	47,986
2000	Rollover	4,198	1,998	2,618	729	23	9,566
	No Rollover	23,298	3,510	8,165	3,144	108	38,225
	All Crashes	27,496	5,508	10,783	3,873	131	47,791

Source: NCSA, NHTSA, FARS 1991-2000

As noted above, sport utility vehicles (SUVs) and vans played an increasing role in fatal crashes, particularly after 1992. The number of SUVs involved has more than doubled since that year, possibly reflecting their increasing popularity and representation in the mix of vehicles traveling the nation's highways. In 1992, SUVs represented 5 percent of all passenger vehicles involved in fatal crashes. By 2000, they accounted for 12 percent of involved passenger vehicles. During the same period, pickup trucks continued to figure prominently as they accounted for about 21 to 22 percent of involved vehicles.

Figure 3 shows the number of passenger vehicles involved in fatal crashes annually since 1991. Following a decline from 1991 to 1992, the number involved rose to almost 49,000 vehicles in 1996, and had dropped to approximately 47,800 vehicles by 2000. Rollover crashes follow a very similar pattern, with a rise in the number of involved vehicles beginning in 1994 and ratcheting upward through 1999. The number was down only slightly to about 9,600 in 2000.

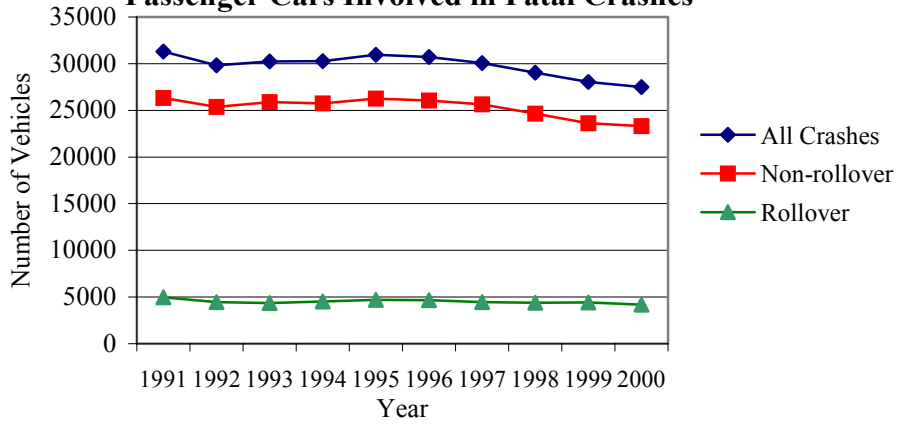
Figure 3
Passenger Vehicles Involved in Fatal Crashes



Source: NCSA, NHTSA, FARS 1991-2000

Figure 4 shows the declining trend in the numbers of passenger cars involved in the different types of fatal crashes from 1991 through 2000, particularly after 1995.

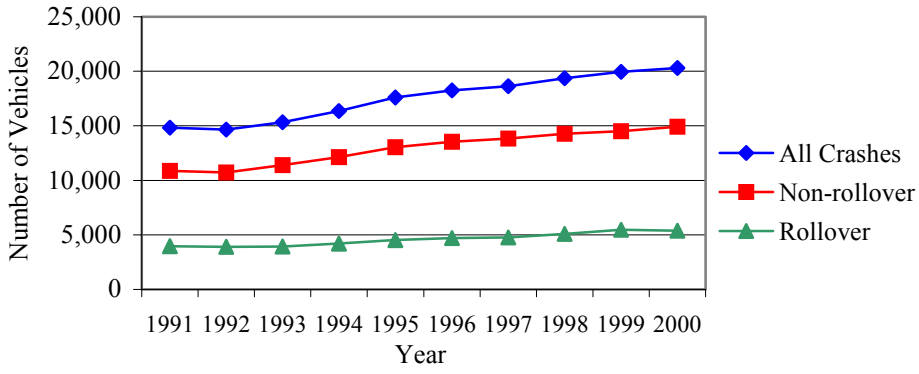
Figure 4
Passenger Cars Involved in Fatal Crashes



Source: NCSA, NHTSA, FARS 1991-2000

Despite the decline in the number of involved passenger cars, rising numbers of light trucks have kept the overall number of passenger vehicles involved fairly constant at about 48,000 annually since 1996. The increasing number of involved SUVs and, to a lesser extent, vans, in turn drives the increase in the total number of light trucks. Figure 5 shows the sharp increase in the number of light trucks involved in fatal crashes beginning with 1993 and continuing through 2000.

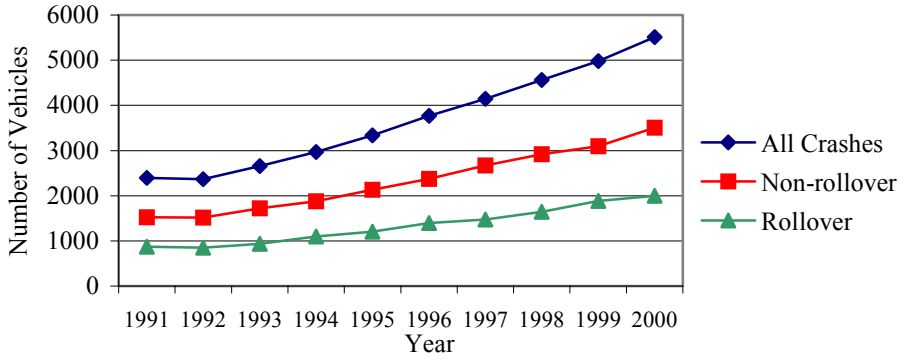
Figure 5
Light Trucks Involved in Fatal Crashes



Source: NCSA, NHTSA, FARS 1991-2000

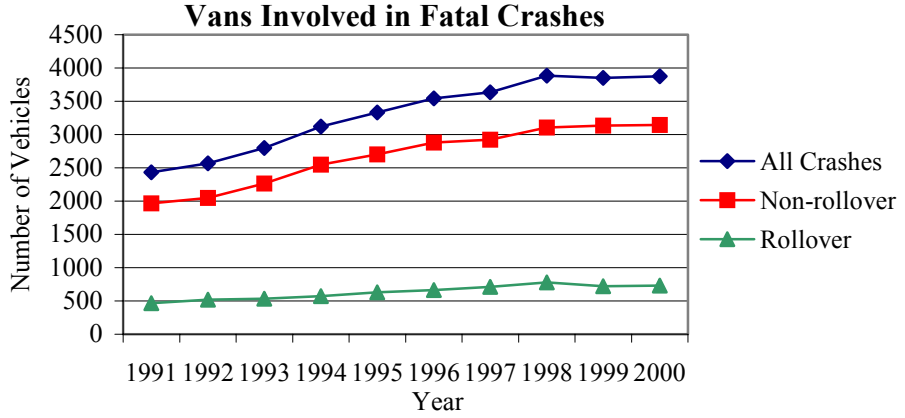
Figures 6 through 8 show the increases in involved SUVs, vans, and pickup trucks during the same period. While all types of light trucks have increased, it is clearly the SUVs that have shown the most pronounced rise in involvement in all types of fatal crashes.

Figure 6
Sport Utility Vehicles Involved in Fatal Crashes



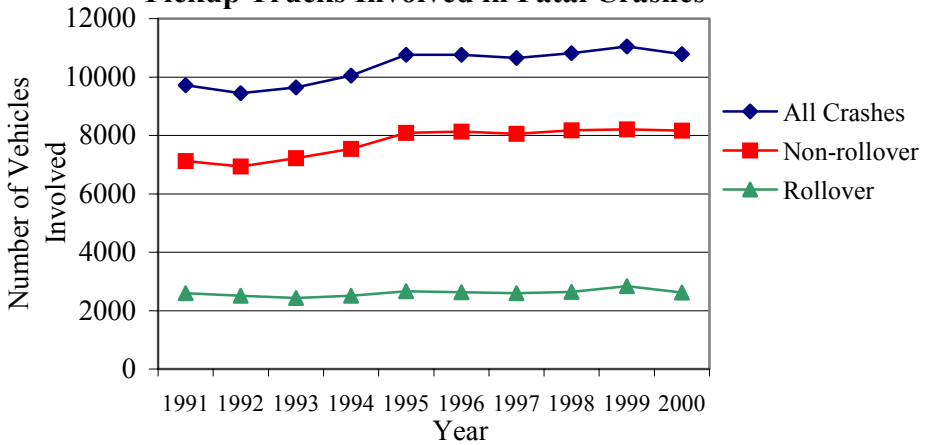
Source: NCSA, NHTSA, FARS 1991-2000

Figure 7
Vans Involved in Fatal Crashes



Source: NCSA, NHTSA, FARS 1991-2000

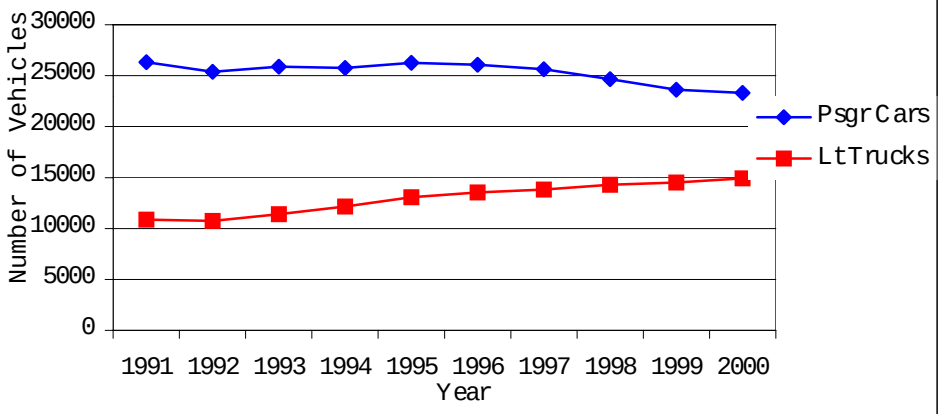
Figure 8
Pickup Trucks Involved in Fatal Crashes



Source: NCSA, NHTSA, FARS 1991-2000

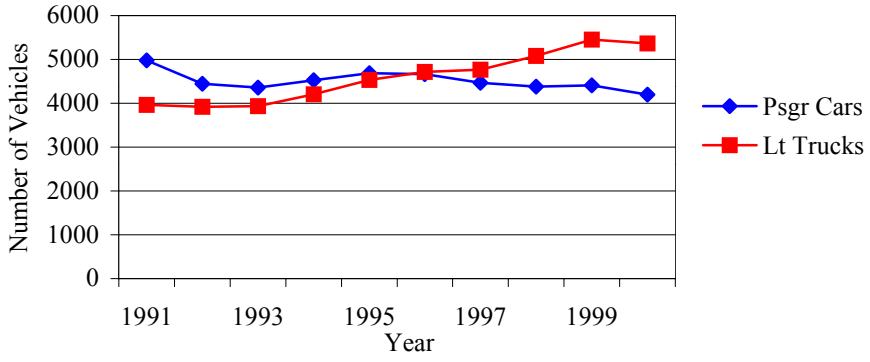
An indication of the impact of the growing numbers of involved light trucks on the total number of fatal crashes can be seen by comparing the numbers of passenger cars and light trucks in both rollover and non-rollover crashes through time. The following two charts, Figures 9 and 10, show the relative changes in the level of passenger car and light truck involvement in both types of fatal crashes. In the rollover category, the number of involved light trucks exceeded the number of passenger cars for the first time in 1996, and has continued to grow as the numbers of involved passenger cars decreased.

