

*Eric's Copy*

**Fatal Rollover Rates of Small Utility  
Vehicles and Pickups**

Paul L. Zador  
Allan F. Williams  
Michael A. Ciccone

April 1992

INSURANCE  
INSTITUTE  
FOR  
HIGHWAY  
SAFETY

1005 N. GLEBE ROAD, ARLINGTON, VA 22201 (703) 247-1500

## **ABSTRACT**

Occupant death rates in rollover crashes for utility vehicles, pickups, and passenger cars for model year 1985-89 vehicles in single-vehicle crashes during 1986-90 were calculated. Small utility vehicles had the highest rollover death rate, followed by small pickups. More than 80 percent of the single-vehicle crash deaths in small utility vehicles involved rollovers. The Ford Bronco II, especially the two-wheel drive version of this utility vehicle, had the highest rollover rate, followed by the four-wheel drive Nissan 720 short bed pickup.

It has long been known that some types of vehicles are more likely than others to roll over. Major attention has been given to the particular propensity of small utility vehicles to roll over. This problem was first identified in 1980 (Snyder, McDole, Ladd, and Minahan) and has been confirmed repeatedly during the 1980s (Reinfurt, Lina, Popkin et al., 1981; Reinfurt, Stutts, and Hamilton, 1984; Partyka, Sikora, Surti, and Van Dyke, 1987; Robertson, 1989; Smith, 1982). The Jeep CJ-5, which was found to have an extremely high rollover rate, was redesigned to reduce its rollover propensity and reintroduced as the Jeep Wrangler (Reinfurt et al., 1981; Reinfurt, Stutts, and Hamilton, 1984). However, manufacturers have continued to produce utility and other vehicles with poor stability properties (i.e., relatively high center of gravity and narrow track width) that make them more likely to roll over. Although federal motor vehicle safety standards provide injury prevention measures once a rollover occurs (e.g., Standard 216, Roof Crush Resistance), there is currently no federal regulation that deals with the propensity of vehicles to roll over.

This report presents occupant death rates in single-vehicle crashes for recent models of small utility vehicles and small pickups. For comparison, rollover rates of larger utility vehicles and pickups, and cars of various sizes, are also presented.

## METHODS

Occupant death rates per 10,000 registrations for passenger cars, pickups, and utility vehicles were calculated for model year 1985-89 vehicles in single-vehicle crashes during 1986-90. Fatality data were obtained from the Fatal Accident Reporting System (FARS) (NHTSA, 1991) and registration data were obtained from R.L. Polk and Company (1991). FARS is a descriptive census of virtually all fatal crashes that occur on public roads in the United States. R.L. Polk data are based on state registration records. Occupant deaths were classified by occurrence of rollover and whether the rollover was the first or a subsequent event in the crash. Passenger cars were classified into six wheelbase size categories (less than 95 inches, 96-99 inches, 100-104 inches, 105-109 inches, 110-114 inches, and greater than 114 inches).

Using criteria established by the Highway Loss Data Institute (HLDI), utility vehicles were classified into three size categories based on wheelbase (less than 100 inches, 100-120 inches, and more than 120 inches) (HLDI, 1990). Pickups were classified into two curb weight categories using the HLDI classifications of less than 3,500 pounds or 3,500 pounds or more. For small utility vehicles and small pickups, individual make/series with at least 100,000 registrations were identified. If a make/series underwent a design change during the 1985-1989 model year that would be expected to affect its crash protection capabilities, e.g., a significant change in wheelbase, it was classified as two separate vehicles. Thus, for example, the Nissan 720 short bed pickup (1985-early 1986) was classified separately from the Nissan D21 short bed pickup (late 1986-89) because the wheelbase increased from 101 to 104 inches.