Figure 9
Passenger Vehicles Involved in Fatal Non-rollover Crashes



Source: NCSA NHTSA, FARS 1991-2000

Figure 10
Passenger Vehicles Involved in Fatal Rollover Crashes



Source: NCSA, NHTSA, FARS 1991-2000

One-fifth of all passenger vehicles involved in fatal crashes in 2000 experienced rollovers, a proportion that has remained essentially unchanged over the past ten years. Indeed, the incidence of vehicle rollovers as a percentage of vehicles involved in fatal crashes has been relatively constant for each of the passenger vehicle body types, although at different levels. Historically, SUVs have been the most rollover prone of the

passenger vehicles. In 2000, about 36 percent of all SUVs involved in fatal crashes experienced a rollover. The second most rollover prone vehicles were pickup trucks (24 percent), followed by vans (19 percent) and, finally, passenger cars (15 percent). The fact that these proportions have all remained relatively unchanged over time suggests that the increasing incidence of fatal rollovers results from growth in the numbers of vehicles exposed to the risk of a crash rather than any increase in the instability of the vehicles themselves (Table 2).

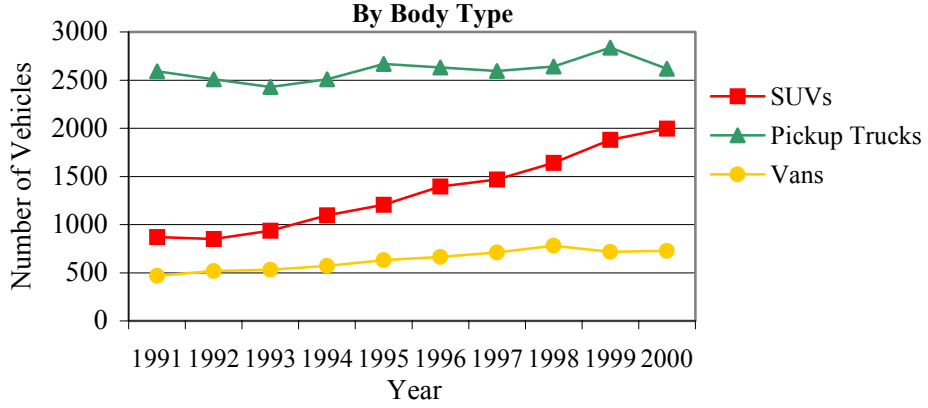
Table 2
Passenger Vehicles Involved in Fatal Crashes
By Year, Crash Type, and Vehicle Body Type

Year	Crash Type	Passenger Cars	Light Trucks			Total
			SUVs	Pickup Trucks	Vans	
		%	%	%	%	%
1991	Rollover	16	36	27	19	19
	No Rollover	84	64	73	81	81
	All Crashes	100	100	100	100	100
1995	Rollover	15	37	25	18	19
	No Rollover	85	63	75	82	81
	All Crashes	100	100	100	100	100
2000	Rollover	15	36	24	19	20
	No Rollover	85	64	76	81	80
	All Crashes	100	100	100	100	100

Source: NCSA, NHTSA, FARS 1991, 1995, 2000

The number of SUVs involved in fatal rollover crashes more than doubled between 1991 and 2000; a rate of growth that greatly exceeded that of pickup trucks and vans. It was this increase that resulted in the continuing climb in the number of light trucks involved in fatal crashes despite the negligible increase in pickup truck rollovers. Figure 11 compares the growth in SUV rollover crashes with that of the other classes of light trucks and shows how the influence of SUVs and, to a lesser extent, vans, drove the overall increase in light trucks involved in rollover crashes.

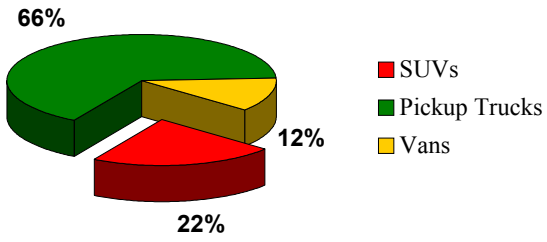
Figure 11
Light Trucks Involved in Fatal Rollover Crashes
By Body Type



Source: NCSA, NHTSA, FARS 1991-2000

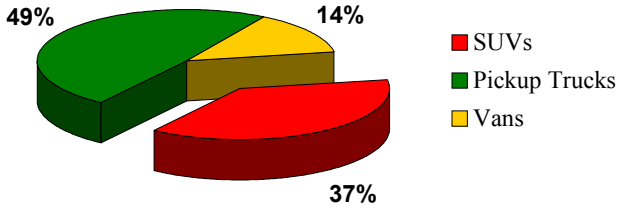
As a result of the disproportionate growth in the number of fatal SUV rollovers, the proportion of fatal light truck rollovers that was attributable to SUV crashes rose from 22 percent to 37 percent between 1991 and 2000. The relative stability in the number of fatal pickup truck rollovers during this period left them accounting for slightly less than half of all fatal light truck rollovers. The pie charts in Figures 12 and 13 illustrate this change over time in the proportion of fatal SUV rollovers.

Figure 12
Light Trucks involved in Fatal Rollover Crashes, 1991
By Body Type



Source: NCSA, NHTSA, FARS 1991

Figure 13
Light Trucks involved in Fatal Rollover Crashes, 2000
By Body Type



Source: NCSA, NHTSA, FARS 2000

While the total number of traffic crash fatalities has remained fairly constant at between 41,000 and 42,000 deaths annually, Table 3 shows that passenger car occupant fatalities actually declined from 22,505 in 1996 to 20,492 in 2000, a drop of 9 percent. Fatalities among occupants of light trucks, on the other hand, increased by 41 percent from 8,098 in 1992 to 11,418 in 2000. As is the case with the number of vehicles involved in fatal crashes, the increase in light truck occupant fatalities accounts for the continued high level of overall occupant fatalities, having offset the decline in traffic deaths of passenger car occupants.

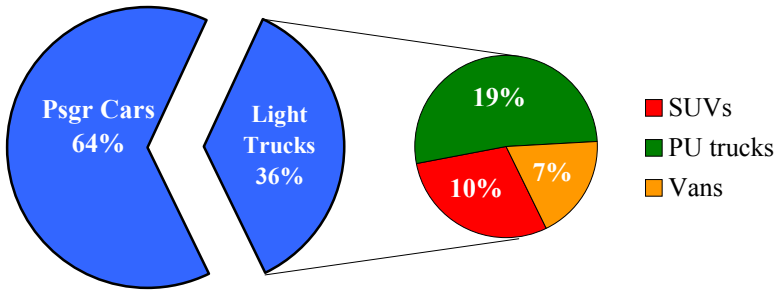
Table 3
Occupant Fatalities
By Year, Crash Type, and Vehicle Body Type

Year	Crash Type	Passenger Cars	Light Trucks				Total
			SUVs	Pickup Trucks	Vans	Other Light Trucks	
1991	Rollover	5,328	882	2,543	472	33	9,258
	No Rollover	17,057	594	3,128	671	68	21,518
	All Crashes	22,385	1,476	5,671	1,143	101	30,776
1992	Rollover	4,738	834	2,460	564	40	8,636
	No Rollover	16,649	501	2,925	728	46	20,849
	All Crashes	21,387	1,335	5,385	1,292	86	29,485
1993	Rollover	4,648	934	2,403	541	35	8,561
	No Rollover	16,918	587	3,135	824	52	21,516
	All Crashes	21,566	1,521	5,538	1,365	87	30,077
1994	Rollover	4,870	1,063	2,409	610	29	8,981
	No Rollover	17,127	694	3,165	898	36	21,920
	All Crashes	21,997	1,757	5,574	1,508	65	30,901
1995	Rollover	5,076	1,210	2,571	650	30	9,537
	No Rollover	17,347	725	3,367	989	26	22,454
	All Crashes	22,423	1,935	5,938	1,639	56	31,991
1996	Rollover	4,997	1,384	2,545	681	17	9,624
	No Rollover	17,508	763	3,359	1,151	32	22,813
	All Crashes	22,505	2,147	5,904	1,832	49	32,437
1997	Rollover	4,765	1,489	2,479	768	26	9,527
	No Rollover	17,434	891	3,408	1,146	42	22,921
	All Crashes	22,199	2,380	5,887	1,914	68	32,448
1998	Rollover	4,672	1,705	2,560	853	13	9,773
	No Rollover	16,522	1,008	3,361	1,219	16	22,126
	All Crashes	21,194	2,713	5,921	2,042	29	31,899
1999	Rollover	4,718	1,902	2,724	784	12	10,140
	No Rollover	16,144	1,124	3,403	1,304	12	21,987
	All Crashes	20,862	3,026	6,127	2,088	24	32,127
2000	Rollover	4,502	2,049	2,537	767	18	9,873
	No Rollover	15,990	1,275	3,416	1,337	19	22,037
	All Crashes	20,492	3,324	5,953	2,104	37	31,910

Source: NCSA, NHTSA, FARS 1991-2000

By 2000, the proportion of occupant fatalities attributable to light trucks was 36 percent of all passenger vehicle fatalities, up from 27 percent in 1991. SUV occupant fatalities more than doubled over this period and, by 2000, represented about 10 percent of all passenger vehicle occupant fatalities (Figure 14).

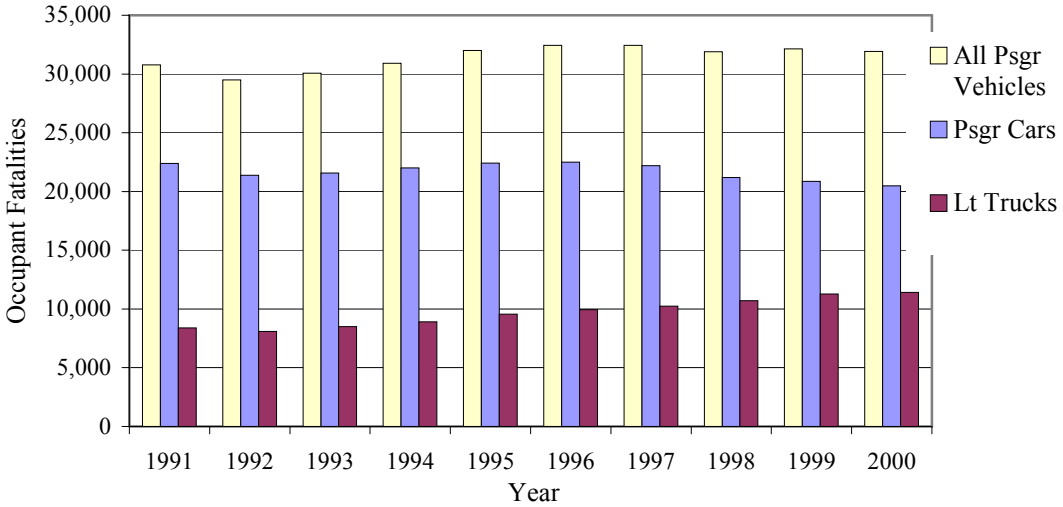
Figure 14
Passenger Vehicle Occupant Fatalities in 2000
By Vehicle Body Type



Source: NCSA, NHTSA, FARS 2000

The net effect of increasing numbers of light truck fatalities on the total number of occupant fatalities is illustrated in Figure 15, below. Following a decline that ended in 1992, passenger vehicle occupant fatalities rose through 1997, finally leveling off at about 32,000. After peaking in 1996, passenger car fatalities steadily declined through 2000, while light truck fatalities have steadily risen since 1992 replacing the passenger car occupant deaths.

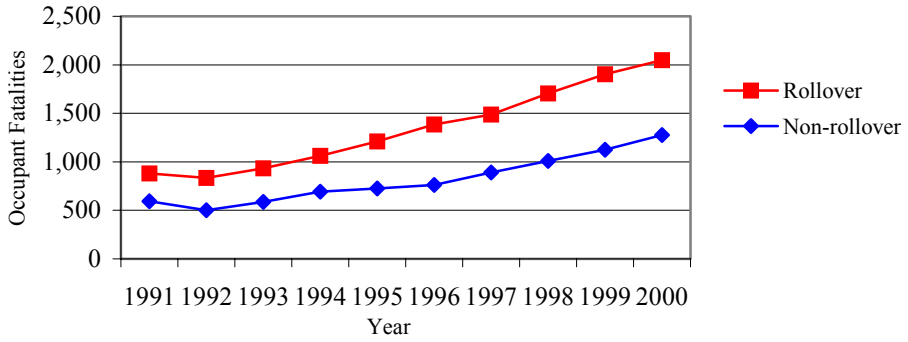
Figure 15
Passenger Vehicle Occupant Fatalities



Source: NCSA, NHTSA, FARS 1991-2000

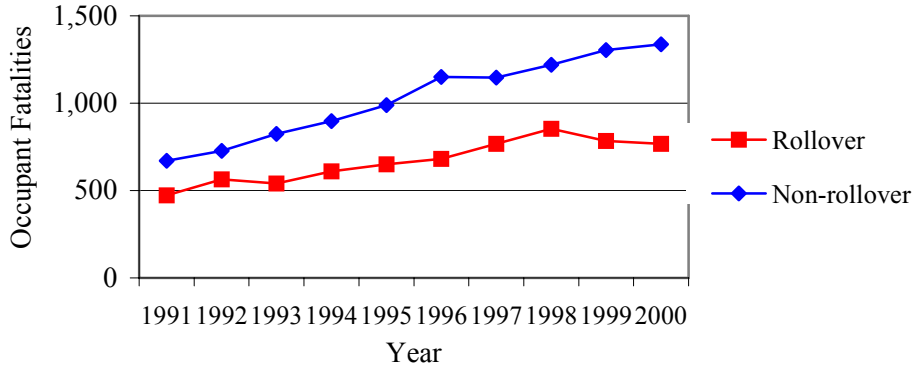
Within the light truck category, the most notable increase in fatalities has occurred among occupants of SUVs. SUV occupant fatalities have risen steadily from 1,335 in 1992 to 3,324 in 2000. A disproportionately high level of rollover related fatalities characterizes SUV crashes – this is the only vehicle type in which the number of occupant fatalities in rollovers exceeds the number of occupant fatalities in non-rollover crashes. In 2000, almost two-thirds of occupant fatalities in SUV crashes occurred in rollovers. Figures 16, 17 and 18 compare trends in the levels of occupant fatalities in the various body configurations of light trucks by rollover and non-rollover crash types. The overall effect of SUV fatal crashes on the light trucks is clearly discernable.

Figure 16
SUV Occupant Fatalities By Crash Type



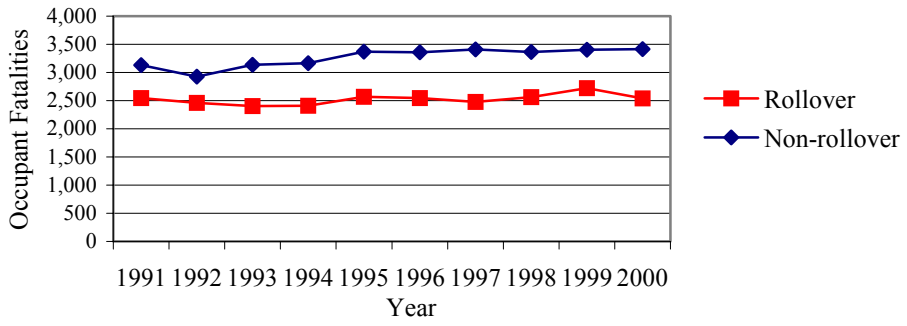
Source: NCSA, NHTSA, FARS 1991-2000

Figure 17
Van Occupant Fatalities By Crash Type



Source: NCSA, NHTSA, FARS 1991-2000

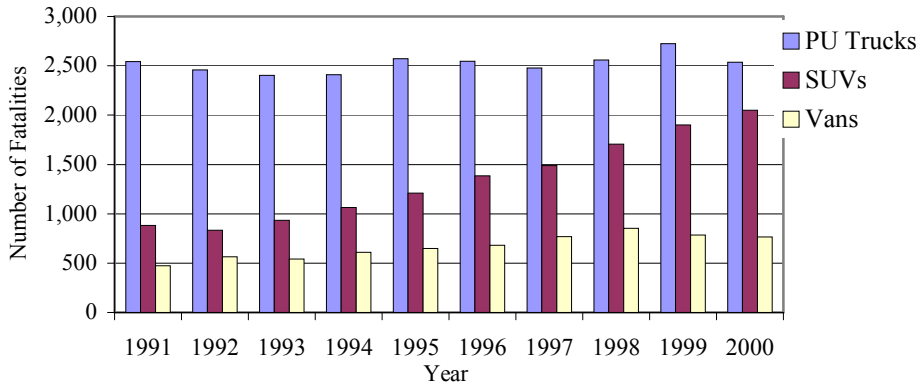
Figure 18
Pickup Truck Occupant Fatalities By Crash Type



Source: NCSA, NHTSA, FARS 1991-2000

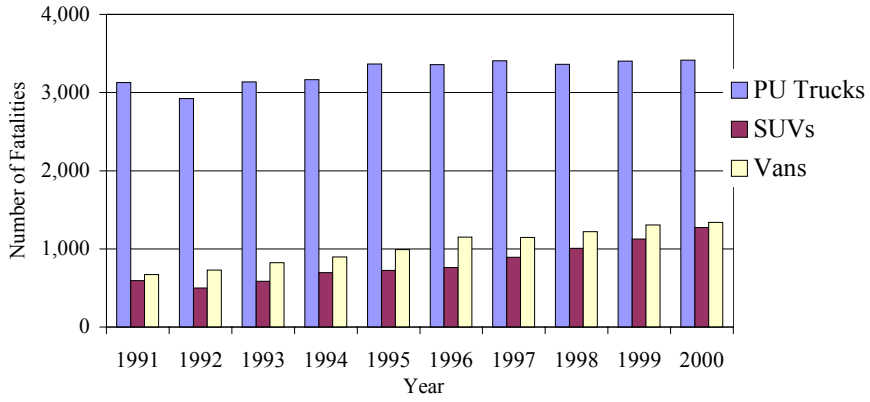
Looking at the rollover and non-rollover crashes by type of light truck is even more enlightening. Particularly in fatal rollover crashes, the growth in the number of SUV occupant deaths overshadows the trends among other types of light trucks, as shown in Figures 19 and 20.

Figure 19
Occupant Fatalities in Rollover Crashes



Source: National Center for Statistics and Analysis, NHTSA, FARS 1991-2000

Figure 20
Occupant Fatalities in Non-rollover Crashes



Source: NCSA, NHTSA, FARS 1991-2000

With the exception of vans and pickup trucks, approximately two-thirds of occupants killed in passenger vehicles that roll over in fatal crashes are drivers. About half of the fatalities in vans are drivers, and nearly three-quarters of occupant fatalities in pickup trucks are drivers, proportions that have been relatively constant over the ten-year period (Table 4). This distribution of occupant fatalities possibly reflects the occupancy patterns of the several passenger vehicle types. For example, pickup trucks generally can accommodate two to three passengers in the cab, while passenger cars and SUVs seat five to six persons and vans have a seating capacity as high as fifteen persons.

Table 4
Occupant Fatalities In Rollover Crashes, Selected Years
By Person Role and Vehicle Body Type (Percent Distribution)

Year	Person Role	Passenger Cars (%)	Light Trucks				All Passenger Vehicles (%)
			SUVs (%)	Pickup Trucks (%)	Vans (%)	Other (%)	
1991	Driver	67	61	73	50	82	67
	Passenger	33	39	27	50	18	33
	Total	100	100	100	100	100	100
1995	Driver	68	58	72	46	63	66
	Passenger	32	42	28	54	37	34
	Total	100	100	100	100	100	100
2000	Driver	68	60	74	46	78	66
	Passenger	32	40	26	54	22	34
	Total	100	100	100	100	100	100

Source: NCSA, NHTSA, FARS 1991, 1995, 2000

3.2.2 Vehicle Involvement Rates

The shift in the mix of vehicles involved in fatal crashes is also apparent in the mix of vehicles registered. Data collected by the Federal Highway Administration show that in 1991, 30 percent of passenger vehicles registered were light trucks. By 2000, light trucks had increased their share of the vehicle mix to 37 percent of registered passenger vehicles.

The growing numbers of light trucks on the road closely parallels the increase in the number of light trucks involved in fatal crashes. The number of light truck registrations has grown from 52 million in 1991 to 76 million in 1999, an increase of about 46 percent. Over the same period, the number of vehicle miles traveled (VMT) by light trucks has increased at an even faster pace than the number of registrations, up 58 percent to 943 million miles. Table 5 shows that the rate of involvement in fatal crashes per 100,000 registered vehicles has declined more for passenger cars than for light trucks over the 1991 to 2000 period, another indicator of the significance of the increase of light trucks in the vehicle mix.

Table 5
Vehicle Involvement in Fatal Crashes: Rate per 100,000 Registered Vehicles
By Year and Body Type of Vehicle

Year	Passenger Cars			Light Trucks		
	Number Registered	Number Involved	Rate	Number Registered	Number Involved	Rate
1991	123,327,336	31,291	25.37	52,062,064	14,832	28.49
1992	120,346,747	29,817	24.18	53,836,046	14,648	27.21
1993	121,055,398	30,233	24.97	56,573,835	15,332	27.1
1994	121,996,580	30,273	24.81	59,485,995	16,353	27.49
1995	123,241,881	30,940	25.11	62,520,872	17,587	28.13
1996	124,612,787	30,727	24.66	65,438,877	18,246	27.88
1997	124,672,920	30,059	24.11	67,287,470	18,628	27.68
1998	125,965,709	29,040	23.05	69,783,500	19,363	27.75
1999	126,868,744	28,027	22.09	73,143,777	19,959	27.29
2000	127,720,809	27,496	21.53	76,192,673	20,295	26.64

Source: R.L. Polk and Company, Registration data, and NCSA, NHTSA, FARS 1991-2000

Table 6 shows fatality rates for passenger cars and light trucks based on the number of vehicles registered. The occupant fatality rates per 100,000 registered passenger cars have been dropping since 1995, while the rates for light trucks, although somewhat lower than for passenger cars, have remained relatively stable.

Table 6 Fatality Rates per 100,000 Registered Vehicles By Year and Body Type of Vehicle						
Year	Passenger Cars			Light Trucks		
	Number Registered	Occupant Fatalities	Fatality Rate	Number Registered	Occupant Fatalities	Fatality Rate
1991	123,327,336	22,385	18.15	52,062,064	8,391	16.12
1992	120,346,747	21,387	17.77	53,836,046	8,098	15.04
1993	121,055,398	21,566	17.81	56,573,835	8,511	15.04
1994	121,996,580	21,997	18.03	59,485,995	8,904	14.97
1995	123,241,881	22,423	18.19	62,520,872	9,568	15.30
1996	124,612,787	22,505	18.06	65,438,877	9,932	15.18
1997	124,672,920	22,199	17.81	67,287,470	10,249	15.23
1998	125,965,709	21,194	16.83	69,783,500	10,705	15.34
1999	126,868,744	20,862	16.44	73,143,777	11,435	15.63
2000	127,720,809	20,492	16.04	76,192,673	11,418	15.99
Source: R.L. Polk and Company, Registration data, and NCSA, NHTSA, FARS 1991-2000						

Beginning in 1995, registration data are available by selected body types within the light truck category. While all categories of passenger vehicles have been growing in numbers, SUVs comprise the fastest growing component of the light truck family. In 1995, 18 percent of registered light trucks were SUVs, and they accounted for 6 percent of the registered passenger vehicle fleet. By 1999, the latest year for which data are available, SUVs made up 9 percent of passenger vehicles and 24 percent of the light truck fleet in the United States and had all but caught up with the number of registered vans (Table 7). These changes in the mix of vehicles that comprise the passenger vehicle fleet will be shown to have an effect on the type and incidence of fatal crashes.