Small utility vehicles and small pickups were further classified in terms of whether they had two-wheel or four-wheel drive and what proportion of the vehicles had rear antilock brakes. Only a few 1985-89 vehicles had antilocks, and many of those that did had them only for 1989 models. The numbers of vehicles with antilocks were too small to allow meaningful analysis of the effect of antilocks on rollovers, although this is an important question.

## RESULTS

Occupant death rates in single-vehicle crashes for cars, utility vehicles, and pickups are presented in Table 1. In each vehicle category, the smallest vehicles had the highest death rates both for rollover and nonrollover crashes. Small utility vehicles had the highest rollover death rate (1.64) per 10,000 registered and highest total death rate (2.05) followed by small pickups (1.11 for rollovers, 1.73 total death rate). Midsize utility vehicles (0.78) and large pickups (0.72) had the next highest rollover death rates, followed by small cars (0.68).

Table 1 also shows the percentage of occupant deaths in single-vehicle crashes that occur in rollovers. This measure is another indicator of the relative proneness of vehicles to be in rollover crashes. Eighty percent of the single-vehicle crash deaths in small utility vehicles involved rollovers; in about half of all deaths, rollover was the first event in the crash. For midsize and large utility vehicles, more than 70 percent of the deaths in single-vehicle crashes occurred in rollovers; for both pickup size groups, more than 60 percent of all deaths in single-vehicle crashes involved rollover.

**Table 1**  
**Occupant Deaths Per 10,000 Registrations In Model Year 1985-89**  
**Vehicles During 1986-90 in Single Vehicle Crashes, and Percent of Single**  
**Vehicle Occupant Deaths Occurring In Rollovers**

Vehicle Size*	Number of Registrations	All Single Vehicle Crashes	Rollover			Percent of Deaths Occurring in Rollovers
			1st Event	Subsequent Event	Any Rollover	
<b>Passenger Cars</b>						
<95	16,377,767	1.23	0.28	0.40	0.68	(55)
95-99	31,323,146	0.91	0.18	0.26	0.44	(48)
100-104	47,065,228	0.97	0.16	0.30	0.46	(48)
105-109	31,846,211	0.53	0.09	0.12	0.21	(39)
110-114	25,765,224	0.32	0.05	0.07	0.12	(38)
>114	8,681,177	0.46	0.06	0.10	0.16	(34)
<b>Utility Vehicles</b>						
<100	2,289,700	2.05	0.98	0.66	1.64	(80)
100-120	7,851,046	1.06	0.46	0.32	0.78	(73)
>120	1,131,570	0.57	0.27	0.17	0.43	(75)
<b>Pickups</b>						
<3500 lbs.	18,570,084	1.73	0.61	0.50	1.11	(64)
≥3500 lbs.	15,453,888	1.17	0.36	0.37	0.72	(62)

\* Wheelbase size in inches, or curb weight.

Table 2 presents rollover death rates for the five individual small utility vehicles with at least 100,000 registrations; Table 3 shows the same information for small pickups. Not all vehicles existed for all five model years; if not the model years included are listed for each make and series. Vehicles are listed in both tables from highest to lowest death rates in crashes with any rollover. Among utility vehicles the four-wheel drive Ford Bronco II, the Jeep CJ-7, and especially the two-wheel drive Ford Bronco II had fatal occupant rollover rates that were higher than the overall rate for all small utility vehicles. The rate for the two-wheel drive Ford Bronco II (3.78) was by far the highest; 60 of the 62 occupant deaths in single-vehicle crashes in two-wheel drive Ford Bronco II's occurred in rollover crashes.