Table 7 Numbers of Passenger Vehicles Registered By Year and Vehicle Body Type					
Year	Body Type of Vehicles				Total
	Passenger Cars	SUVs	Pickup Trucks	Vans	
1995	123,241,881	10,629,607	34,436,236	14,902,820	183,212,539
1996	124,612,787	11,980,964	35,465,358	15,791,759	187,852,864
1997	124,672,920	13,322,783	36,089,127	16,400,692	190,487,519
1998	125,965,709	14,958,152	36,729,063	16,976,847	194,631,769
1999	126,868,744	17,022,531	37,732,114	17,597,719	199,223,107
Source: Summarized from R. L. Polk and Company detailed registration data					

Table 8 shows the numbers of vehicles that rolled over in fatal crashes and the ratio of the number of vehicles that rolled over to the number of vehicles registered from 1995 through 1999. Over time there has been very little, if any, change in the rate of involvement in fatal rollover crashes among the various vehicle types.

The table shows that the highest rates of rollovers per 100,000 vehicles registered occur among SUVs followed by Pickup Trucks, Vans, and Passenger Cars, in that order. While all categories of light trucks experienced greater rates of fatal rollover crashes, the SUVs stand out particularly with a rate that is more than three times as that of passenger cars. As the various types of light trucks grow in popularity, other factors remaining unchanged, their increasing presence in the vehicle mix will be reflected in increasing numbers of rollover crashes and fatalities resulting from rollover crashes.

Table 8
Passenger Vehicles that Rolled Over in Fatal Traffic Crashes

Year	Number of Vehicles and Rate per 100,000 Registered								Total	
	Passenger Cars		SUVs		Pickup Trucks		Vans			
	Num.	Rate	Num.	Rate	Num.	Rate	Num.	Rate	Num.	Rate
1995	4,689	3.80	1,205	11.34	2,667	7.74	630	4.23	9,191	5.02
1996	4,666	3.74	1,396	11.65	2,632	7.42	664	4.20	9,358	4.98
1997	4,433	3.56	1,470	11.03	2,596	7.19	712	4.34	9,211	4.84
1998	4,377	3.47	1,641	10.97	2,640	7.19	781	4.60	9,439	4.85
1999	4,411	3.48	1,882	11.06	2,837	7.52	719	4.09	9,849	4.94

Source: R.L. Polk and Company, Registration data, and NCSA, NHTSA, FARS 1995-1999.

Table 9 shows fatality rates per 100,000 registered vehicles for the various body types. While fatality rates for all passenger vehicles have decreased over the study period, most of the decrease is among passenger cars, and vans have shown a slight increase. Prior to 1998 the differences in fatality rates between SUVs and Passenger cars were minimal, but as passenger car rates declined, the rates for light trucks in general remained at or near previous levels. It is interesting that, despite their higher seating capacity, vans exhibit the lowest fatality rates of the four types of vehicles.

Table 9
Occupant Fatality Rates per 100,000 Registered Vehicles
By Year and Body Type of Vehicle

Year	Number of Fatalities and Rate per 100,000 Registered Vehicles								Total	
	Passenger Cars		SUVs		Pickup Trucks		Vans			
	Num.	Rate	Num.	Rate	Num.	Rate	Num.	Rate	Num.	Rate
1995	22,423	18.19	1,935	18.20	5,938	17.24	1,639	11.00	31,991	17.46
1996	22,505	18.06	2,147	17.92	5,904	16.65	1,832	11.60	32,437	17.27
1997	22,199	17.81	2,380	17.86	5,887	16.31	1,914	11.67	32,448	17.03
1998	21,194	16.83	2,713	18.14	5,921	16.12	2,042	12.03	31,899	16.39
1999	20,862	16.44	3,026	17.78	6,127	16.24	2,088	11.87	32,127	16.13

Source: R.L. Polk and Company, Registration data, and NCSA, NHTSA, FARS 1995-1999.

Another measure of exposure to risk is the number of miles traveled in a year by a particular type of vehicle. The Federal Highway Administration provides data on the number of vehicle miles traveled (VMT) broken down by passenger cars and light trucks. Table 10 shows that the rate of involvement in fatal crashes per 100 million vehicle miles traveled has declined for both classes of passenger vehicles over the period from 1991 to 2000. (VMT data are not available for vehicle classes within the light truck category.)

Table 10
Rate of Involvement in Fatal Crashes per 100 Million VMT
By Year and Body Type of Vehicle

Year	Passenger Cars			Light Trucks		
	VMT (Millions)	Number Involved	Rate	VMT (Millions)	Number Involved	Rate
1991	1,411,655	31,291	2.22	595,924	14,832	2.49
1992	1,436,035	29,817	2.11	642,397	14,648	2.28
1993	1,445,106	30,233	2.09	675,353	15,332	2.27
1994	1,459,208	30,273	2.07	711,515	16,353	2.30
1995	1,478,352	30,940	2.09	749,971	17,587	2.35
1996	1,499,139	30,727	2.05	787,255	18,246	2.32
1997	1,528,399	30,059	1.97	824,896	18,628	2.26
1998	1,555,901	29,040	1.87	861,951	19,363	2.25
1999	1,566,979	28,027	1.79	903,412	19,959	2.21
2000	1,582,113	27,496	1.74	943,819	20,295	2.15

Source: FHWA, VMT data, and NCSA, NHTSA, FARS 1991-2000

Table 11 shows the rate of fatalities per hundred million vehicle miles traveled. This measure shows that the annual rate of occupant fatalities per year remained relatively stable as exposure increased. The number of vehicle miles traveled has been steadily rising over the ten-year period from 1991 to 2000 for both passenger cars (up 12 percent) and light trucks (up 58 percent). The same period has seen the number of occupant fatalities decrease by 8 percent for passenger cars and increase by 36 percent for light trucks.

Table 11
Fatality Rates per 100 Million Vehicle Miles Traveled (VMT)
By Year and Body Type of Vehicle

Year	Passenger Cars			Light Trucks		
	VMT (Millions)	Occupant Fatalities	Fatality Rate	VMT (Millions)	Occupant Fatalities	Fatality Rate
1991	1,411,655	22,385	1.6	595,924	8,391	1.4
1992	1,436,035	21,387	1.5	642,397	8,098	1.3
1993	1,445,106	21,566	1.5	675,353	8,511	1.3
1994	1,459,208	21,997	1.5	711,515	8,904	1.3
1995	1,478,352	22,423	1.5	749,971	9,568	1.3
1996	1,499,139	22,505	1.5	787,255	9,932	1.3
1997	1,528,399	22,199	1.5	824,896	10,249	1.2
1998	1,555,901	21,194	1.4	861,951	10,705	1.2
1999	1,566,979	20,862	1.3	903,412	11,435	1.3
2000	1,582,113	20,492	1.3	943,819	11,418	1.2

Source: FHWA VMT data and NCSA, NHTSA, FARS 1991-2000

These two measures of exposure to risk, number of vehicles registered and millions of vehicle miles traveled, help to explain the continuing high levels of traffic crash fatalities despite decreasing fatalities among occupants of passenger cars. Thus, while the number of fatalities among passenger car occupants is down, the decline is being offset by a concomitant increase in the numbers of fatalities among occupants of light trucks, a growing factor in the mix of both vehicles registered and vehicles involved in fatal crashes.

3.2.3 Population Trends

According to the January 2, 2001 Census Bureau release, the estimated resident population of the United States increased by 10.7 percent from 249.5 million persons in 1991 to 276.1 million in 2000.

Turning to the population by age groups, Table 12 shows that the population has been aging over the inter-censual period from 1990 to 2000. In 1990, 62 percent of the population was less than 40 years old. By 2000, the under 40 population was 57 percent of the all ages total. Twenty to twenty-nine year olds in particular showed a steady decline from 1990 through 1995, with a more gradual decline from 1995 through 1999. By 2000, a slight increase was noticeable in the 20 to 29 year old group.

The 30 to 39 year old age group increased from 1990 through 1995, when their numbers began to turn downward, dropping from 44.1 million to 41.6 million in 2000. The overall effect of the aging "baby boomers" can be seen in the growing numbers of persons over age 39 in the table.

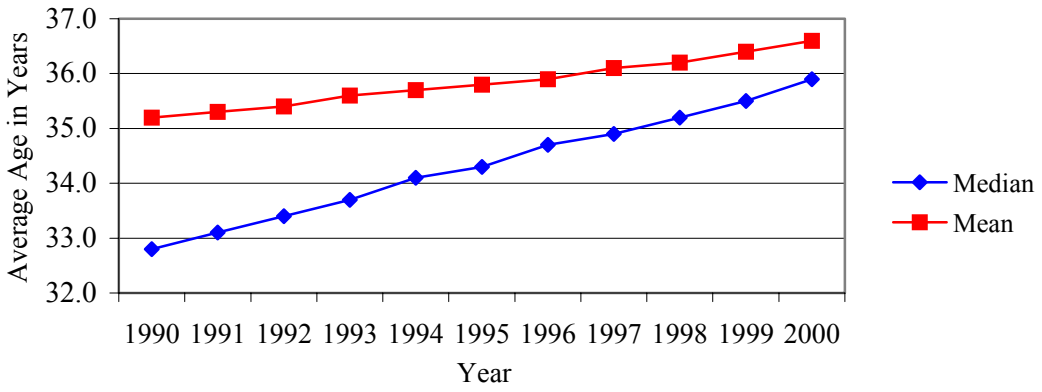
Table 12
US Resident Population In Millions
By Year and Age Group

Year	Age Group						Total
	<20	20-29	30-39	40-49	50-59	60 +	
1990	71,878	40,371	41,894	31,619	21,844	41,860	249,466
1991	72,308	39,869	42,687	32,860	22,070	42,360	252,154
1992	73,067	39,187	43,338	34,166	22,538	42,734	255,030
1993	73,999	38,355	43,832	35,140	23,406	43,050	257,782
1994	74,911	37,496	44,111	36,394	24,126	43,288	260,326
1995	75,684	36,887	44,121	37,717	24,728	43,665	262,802
1996	76,443	36,441	43,866	39,242	25,284	43,954	265,230
1997	77,096	36,308	43,375	39,845	26,913	44,246	267,783
1998	77,702	36,253	42,783	40,736	28,125	44,648	270,247
1999	78,185	36,235	42,272	41,624	29,321	45,054	272,691
2000	78,537	36,318	41,608	42,828	31,078	45,690	276,059

Source: US Census Bureau, Population Estimates Program, Population Division

Despite the growth in the number of persons 19 years old and younger, the total resident population has aged steadily since 1990, as evidenced by the mean and median age of the population displayed in Figure 21 below. In 2000, the median age of the population was 35.9 years, up from 32.8 years in 1990.

Figure 21
Aging Of The US Population, 1990 - 2000



Source: US Census Bureau, Population Estimates Program, Population

4. FINDINGS

4.1 Restraint Use and Ejection

According to the National Occupant Protection Survey (NOPUS) conducted by NHTSA, safety belt usage is at an all time high since the surveys began in 1994. The latest results, published in Research Note HS 809 319 "Observed Shoulder Belt Use From the June 2001 Mini NOPUS", report an average nationwide belt usage rate of 73 percent.

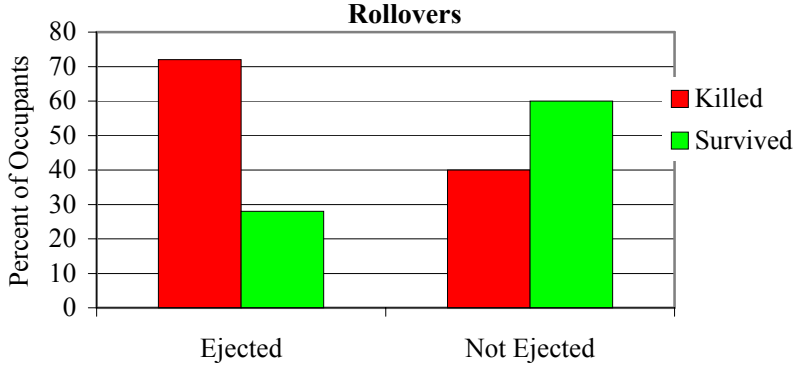
Despite the increased use of restraint devices, 72 percent of occupants who died in rollover crashes in 2000 were not using them. Restraints can be very effective in protecting occupants both from injuries and from being completely ejected from the vehicle during a rollover crash. Figure 22 shows that of all vehicle occupants in fatal rollovers, only 4 percent of those using restraints were completely ejected compared with 53 percent of those who were not using their restraints.

Figure 22
Occupant Restraint Use and Complete Ejection in Fatal Rollovers

Source: NCSA, NHTSA, FARS 2000

Whether or not an occupant is ejected from a vehicle that rolls over can mean the difference between living and dying. Of those occupants who were killed in fatal rollovers, 62 percent were ejected from the vehicle compared with 23 percent of those who survived. Figures 22 and 23 show that when restraints are used, occupants are less likely to be ejected and therefore have a higher likelihood of surviving a rollover crash.

Figure 23
Occupant Survival and Complete Ejection in Fatal Rollovers

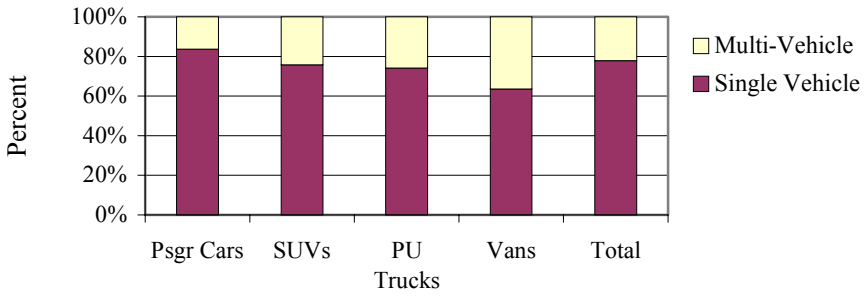


Source: NCSA, NHTSA, FARS 2000

4.2 Single Vehicle/Multi Vehicle Rollovers

For the most part, fatal rollovers of passenger vehicles tend to be single vehicle crashes. In 2000, more than three-fourths of the fatal rollovers were single vehicle crashes, with passenger cars registering the highest at 84 percent of all passenger car rollover crashes. The high incidence of single vehicle rollovers suggests that driver distraction or drowsiness could play a role in this type of crash. These relationships are illustrated in Figure 24.

Figure 24
Vehicles Involved in Fatal Rollover Crashes in 2000 By Type of Crash



Source: NCSA, NHTSA, FARS 2000

4.2.1 Vehicle Maneuver

It is interesting to note that in the case of both single and multi-vehicle crashes most vehicles were reported to be either traveling straight ahead or negotiating a curve at the time of the crash. Table 13 shows that of vehicles involved in single vehicle rollovers, 61 percent were reported to be traveling straight ahead just prior to the rollover while 31 percent were negotiating a curve.

Multi-vehicle crashes follow the same pattern in this respect. 71 percent of vehicles that rolled over in multi-vehicle crashes were traveling straight ahead and 8 percent were negotiating a curve just prior to the crash.

Table 13 Single Vehicle Fatal Rollovers By Selected Vehicle Maneuver and Body Type										
Vehicle Maneuver	Vehicle Body Type								Total	
	Psgr Cars		SUVs		PU Trucks		Vans			
	No.	%	No.	%	No.	%	No.	%	No.	%
Going Straight	2,035	58	1,000	66	1,196	62	328	71	4,812	61
Passing	87	2	29	2	22	1	5	1	143	2
Changing Lane	55	2	47	3	19	1	6	1	129	2
Negotiating Curve	1,198	34	358	24	645	33	106	23	2,471	31
Total	3,518	100	1,514	100	1,940	100	463	100	7,898	100

Source: NCSA, NHTSA, FARS 2000
Note: Sums of individual items do not add to totals because not all vehicle maneuvers are included.

4.2.2 Crash Avoidance Maneuvers

Table 14 Vehicles Involved in Fatal Rollovers By Crash Avoidance Maneuver and Type of Crash (Percent Distributions)			
Type of Maneuver	Type of Rollover Crash		
	All Rollovers	Single Vehicle	Multi Vehicle
None	27	25	32
Braking	6	6	5
Steering	28	31	19
Not Reported	39	38	43
Total	100	100	100

Source: NCSA, NHTSA, FARS 2000

In addition to the vehicle maneuver prior to the crash, there is a FARS variable that describes the type of maneuver taken by the driver of the vehicle to avoid a crash as reported by the police. Although there were large numbers of cases in which police did not report crash avoidance maneuvers, in those cases where avoidance maneuvers were reported the principle maneuvers undertaken were braking or steering. In the case of fatal rollover crashes, more than one-fourth of drivers did not attempt any kind of avoidance maneuver. In fatal multi-vehicle rollovers, about one-third of the drivers did not attempt an avoidance maneuver, while about one-fifth used a steering maneuver. In single vehicle rollovers, about one-third of drivers employed a steering maneuver (Table 14).

4.2.3 Time of Day

In single vehicle crashes, 60 percent of those in which police reported no avoidance maneuver took place at night. Multi-vehicle crashes, on the other hand, exhibited the opposite tendency, approximately 60 percent of them occurring during day light hours. When an avoidance maneuver such as braking or steering was used, a similar day-night pattern was observed (Table 15).

Table 15
Vehicles Involved in Fatal Rollovers
By Crash Avoidance Maneuver, Type of Crash, and Time of Day
(Percent Distributions)

Type of Maneuver	Time of Day		Total
	Night	Day	
Single Vehicle			
None	60	40	100
Braking	61	39	100
Steering	54	46	100
Multi-Vehicle			
None	40	60	100
Braking	29	71	100
Steering	31	69	100

Source: NCSA, NHTSA, FARS 2000

4.3 Drivers

Note that in the discussion that follows, the number of vehicles involved does not equal the number of involved drivers. This is due to a small number of cases in which there was a driverless vehicle, the driver left the scene of the crash, or investigators were unable to determine which occupant was the driver.

4.3.1 Age Distribution of Drivers

In general, the drivers of vehicles that rolled over in fatal crashes tended to be younger than the median population age. With the exception of the drivers of vans, most were less than 40 years old, and approximately half were between the ages of 20 and 39 years old. Drivers of passenger cars involved in fatal rollovers were the youngest group. More than half (54 percent) were under 30 years old. Twenty-two percent were teenagers, and 33 percent were in the group aged 20 to 29 years old. The proportions of involved drivers over age 39 tend to drop off with each succeeding age group through age 59, although there was a slight increase in the numbers of involved passenger car drivers who were 60 years old and over.

SUV and pickup truck drivers tended to be older than passenger car drivers, while van drivers were weighted more toward the middle of the age distribution. Almost half of the van drivers were from 30 to 49 years old (Table 16).

Table 16
Age of Driver in Fatal Rollover Crashes
By Type of Vehicle

Vehicle Body Type	Age Group						Total
	<20	20-29	30-39	40-49	50-59	60 +	
Psgr Cars	906	1368	711	530	270	375	4,170
Percent	22	33	17	13	6	9	100
SUVs	266	606	442	345	186	146	1,995
Percent	13	30	22	17	9	7	100
PU Trucks	362	701	517	465	291	266	2,610
Percent	14	27	20	18	11	10	100
Vans	56	121	178	157	101	109	727
Percent	8	17	24	22	14	15	100
Total	1,590	2,796	1,848	1,497	848	896	9,502
Percent	17	29	20	16	9	9	100

Source: NCSA, NHTSA, FARS 2000

4.3.2 Sex of Drivers

In 2000, most of the drivers involved in fatal rollovers, 73 percent, were men. There have been some small changes in the sex distribution of drivers over time. Overall, women accounted for 22 percent of the drivers in 1991, and the proportion has slowly increased to 26 percent in 2000. When the numbers are controlled by vehicle type, the same pattern is observed. The highest proportion of male drivers was among pickup trucks, where the percentage of men ranged from a high of 90 percent in 1991 to a low of 86 percent in 1996. Since that time, the proportion of involved pickup truck drivers who were men has remained at 88 percent.

The slight changes that have taken place over time in the distribution of drivers by gender are noticeable across the board other than among involved drivers of pickup trucks. The increase in the proportion of women is about 4 percentage points, with the exception of SUVs. The proportion of involved SUV drivers who are women began rising after 1992, when they constituted 23 percent of the SUV drivers. By 2000, the proportion has grown 10 percentage points to reach 33 percent (Table 17).

Table 17 Drivers Involved in Fatal Rollovers, 1991 through 2000 By Sex and Type of Vehicle (Percent by Sex)						
Year	Sex	Vehicle Type				Total (%)
		Passenger Cars	SUVs (%)	Pickup Trucks (%)	Vans (%)	
1991	Men	73	77	90	73	78
	Women	27	23	10	27	22
1992	Men	70	77	88	72	76
	Women	30	23	12	28	23
1993	Men	71	75	88	73	76
	Women	29	25	12	27	24
1994	Men	69	71	88	75	75
	Women	31	28	12	25	24
1995	Men	70	72	88	69	75
	Women	30	28	12	31	24
1996	Men	69	72	86	72	75
	Women	31	28	13	27	25
1997	Men	69	69	88	70	74
	Women	31	31	12	30	26
1998	Men	68	69	87	70	73
	Women	32	31	13	30	26
1999	Men	68	67	88	66	73
	Women	32	33	12	33	26
2000	Men	68	67	88	68	73
	Women	31	33	12	31	26
Source: NCSA, NHTSA, FARS 1991-2000						

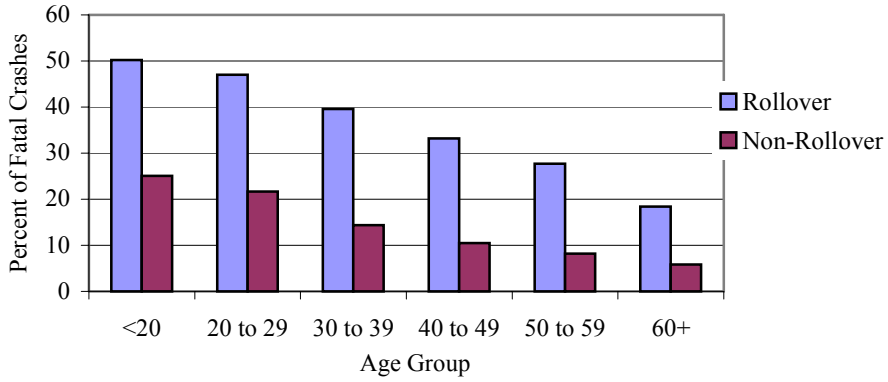
4.3.3 Speeding as a Factor

Fatal rollovers of passenger vehicles are reported to be speed related more often than are non-rollover fatal crashes. In 2000, some 40 percent of fatal rollover crashes involved speeding, as noted on police accident reports (PARs). This compares with a rate of reported speeding in non-rollover crashes of 15 percent. Historically, the relationship between reported speeding and fatal crashes has been relatively constant for both rollover and non-rollover fatal crashes since 1991.

Reported speeding as a factor in fatal rollovers tended to decrease with advancing age, as shown in Figure 25. Half of the involved drivers under 20 years old were reported to be

speeding when the rollover occurred, and 76 percent of all speeding drivers were under 40 years old.

Figure 25
Percent of Fatal Crashes That Were Speed Related in 2000



Source: NCSA, NHTSA, FARS 2000

The highest rate of reported speeding as a factor in fatal rollovers, 48 percent, was among the drivers of passenger cars, followed by pickup truck drivers and SUV drivers. Van drivers had the lowest rate at 24 percent (Table 18).