Among the 37 small pickups that met the exposure criterion, there was a wide range in rollover rates, from 0.28 to 2.94. Thirteen pickups had rollover rates higher than the overall rate (1.11) for all small pickups. Five four-wheel drive pickups had rollover rates higher than all small utility vehicles except the two-wheel drive Ford Bronco II. These were the 1985-1986 model Nissan

**Table 2**  
**1985-89 Small Utility Vehicles: Occupant Death Rates in**  
**Single-Vehicle Crashes During 1986-1990, and**  
**Percent of Deaths Occurring in Rollovers**

Make/Series	Exposure	4-Wheel Drive	Percent Rear Antilock Brakes	Number of Deaths	Deaths per 10,000 Registrations				Percent of Deaths Occurring in Rollovers
					All Single Vehicle Crashes	1st Event	Rollover		
							Subsequent Event	Any Rollover	
Ford Bronco II (1987-89)*	158,901	No	100	62	3.90	2.71	1.07	3.78	(97)
Jeep CJ-7 (1985-86)	261,495	Yes	None	63	2.41	1.03	0.88	1.91	(79)
Ford Bronco II (1985, 1987-89)*	977,297	Yes	53	199	2.04	1.07	0.67	1.74	(85)
Jeep Wrangler (1987-89)	216,597	Yes	None	40	1.85	0.60	0.88	1.48	(80)
Suzuki Samurai Convertible (1986-89)	379,842	Yes	None	69	1.82	0.61	0.50	1.11	(61)

\* 1986 model year excluded because exposure was not separately available for 2-wheel and 4-wheel drive versions (in 1985, only the 4-wheel drive version existed).

Table 3  
 1985-89 Small Pickups: Occupant Death Rates in  
 Single-Vehicle Crashes During 1986-1990, and  
 Percent of Deaths Occurring in Rollover

Make/Series	Exposure	4-Wheel Drive	Percent Rear Antilock Brakes	Number of Deaths	Deaths per 10,000 Registrations				Percent of Deaths Occurring in Rollovers
					All Single Vehicle Crashes	1st Event	Rollover		
							Subse- quent Event	Any Rollover	
Nissan 720 Short bed (1985-86)	105,525	Yes	None	35	3.32	1.71	1.23	2.94	(89)
Toyota Short bed 1/2T (1985-88)	806,699	Yes	None	255	3.16	1.62	1.02	2.64	(84)
Nissan D21 Short bed (1986-89)	134,808	Yes	None	38	2.82	1.48	0.96	2.45	(87)
Nissan 720 King Cab (1985-86)	226,550	Yes	None	54	2.38	1.19	0.93	2.12	(89)
Ford Ranger	651,160	Yes	4	176	2.70	1.26	0.84	2.10	(78)
Toyota Xtra Cab 1/2T (1985-88)	436,372	Yes	None	94	2.15	1.21	0.60	1.81	(84)
Toyota Long bed 1/2T (1985-88)	179,948	Yes	None	38	2.11	1.22	0.44	1.67	(79)
Dodge Ram 50 (1985-86)	106,683	Yes	None	27	2.53	0.66	0.94	1.59	(63)
Nissan D21 King Cab (1986-89)	196,172	Yes	None	47	2.40	0.92	0.66	1.58	(66)
Ford Ranger	2,402,014	No	6	532	2.21	0.91	0.62	1.53	(69)

**Table 3 (cont'd)**  
**1985-89 Small Pickups: Occupant Death Rates in**  
**Single-Vehicle Crashes During 1986-1990, and**  
**Percent of Deaths Occurring in Rollover**

Make/Series	Exposure	4-Wheel Drive	Percent Rear Antilock Brakes	Number of Deaths	Deaths per 10,000 Registrations				Percent of Deaths Occurring in Rollovers
					All Single Vehicle Crashes	1st Event	Subsequent Event	Any Rollover	
Nissan D21 Short bed (1986-88)	808,752	No	None	178	2.20	0.58	0.68	1.26	(57)
Toyota Short bed 1/2T (1985-88)	1,195,284	No	None	226	1.89	0.76	0.50	1.26	(67)
Nissan D21 Long bed (1986-89)* Short bed (1989)* Chassis Cab (1986-87)*	142,184	No	None	31	2.18	0.70	0.49	1.20	(55)
Mitsubishi Short bed (1987-89)	164,304	No	None	23	1.40	0.30	0.73	1.03	(74)
Ford Ranger Super Cab (1986-89)	302,524	Yes	9	37	1.22	0.53	0.40	0.93	(76)
Dodge Ram 50 Short bed/Long bed (1987-89)	252,644	No	None	46	1.82	0.44	0.47	0.91	(50)
Toyota Long bed 1/2T (1985-88)	428,991	No	None	60	1.40	0.49	0.42	0.91	(65)
Chevrolet S-10	2,373,296	No	7	374	1.58	0.39	0.45	0.84	(53)
Dodge Dakota (1987-89)	440,548	No	14	65	1.48	0.34	0.48	0.82	(55)