Table 18
Drivers Involved in Fatal Rollover Crashes
By Relative Speed and Type of Vehicle

Drivers	Type of Vehicle					Total
	Relative Speed	Passenger Cars	SUVs	Pickup Trucks	Vans	
Number	Speeding	2,003	646	938	173	3,766
	Not Speeding	2,143	1,324	1,651	548	5,682
	Total	4,146	1,970	2,589	721	9,448
Percent	Speeding	48	33	36	24	40
	Not Speeding	52	67	64	76	60
	Total	100	100	100	100	100

Source: NCSA, NHTSA, FARS 2000

Drivers involved in fatal single vehicle rollovers were more likely to have been speeding than were those involved in fatal multi-vehicle rollovers. In 2000, 46 percent of drivers in single vehicle rollovers were reported to have been speeding compared with 17 percent of drivers in multi-vehicle rollovers (Table 19). Passenger car drivers in particular tended to be speeders in both single vehicle (53 percent) and multi-vehicle rollovers (24 percent). Passenger cars are less likely to rollover in a crash due to their inherent

stability, and it may require greater speeds to generate the forces needed to cause a rollover, particularly in single vehicle crashes.

Table 19
Drivers Involved in Fatal Single and Multi-Vehicle Rollover Crashes
By Relative Speed and Type of Vehicle
(Percent Distributions)

Type of Rollover	Relative Speed	Type of Vehicle				Total (%)
		Passenger Cars (%)	SUVs (%)	Pickup Trucks (%)	Vans (%)	
Single Vehicle	Speeding	53	39	44	32	46
	Not Speeding	47	61	56	68	54
	Total	100	100	100	100	100
Multi-Vehicle	Speeding	24	14	13	10	17
	Not Speeding	76	86	87	90	83
	Total	100	100	100	100	100

Source: NCSA, NHTSA, FARS 2000

While reported speeding is a subjective variable at best, the role of speed in rollover crashes becomes readily apparent when the numbers of fatal rollovers are cross-tabulated with the speed limit at the site of the crash. In 2000, 71 percent of fatal rollovers took place where the speed limit was 55 miles per hour or higher. Vans and SUVs were particularly vulnerable to speed, with more than three-fourths of fatal rollovers occurring where speed limits are 55 miles per hour or over (Table 20).

Table 20
Vehicles that Rolled Over in Fatal Crashes
By Body Type and Speed Limit Where Crash Occurred

Vehicle Body Type	Speed Limit in MPH						Total	
	50 and Under		55		Over 55			
	No.	%	No.	%	No.	%	No.	%
Psgr Cars	1,353	33	1,640	40	1,151	28	4,144	100
SUVs	468	24	626	32	876	44	1,970	100
PU Trucks	684	26	1,070	41	833	32	2,587	100
Vans	159	21	236	31	368	48	763	100
Total	2,664	28	3,572	38	3,228	34	9,464	100

Source: NCSA, NHTSA, FARS 2000

4.4 Crash Site

Most of the vehicles (90 percent) that experienced fatal rollovers were traveling on undivided, two-way roads or divided roads with no barriers when the crash occurred, both for single vehicle and multi vehicle crashes (Table 21). Undivided two-way roads accounted for the bulk of these crashes, particularly those involving passenger cars and pickup trucks. Only 9% of rollovers occurred on divided roadways with barriers. Rural roads were more likely to be the scene of a fatal rollover as well, with almost three-fourths of the crashes occurring in rural areas and, as noted above, where speed limits were 55 miles per hour and over. According to NHTSA's Highway and Vehicle Safety Report published September 10, 1999, about 40% of Vehicle Miles Traveled are on rural roads, and about 60% of all traffic crash fatalities took place on rural roads in 2000.

Table 21
Vehicles that Rolled Over in Fatal Crashes
By Body Type and Description of Road Where Crash Occurred

Type of Road	Vehicle Body Type									
	Passenger Cars		SUVs		Pickup Trucks		Vans		Total [1/]	
	No.	%	No.	%	No.	%	No.	%	No.	%
Undivided two Way	2,826	67	1,012	51	1,881	72	359	49	6,650	70
Divided, No Barrier	921	22	736	37	552	21	281	39	2,679	28
Divided, Barrier	379	9	228	11	160	6	79	11	927	10
One-way	22	0.5	9	0.5	7	0.3	3	0.4	46	1
Unknown	50	1	13	0.7	18	2	7	1	98	1
Total	4,198	100	1,998	100	2,618	100	729	100	9,566	100

Source: NCSA, NHTSA, FARS 2000 [1/] **Total includes unknown light truck body types**

4.5 Day and Time

Fatal rollovers can occur at any time of the day or on any day of the week, but tend to be particularly prevalent on weekends, from Friday through Sunday. Given that this is "party time", drivers probably experience more distractions during weekend driving, and it is likely that alcohol also plays a role in these crashes. Two-thirds of the crashes that took place on these days occurred during the hours of darkness, from 6:00 P.M. to 6:00 A.M. with a notable peak occurring between midnight and 3 A.M., the period when fatigue is most likely to strike. During the weekday period from Monday through Friday, the "rush hour" periods, from 6:00 to 9:00 A.M. and from 3:00 to 6:00 P.M., also saw a larger proportion of these crashes (Table 22).

Table 22
Vehicles That Rolled Over in Fatal Crashes
By Time of Day and Day of Week

Time of Day	Day of Week				Total	
	Monday Through Thursday		Friday Through Sunday			
	No.	%	No.	%	No.	%
Midnt-3AM	552	13	1,064	20	1,616	17
3 AM to 6 AM	359	8	617	12	976	10
6 AM to 9 AM	457	11	447	8	904	10
9 AM to Noon	380	9	363	7	743	8
Noon-3 PM	532	12	522	10	1,054	11
3 PM to 6PM	734	17	708	13	1,442	15
6 PM to 9 PM	596	14	664	13	1,260	13
9 PM to Midnight	606	14	799	15	1,405	15
Unknown	66	2	97	2	163	2
Total	4,282	100	5,281	100	9,563	100

Source: NCSA, NHTSA, FARS 2000

4.6 Alcohol Involvement

In 2000, there were a total of 9,525 passenger vehicle drivers involved in fatal rollover crashes. Of these, nearly one-half, 4,337, were cases in which the driver's blood alcohol level (BAC) was 0.01 grams per deciliter (g/dl) or higher and 3,479, or 37 percent of the drivers, had a BAC of 0.10 g/dl or over. Persons with a BAC of .08 g/dl or over who are involved in fatal crashes are considered to be intoxicated, and in many states a BAC of 0.08 now constitutes the lower bound for the legal definition of intoxication. In those cases where alcohol test results are unknown, BAC values are assigned to drivers involved in fatal crashes by a statistical procedure known as imputation. A complete description of the methods used to impute unknown BAC test results in the FARS

database can be found in a technical report available from the National Center for Statistics and Analysis (see reference 3).

Interestingly, with the exception of pickup truck drivers, the drivers of light trucks were less likely to have a positive BAC test result (0.01 or higher BAC) then were the drivers of passenger cars. Only 37 percent of the involved SUV drivers and 28 percent of the involved van drivers had a BAC of 0.01 or higher (Table 23).

Table 23
Vehicles That Rolled Over In Fatal Crashes
Blood Alcohol Concentration (BAC) of Drivers
By Type of Vehicle

Vehicle Body Type	0.00		0.01 to 0.09		0.10 or Over		Total	
	No.	%	No.	%	No.	%	No.	%
Psgr Cars	2,112	51	421	10	1,637	39	4,170	100
SUVs	1,264	63	193	10	538	27	1,995	100
PU Trucks	1,271	49	215	8	1,124	43	2,610	100
Vans	529	73	27	4	172	24	727	100
Total [1/]	5,188	54	857	9	3,479	36	9,525	100

Source: NCSA, NHTSA, FARS 2000 **[1/] Total includes unknown light truck body types**

4.6.1 Single and Multi-Vehicle Crashes

Involved drivers in single vehicle fatal rollovers were even more likely to have tested positive for blood alcohol. With the exception of SUV and van drivers, the proportion of drivers with positive BAC was over 50 percent, led by the pickup truck drivers, 61 percent of whom had positive BAC test results (Table 24).

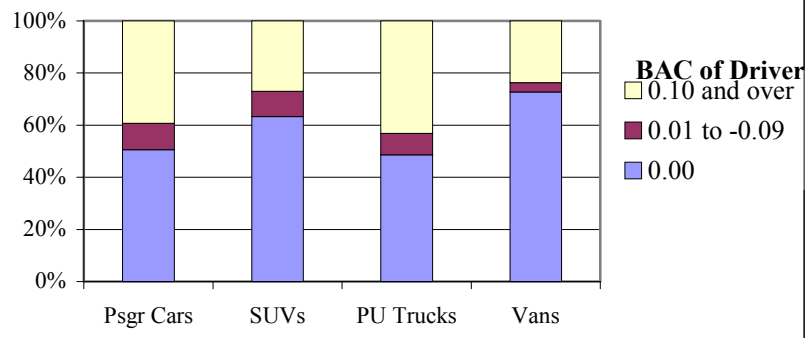
Table 24
Vehicles That Rolled Over In Single Vehicle Fatal Crashes
Blood Alcohol Concentration (BAC) of Drivers By Type of Vehicle

Vehicle Body Type	0.00		0.01 to 0.09		0.10 or Over		Total	
	No.	%	No.	%	No.	%	No.	%
Psgr Cars	1,612	46	369	11	1,513	43	3,494	100
SUVs	861	57	160	11	491	32	1,512	100
PU Trucks	753	39	161	8	1,021	53	1,935	100
Vans	289	63	21	4	152	33	462	100
Total [1/]	3,519	48	712	10	3,184	43	7,415	100

Source: NCSA, NHTSA, FARS 2000 **[1/] Total includes unknown light truck body types**

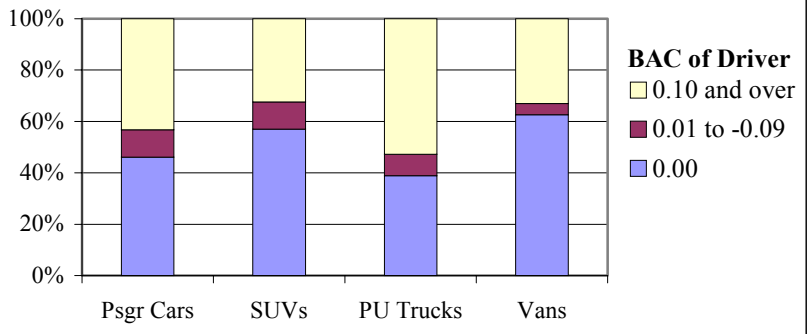
Figure 26 shows the BAC groups for drivers involved in fatal rollover crashes. The bars show that involved drivers of SUVs and Vans are less likely to have positive BAC than are the drivers of pickup trucks and passenger cars. In Figures 27 and 28, the same information is displayed for drivers involved in single vehicle and multi-vehicle crashes respectively. These two charts illustrate the dramatic differences in alcohol use patterns of drivers involved in fatal single and multi-vehicle rollovers. Drivers involved in single vehicle rollovers were more likely to have used alcohol, but in both types of crashes, drivers of passenger cars and pickup trucks were more likely to have positive BACs then were the van and SUV drivers. It should also be noted that, in all cases, most of the drivers with positive BAC test results had alcohol levels equal to or greater than 0.10.

Figure 26
Drivers Involved in Fatal Rollover Crashes, 2000



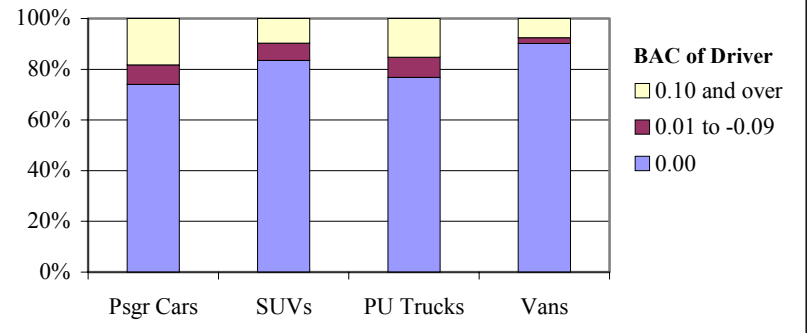
Source: NCSA, NHTSA,FARS 2000

Figure 27
Drivers Involved in Single Vehicle Fatal Rollover Crashes, 2000



Source: NCSA, NHTSA, FARS 2000

Figure 28
Drivers Involved in Multi-Vehicle Fatal Rollover Crashes, 2000



Source: NCSA, NHTSA, FARS 2000

4.6.2 Alcohol and Age

As was the case for crash type and vehicle type, in every age group those involved drivers who had a positive BAC were more likely to fall within the legal definition of intoxicated, 0.10 percent or greater. However, with the exception of drivers under 20 years old, alcohol involvement decreased with increasing age after age 39. Drivers between the ages of 20 and 39 were the most likely to have a BAC of 0.10 or over, particularly those in the age group 30 to 39 (Table 25).

Table 25
BAC of Drivers of Vehicles That Rolled Over In Fatal Crashes
By Age of Driver

Age of Driver	0.00		0.01 to 0.09		0.10 or Over		Total	
	No.	%	No.	%	No.	%	No.	%
<20	1,072	67	186	12	333	21	1,591	100
20 – 29	1,222	44	330	12	1,250	45	2,802	100
30 – 39	833	45	156	8	865	47	1,854	100
40 – 49	753	50	95	6	656	44	1,504	100
50 – 59	549	55	50	6	252	30	851	100
>59	742	83	38	4	116	13	896	100
Unknown	15	57	3	12	8	31	27	100
All Ages	5,188	54	857	9	3,480	36	9,525	100

Source: NCSA, NHTSA, FARS 2000

4.6.3 Alcohol Use and Time of Day

For the most part, fatal rollovers involving drivers who tested positive for BAC took place at night. In those cases where the driver's BAC was 0.10 or higher, 79 percent of the crashes took place between the hours of 6 PM and 6 AM (Table 26).

Table 26
BAC of Drivers of Vehicles That Rolled Over In Fatal Crashes
By Time of Day

Time of Day	0.00		0.01 to 0.09		0.10 or Over		Total	
	No.	%	No.	%	No.	%	No.	%
Night	1,853	36	588	70	2,677	79	5,117	55
Day	3,284	64	253	30	709	21	4,245	45
Unknown	52	1	17	2	94	3	163	2
Total	5,188	100	857	100	3,480	100	9,525	100

Source: NCSA, NHTSA, FARS 2000

In terms of alcohol related fatal crashes, the deadliest time of day is the period between midnight and 3 AM, when restaurants and bars are closed or closing and their patrons are making there way home. During that period of time, three-fourths of involved drivers tested positive for BAC, and 62 percent had a BAC of 0.10 or higher (Table 27).

Table 27
BAC of Drivers of Vehicles That Rolled Over In Fatal Crashes
By Hour of Day

Time of Day	0.00		0.01 to 0.09		0.10 or Over		Total	
	No.	%	No.	%	No.	%	No.	%
6AM to 3PM	2,375	83	147	5	339	12	2,861	100
3PM to 6PM	908	66	105	8	369	27	1,382	100
6PM to Midnight	900	40	233	10	1,105	49	2,238	100
Midnight to 3AM	489	25	263	13	1,230	62	1,982	100
3AM to 6AM	464	52	92	10	342	38	898	100
Unknown	52	32	17	10	94	58	163	100
Total	5,188	55	857	9	3,749	36	9,525	100

Source: NCSA, NHTSA, FARS 2000

4.7 Fatalities in Rollover Crashes

There seems to be little difference between the types of passenger vehicles in the proportion of rollovers that involves fatalities. In 2000, the percentage of rollovers that were fatal varied from a low of 3.0 percent for SUVs to a high of 4.1 percent among vans. The impact of rollovers on total crash deaths is a function of the frequency of their occurrence among the different types of vehicles.

4.7.1 Role of Occupant

About two-thirds of the occupant fatalities in passenger vehicle rollover crashes were vehicle drivers. This relationship holds true for passenger cars when the data are controlled for vehicle type, but among light trucks, the proportion of fatalities who were drivers varies from less than half of the van fatalities to almost three-fourths of the pickup truck fatalities. This is at least partially explained by the seating capacity of the different vehicle types, vans having the greatest potential seating capacity and pickup trucks the least (Table 28).

Table 28
Occupants Killed in Fatal Rollover Crashes
By Year, Occupant Role and Type of Vehicle

Year	Occupant Role	Vehicle Body Type				Total
		Passenger Cars	SUVs	Pickup Trucks	Vans	
1995	Drivers	3,426	701	1,858	302	6,306
	Passengers	1,650	509	713	348	3,231
	Total	5,076	1,210	2,571	650	9,537
1996	Drivers	3,334	858	1,853	333	6,397
	Passengers	1,653	526	692	348	3,227
	Total	4,987	1,384	2,545	681	9,624
1997	Drivers	3,208	923	1,834	353	6,337
	Passengers	1,557	566	645	415	3,190
	Total	4,765	1,489	2,479	768	9,527
1998	Drivers	3,321	1,005	1,914	404	6,654
	Passengers	1,451	700	646	419	3,219
	Total	4,772	1,705	2,560	823	9,873
1999	Drivers	3,202	1,220	2,036	366	6,833
	Passengers	1,516	682	688	418	3,307
	Total	4,718	1,902	2,724	784	10,140
2000	Drivers	3,065	1,240	1,874	354	6,547
	Passengers	1,437	809	663	413	3,326
	Total	4,502	2,049	2,537	767	9,873

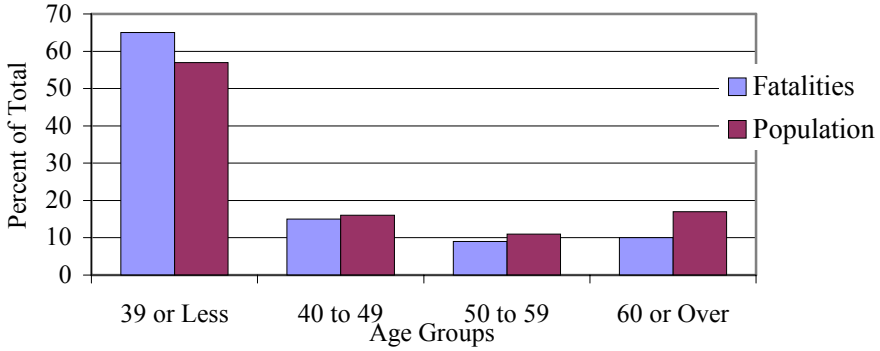
Source: NCSA, NHTSA, FARS 2000

4.7.2 Age

Almost half (49 percent) of the occupant deaths in rollovers were persons under 30 years old, and 63 percent were under 40. In addition to the age patterns observed in alcohol use and speeding, this also suggests a higher rate of exposure to risk among young people,

considering that the median age of the resident population in 2000 was 35.9 years. Only 20 percent of occupant fatalities were persons 50 years old and over. Figure 29 shows the occupant fatalities by age group relative to the same age groups in the resident US population.

Figure 29
Comparison of Occupant Fatalities and Population By Age Group, 2000



Source: NCSA, NHTSA, FARS 2000

5. CONCLUSIONS

This report does not analyze all variables within the FARS database and the other data sources used. While there is a wealth of data available from these sources, the present analysis concentrates on the general characteristics of passenger vehicle fatal rollover crashes, and does not make use of the injury and property damage data available from the General Estimates System (GES). Further analysis of rollover crashes could be carried out using the extensive selection of variables that are available within the GES database to identify factors such as the mechanisms that trigger rollovers, the incidence of injury only and property damage only rollovers, and factors that determine survival in a rollover crash.

5.1 Restraint use

A very high percentage of fatal rollover crashes are characterized by a failure to use restraints. Those occupants who were not using restraints were far more likely to be ejected from a rolling vehicle, and those who were ejected were more likely to be killed. Although a slightly higher proportion of restraint users than non-users who were ejected were killed, the number of ejected restraint users was smaller. This finding suggests that a rollover crash that is violent enough to eject a restraint user is certainly less survivable than crashes in which restraint users had higher survival rates. While new developments in side airbags and other devices intended to prevent ejection hold promise of reducing fatalities, simply increasing the use of currently available restraint devices would be a significant factor in fatality reduction.

5.2 Single Vehicle/Multi-Vehicle Crashes

More than three-fourths of fatal rollover crashes are single vehicle crashes. Of the different body types, passenger cars had the greatest proportion of single vehicle crashes, almost 84 percent, and vans had the least at 63 percent. As far as vehicular maneuvering is concerned, the majority of vehicles were traveling in a straight line prior to the crash in both single and multi-vehicle crashes. Other maneuvers were very small proportions of the total with the exception of negotiating a curve in the case of single vehicle crashes.

More than half of the multi-vehicle rollovers, and a little less than half of the single vehicle rollovers, were not preceded by a crash avoidance maneuver, as reported by investigating police officers. When crash avoidance maneuvers were reported, they tended to be steering actions.

These findings, coupled with the fact that such a large proportion of fatal rollover crashes are single vehicle crashes, invite further research into the causative factors at work.

5.3 Alcohol

Of those involved drivers who had used alcohol, it was more likely that their BACs would be 0.10 or higher than below 0.10. Alcohol was a factor in almost one half of the

fatal rollovers that occurred in 2000, and a little over a third of the involved drivers had a BAC of 0.10 or over. Of the different vehicle body types, passenger car drivers were more likely to have used alcohol before the crash than were drivers of light trucks. Night time hours saw the heaviest incidence of alcohol involvement, particularly the hours between midnight and 3 AM, when people are leaving bars and restaurants.

Positive BAC numbers were more likely to be encountered in the case of single vehicle rollovers than multi vehicle rollovers, the predominate type of rollover crash. Needless to say, continued efforts to reduce drinking and driving are indicated as an additional countermeasure against fatal rollover crashes.

5.4 Deadly Nature of Rollover Crashes

Particularly when vehicle occupants are not restrained, rollover crashes are more likely to result in fatalities than are other types of crashes. In 2000, only 2.6 percent of passenger vehicle crashes resulted in rollovers, but they accounted for 20 percent of fatal crashes. The rates were higher for light trucks than for passenger cars, and within the light truck category SUVs posted particularly high rates. The changing vehicle mix and the rise in the number of fatal rollover crashes of light trucks are an increasing factor in traffic crash fatalities. Despite declines in passenger car occupant fatalities, the increasing influence of light truck fatal crashes in general, and rollover crashes in particular, is instrumental in maintaining the high level of traffic crash fatalities.

5.5 Exposure to the Risk of a Fatal Rollover

Federal Highway Administration data concerning vehicle miles traveled and the numbers of passenger vehicles registered annually show that the light truck category of vehicles, and particularly SUVs, have been increasing in popularity over the past ten years. These vehicles have also been increasingly exposed to the risk of experiencing a fatal crash, and the incidence of fatal light truck rollovers, both in absolute numbers and as a percentage of all fatal passenger vehicle rollovers, is also increasing. The data show that the number of fatalities among occupants of passenger cars has been declining in recent years, while the number of total fatalities has remained relatively stable. The rise in occupant fatalities can be attributed to the increased numbers of light trucks with their greater propensity to be involved in fatal crashes in general and fatal rollover crashes in particular.