Table 3 (cont'd)  
 1985-89 Small Pickups: Occupant Death Rates in  
 Single-Vehicle Crashes During 1986-1990, and  
 Percent of Deaths Occurring in Rollover

Make/Series	Exposure	4-Wheel Drive	Percent Rear Antilock Brakes	Number of Deaths	Deaths per 10,000 Registrations				Percent of Deaths Occurring in Rollovers
					All Single Vehicle Crashes	Rollover			
						1st Event	Subse- quent Event	Any Rollover	
Mazda B-Series Short bed (1986-89)	834,481	No	None	132	1.58	0.42	0.36	0.78	(49)
Dodge Ram 50 (1985-86)	441,265	No	None	64	1.45	0.36	0.41	0.77	(53)
GMC S-15	525,626	No	7	75	1.43	0.44	0.30	0.74	(52)
Chevrolet S-10	529,283	Yes	4	69	1.30	0.32	0.38	0.70	(54)
Nissan 720 King Cab (1985-86)	329,987	No	None	27	0.82	0.36	0.27	0.64	(78)
Nissan 720 Short bed (1985-86)	625,910	No	None	79	1.26	0.18	0.43	0.61	(48)
Nissan D21 King Cab (1986-89)	269,158	No	None	33	1.23	0.26	0.30	0.56	(45)
Ford Ranger Super Cab (1986-89)	504,262	No	11	47	0.93	0.22	0.28	0.50	(53)
Mazda B-Series Long bed (1986-89)	240,482	No	None	20	0.83	0.25	0.25	0.50	(60)
Toyota Xtra Cab Long 1/2T (1986-88)	173,681	No	None	19	1.09	0.35	0.12	0.46	(42)
Mitsubishi Pickup (1985-86)	179,416	No	None	17	0.95	0.28	0.17	0.45	(47)

**Table 3 (cont'd)**  
**1985-89 Small Pickups: Occupant Death Rates in**  
**Single-Vehicle Crashes During 1986-1990, and**  
**Percent of Deaths Occurring in Rollover**

Make/Series	Exposure	4-Wheel Drive	Percent Rear Antilock Brakes	Number of Deaths	Deaths per 10,000 Registrations				Percent of Deaths Occurring in Rollovers
					All Single Vehicle Crashes	1st Event	Rollover		
							Subsequent Event	Any Rollover	
Isuzu Short bed (1985-88)	390,974	No	None	36	0.92	0.23	0.20	0.43	(47)
Jeep Comanche Short/Long bed (1986-89)	217,141	No	None	14	0.64	0.23	0.18	0.41	(64)
Jeep Comanche Short/Long bed (1986-89)	150,533	Yes	None	16	1.06	0.20	0.20	0.40	(38)
GMC S-15	127,722	Yes	3	8	0.63	0.16	0.23	0.39	(63)
Isuzu Long bed 1/2T (1985-87)	133,624	No	None	13	0.97	0.15	0.22	0.37	(38)
Toyota Xtra Cab 1/2T (1985-88)	305,954	No	None	29	0.95	0.16	0.20	0.36	(38)
Mazda B-Series Cab Plus (1986-89)	318,425	No	None	21	0.66	0.06	0.22	0.28	(43)

\* Series combined because their vehicle identification numbers did not always permit clear separation.