5.6 Light Trucks and SUVs

The trend data show that the number of SUVs involved in fatal rollovers has approximately doubled in the years since 1992. Analysis of the FARS data vis-à-vis the exposure data from FHWA does not indicate that SUVs are becoming more likely to be involved because of increasing propensity to roll in a crash, but rather that their rate of involvement is remaining constant as their proportion of the vehicle mix increases. Fatality rates per 100,000 registered vehicles show that while passenger car fatality rates have been dropping since 1995, fatality rates for the various types of light trucks have

remained relatively constant. Further work needs to be done to improve the stability of these vehicles, as well as to educate consumers in their safe operation.

5.7 Drivers

Drivers tended to be slightly younger than the median population age. Most were under 40 years old, and passenger car drivers involved in fatal rollovers tended to be younger than drivers of other types of passenger vehicles. About three-fourths of the drivers were men, a proportion that has been relatively stable over time. Among SUV drivers, the proportion of women has risen more than among other vehicle types, from 23 percent in 1992 to 33 percent in 2000.

5.8 Speed

Fatal rollovers tended to be reported as speed related more frequently than were other types of crashes. About 40 percent of fatal rollover crashes were reported to be speed related in 2000, compared with 15 percent of fatal non-rollover crashes. Speeding as a factor in the crash tended to drop off with advancing age. Not surprisingly, given the differences in stability, speeding as a factor in the crash was higher among passenger car drivers than among light truck drivers. Aside from speeding in the sense of exceeding posted limits, the propensity to rollover was higher where posted speed limits were over 55 miles per hour, particularly for vans and SUVs. Given that most fatal rollovers occurred while the vehicle was reported to be traveling straight ahead, research into the triggering mechanism of these fatal rollovers would be useful.

5.9 Road Description

Fatal rollovers occurred mostly on undivided, two-way roads or divided roads without barriers. While this may be a reflection of the number of miles of roadways with and without barriers, the presence of barriers would seem to be helpful in preventing vehicle rollovers, particularly those that are triggered by tripping after leaving the roadway.

Rural roads were also more likely to be the scene of a fatal rollover. Although only 40 percent of VMT were on rural roads, 60 percent of the fatal rollovers occurred on them. It is likely that speed plays a part in this, given that rural roads are more conducive to opportunities for speeding than are urban roads.

6. ADDITIONAL DATA

Table: A-1
Passenger Vehicles Involved in Fatal Crashes
By Year, Crash Type, and Vehicle Body Type

Year	Crash Type	Passenger Cars	Light Trucks				Total
			SUVs	Pickup Trucks	Vans	Other	
1991	Rollover	4,980	869	2,593	467	38	8,947
	Non-Rollover	26,311	1,526	7,128	1,966	245	37,176
1992	Rollover	4,444	851	2,508	519	42	8,364
	Non-Rollover	25,373	1,517	6,941	2,047	223	36,101
1993	Rollover	4,360	936	2,428	532	41	8,297
	Non-Rollover	25,873	1,723	7,217	2,266	189	37,268
1994	Rollover	4,524	1,096	2,507	573	32	8,732
	Non-Rollover	25,749	1,874	7,543	2,548	180	37,894
1995	Rollover	4,689	1,205	2,667	630	31	9,222
	Non-Rollover	26,251	2,131	8,093	2,700	130	39,305
1996	Rollover	4,433	1,470	2,596	712	25	9,236
	Non-Rollover	26,061	2,375	8,133	2,878	147	39,594
1997	Rollover	4,433	1,470	2,596	712	25	9,236
	Non-Rollover	25,626	2,671	8,053	2,921	180	39,451
1998	Rollover	4,377	1,641	2,640	781	15	9,454
	Non-Rollover	24,663	2,920	8,180	3,104	82	38,949
1999	Rollover	4,411	1,882	2,837	719	16	9,865
	Non-Rollover	23,616	3,098	8,212	3,134	61	38,121
2000	Rollover	4,198	1,998	2,618	729	23	9,566
	Non-Rollover	23,298	3,510	8,165	3,144	108	38,225

Source: NCSA, NHTSA, FARS 1991-2000

Table: A-2
Passenger Vehicle Occupants Killed in Fatal Crashes
Percent not using Restraints
By Year, Crash Type, and Vehicle Body Type

Year	Crash Type	Passenger Cars	Light Trucks				Total
			SUVs	Pickup Trucks	Vans	Other	
1991	Rollover	76	80	87	76	30	79
	Non-Rollover	58	65	76	62	87	61
1992	Rollover	74	77	86	77	83	78
	Non-Rollover	56	67	76	54	78	59
1993	Rollover	72	75	85	73	83	76
	Non-Rollover	53	58	73	54	69	56
1994	Rollover	70	76	82	77	76	75
	Non-Rollover	51	60	72	52	75	54
1995	Rollover	70	74	85	76	67	75
	Non-Rollover	51	58	70	50	88	54
1996	Rollover	68	75	81	71	88	73
	Non-Rollover	49	60	68	50	72	52
1997	Rollover	69	73	81	74	88	73
	Non-Rollover	48	54	67	52	76	51
1998	Rollover	67	73	81	72	69	72
	Non-Rollover	46	52	67	51	50	50
1999	Rollover	68	75	81	74	83	73
	Non-Rollover	46	52	67	50	92	50
2000	Rollover	68	69	79	72	89	72
	Non-Rollover	45	51	63	48	74	48

Source: NCSA, NHTSA, FARS 1991-2000

Table: A-3
Occupant Fatalities In Rollover Crashes
By Year, Person Role and Vehicle Body Type

Year	Crash Type	Passenger Cars	Light Trucks				Total
			SUVs	Pickup Trucks	Vans	Other	
1991	Driver	3,578	540	1,856	234	27	6,235
	Passenger	1,750	342	687	238	6	3,023
1992	Driver	3,220	503	1,769	239	22	5,753
	Passenger	1,518	331	691	325	18	2,883
1993	Driver	3,094	573	1,745	235	25	5,672
	Passenger	1,554	361	658	306	10	2,889
1994	Driver	3,275	642	1,726	277	20	5,940
	Passenger	1,595	421	683	333	9	3,041
1995	Driver	3,426	701	1,858	302	19	6,306
	Passenger	1,650	509	713	348	11	3,231
1996	Driver	3,344	85	1,853	333	9	6,397
	Passenger	1,653	526	692	348	8	3,227
1997	Driver	3,208	923	1,834	353	19	6,337
	Passenger	1,557	566	645	415	7	3,190
1998	Driver	3,221	1,005	1,914	404	10	6,554
	Passenger	1,451	700	646	419	3	3,219
1999	Driver	3,202	1,220	2,036	366	9	6,833
	Passenger	1,516	682	688	418	3	3,307
2000	Driver	3,065	1,240	1,874	354	14	6,547
	Passenger	1,437	809	663	413	4	3,326

Source: NCSA, NHTSA, FARS 1991-2000

Table: A-4
Occupant Fatalities In Rollover Crashes
Percent Not Using Restraints
By Year, Person Role and Vehicle Body Type

Year	Crash Type	Passenger Cars	Light Trucks				Total
			SUVs	Pickup Trucks	Vans	Other	
1991	Driver	76	78	87	76	89	79
	Passenger	77	82	88	75	100	80
1992	Driver	74	74	85	78	82	77
	Passenger	75	81	87	76	83	79
1993	Driver	71	74	84	74	80	76
	Passenger	73	76	88	73	90	77
1994	Driver	69	76	82	76	90	74
	Passenger	73	77	83	77	44	76
1995	Driver	70	73	84	76	63	75
	Passenger	69	75	87	75	73	75
1996	Driver	67	73	80	67	89	72
	Passenger	70	77	83	74	88	74
1997	Driver	68	72	81	74	84	73
	Passenger	71	76	81	74	100	74
1998	Driver	67	72	79	70	80	72
	Passenger	68	74	85	74	33	74
1999	Driver	67	75	81	73	78	73
	Passenger	71	76	82	76	100	75
2000	Driver	67	69	79	71	86	71
	Passenger	76	70	80	73	100	73

Source: NCSA, NHTSA, FARS 1991-2000

Table: A-5
Drivers of Vehicles In Fatal Crashes
Percent with BAC 0.01 or Greater
By Year, Crash Type, and Vehicle Body Type

Year	Crash Type	Passenger Cars	Light Trucks				Total
			SUVs	Pickup Trucks	Vans	Other	
1991	Rollover	57	52	63	32	50	57
	Non-Rollover	26	26	31	19	22	26
1992	Rollover	55	46	60	30	49	54
	Non-Rollover	25	23	28	16	18	25
1993	Rollover	53	44	58	30	41	52
	Non-Rollover	23	21	28	16	20	23
1994	Rollover	51	41	55	29	56	50
	Non-Rollover	21	21	26	13	12	22
1995	Rollover	52	39	56	27	38	50
	Non-Rollover	21	20	25	14	11	21
1996	Rollover	50	42	55	27	29	49
	Non-Rollover	21	21	24	14	15	21
1997	Rollover	48	37	52	25	32	46
	Non-Rollover	20	18	23	13	13	20
1998	Rollover	47	40	53	27	47	46
	Non-Rollover	20	17	22	13	9	20
1999	Rollover	47	36	51	27	40	45
	Non-Rollover	19	18	22	14	19	19
2000	Rollover	49	37	51	27	48	46
	Non-Rollover	21	20	23	15	13	21

Source: NCSA, NHTSA, FARS 1991-2000

Table: A-6
Drivers of Vehicles In Fatal Crashes
Percent with BAC 0.10 or Greater
By Year, Crash Type, and Vehicle Body Type

Year	Crash Type	Passenger Cars	Light Trucks				Total
			SUVs	Pickup Trucks	Vans	Other	
1991	Rollover	47	41	54	28	42	47
	Non-Rollover	19	16	24	14	18	19
1992	Rollover	44	34	50	24	34	43
	Non-Rollover	18	16	22	12	14	18
1993	Rollover	43	34	50	24	34	43
	Non-Rollover	17	15	22	11	15	17
1994	Rollover	42	31	48	24	50	41
	Non-Rollover	16	15	20	10	7	16
1995	Rollover	42	31	48	21	34	41
	Non-Rollover	15	14	19	10	8	15
1996	Rollover	40	33	48	23	14	40
	Non-Rollover	15	15	18	10	9	15
1997	Rollover	39	29	43	20	20	37
	Non-Rollover	15	12	18	10	10	15
1998	Rollover	39	29	45	22	40	37
	Non-Rollover	14	11	17	10	6	14
1999	Rollover	38	27	44	21	33	37
	Non-Rollover	14	12	16	10	14	14
2000	Rollover	39	27	43	24	39	37
	Non-Rollover	15	13	17	11	11	15

Source: NCSA, NHTSA, FARS 1991-2000

7. REFERENCES

1. Robert McGuigan, *"The Severity of Rollover Crashes on the National Crash Severity Study"*, U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis, July 1980. Included in NHTSA Technical Report DOT-HS-805 883, "Accident Data Analysis of Vehicle Crashworthiness – Ten Papers", April 1981

   In his investigation of the severity of rollover crashes using data from the NCSS, Mr. McGuigan differentiated between rollovers with and without prior impact. Rollovers with no prior impact were divided into three severity levels, based on number of turns and degree of roof crush. While rollovers without prior impact have low delta-v compared with other types of crashes, they have a higher probability of producing severe injuries, primarily because of ejection. In prior impact rollovers, McGuigan found that the odds of sustaining severe injuries were 2.3 times as great as in a non-rollover crash with the same delta-v.

2. Daniel Najjar, *"The Truth About Rollovers"*, U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis, January 1981. Najjar found that while rollover occupants were seriously injured more than twice as often as non-rollover occupants, there was no significant difference in injury rates between pure rollovers and rollovers following impact.

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DOT HS 809 438
April 2002

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