720 short bed and its successor D21 version (1986-1989 models), Toyota short bed 1/2 ton, Nissan 720 King Cab, and Ford Ranger.

## DISCUSSION

Small utility vehicles as a group have the highest rate of fatal rollover crashes, followed by small pickups. The Ford Bronco II, especially the two-wheel drive version, stands out as the utility vehicle with the highest rollover rate; the discontinued Jeep CJ-7 also has a relatively high rollover rate. For two-wheel drive and four-wheel drive Ford Bronco II's combined, 88 percent of the single-vehicle fatalities in these vehicles occurred in rollovers, which is comparable to the Jeep CJ-5 rate of 83 percent found in the early 1980s (NHTSA, 1991; R.L. Polk and Co., 1991). The rate of occupant fatalities in rollovers was more than twice as high in the two-wheel drive Ford Bronco II in this study as in all other small utility vehicles -- a difference comparable to the rollover rate difference found between the Jeep CJ-5 and all other utility vehicles reported 10 years ago in a North Carolina study (Reinfurt, Stutts, and Hamilton, 1984). The 1990 model year was the last year Ford Bronco II's were manufactured; they have been replaced by the longer and wider Ford Explorer model. Nevertheless, Ford Bronco II's from the 1984-1990 model years will be on the roads for many years to come.

Small utility vehicles have received primary attention in regard to rollover propensity, but in this study several small four-wheel drive pickups were found to have higher occupant death rates in rollover crashes than all utility vehicles other than the Ford Bronco II. These pickups tend to be those with high center of gravity and narrow track width.

It should be noted that there are several newly introduced 1990-1992 models of small utility vehicles and pickups that were not included in the present study because sufficient data on their exposure and crashes are not yet available. Small utility vehicles and pickups continue to be a growing segment of the passenger vehicle market. It is possible to design these vehicles in such ways that rollover is less likely; in fact, several of the small pickups had quite low rollover rates. However, the relative instability of some of these vehicles, and the high rollover rates that result, indicate a serious problem that has received far too little attention.

## REFERENCES

- Highway Loss Data Institute. 1990. Technical Appendix. Arlington, VA: Highway Loss Data Institute.
- National Highway Traffic Safety Administration (NHTSA). 1991. Fatal Accident Reporting System. Washington, DC: U.S. Dept. of Transportation.

- Partyka, S.; Sikora, J.; Surti, J.; and Van Dyke, J. 1987. Relative risk to car and light truck occupants. SAE Paper 871093. Warrendale, PA: Society of Automotive Engineers.
- Reinfurt, D.W.; Lina, K.L.; Popkin, C.L.; O'Neill, B.; Burchman, P.F.; and Wells, J.K. 1981. *A Comparison of the Crash Experience of Utility Vehicles, Pickup Trucks and Passenger Cars*. Chapel Hill, NC: University of North Carolina Highway Safety Research Center.
- Reinfurt, D.W.; Stutts, J.C.; and Hamilton, E.G. 1984. *A Further Look at Utility Vehicle Rollovers*. Chapel Hill, NC: University of North Carolina Highway Safety Research Center.
- Robertson, L.S. 1989. Risk of fatal rollover in utility vehicles relative to static stability. *American Journal of Public Health* 79: 300-303.
- R.L. Polk and Company. 1991. National Vehicle Population Profile. (Computer data files). Cincinnati, OH: R.L. Polk and Co.
- Smith, S.R. 1982. *Analysis of Fatal Rollover Accidents in Utility Vehicles*. Washington, DC: National Highway Traffic Safety Administration.
- Snyder, R.C.; McDole, T.L.; Ladd, W.M.; and Minahan, D.J. 1980. *On-Road Crash Experience of Utility Vehicles*. Ann Arbor, MI: University of Michigan Highway Safety Research Institute.