Effect of 1996 Speed Limit Changes on Motor Vehicle Occupant Fatalities

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ABSTRACT

The number of motor vehicle occupant fatalities in 1996 was compared with those in each year during 1990-95. Deaths in 12 states that raised speed limits to 70 mph on at least some roads in December 1995 or early 1996 were compared with deaths in a group of states that did not. On rural and urban interstates and freeways, where most of the speed limit changes occurred, speed limit increases were associated with a 12 percent increase in occupant fatalities. On other roads, where speed limits were raised less frequently, occupant fatalities increased by only 3 percent (nonsignificant). On all roads combined, occupant fatalities increased by 6 percent. It is estimated that during the last 9 months of 1996 there were 500 additional deaths in the 12 states that raised speed limits.

INTRODUCTION

In January 1974, the U.S. Congress established a National Maximum Speed Limit (NMSL) of 55 mph. Prior to this legislation, many states had posted speed limits as high as 70 or 75 mph. Within three months, all states were in compliance with the law. Both motor vehicle fatalities and vehicle miles of travel declined sharply in 1974, due in large part to a national energy shortage. A National Research Council Committee in 1984 concluded the 55 mph NMSL "accounted for 3,000 to 5,000 fewer highway fatalities in 1974," and that the savings continued, estimating that "about 2,000 to 4,000 lives were saved in 1983" (Transportation Research Board, 1984).

Despite the strong evidence of safety benefits of the NMSL, Congress in April 1987 passed legislation allowing states to increase speed limits to 65 mph on qualifying sections of interstate highways in rural areas with fewer than 50,000 population. By the end of the year, 38 states had raised speed limits on rural interstates, and 2 more states raised speed limits in 1988. Using a time-series model of fatalities from 1975 through 1986, the National Highway Traffic Safety Administration (NHTSA, 1992) reported to Congress that there were almost 2,000 more fatalities during 1987-90 than would have been expected based on historical trends.

Other analyses supported the NHTSA finding of a negative effect of raising speed limits. For example, Baum et al. (1991), after adjusting for vehicle miles traveled and occupancy rates, estimated fatalities on rural interstates to be 19 percent higher under the 65 mph limit. McKnight et al. (1989), using a monthly time-series spanning six years, reported a 22 percent increase in fatal crashes per year on rural interstates that raised speed limits to 65 mph. Garber and Graham (1990) estimated a 15 percent increase in fatalities on rural interstates after speed limits were raised to 65 mph.

Some authors have questioned the negative effects of raising speed limits (Chang et al., 1991; Lave and Elias, 1994), but these analyses typically have had methodological problems (see Rauch and Zador, 1992; Lund and Rauch, 1992). For example, Lave and Elias claimed, with meager supporting data, that higher speed limits on interstates allowed police to shift speed enforcement resources to other, more dangerous roads, thus leading to an overall decline in fatality risk. However, the authors did not actually show that fatality rates declined significantly on roads other than rural interstates. Rural interstates typically account for a very small percentage of all motor vehicle fatalities, and it is likely that a fatality increase occurring only on rural interstates would not be detectable when looking at all roads combined. McKnight et al. (1989), after entertaining a similar hypothesis, found no evidence of reduced risk on other roads.

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Congress repealed the NMSL effective December 8, 1995, returning authority to states to set their own speed limits. State law provisions allowed some western states to automatically revert to their pre-1974 speed limits once the federal NMSL was repealed. Other states took actions to quickly raise speed limits. By the end of 1996, 24 states had raised speed limits on rural interstates to at least 70 mph. Many states also raised speed limits on urban interstates and other roads previously limited to 55 mph by the NMSL.

This paper assesses the effect of these speed limit increases on motor vehicle occupant fatalities during the first year. The trends in fatalities over time are compared for a group of states that raised speed limits and a comparison group of states that did not, using both time-series analysis and a quasi-experimental design.

METHOD

The 12 states that raised maximum speed limits to at least 70 mph between December 8, 1995 and April 1, 1996 are included in the group of study states (Table 1). The 18 states that either did not raise maximum speed limits in 1996 or raised them on less than 10 percent of urban interstate mileage are included in the group of comparison states (Table 2). States that raised maximum speed limits after April 1, 1996 were not studied.

Table 1
Speed Limit Changes in Early 1996

		Rural Interstates		Urban Interstates/ Freeways	
State	Date of Change	Old Limit (mph)	New Limit (mph)	Old Limit (mph)	New Limit (mph)
Dec-Jan Change					
Arizona	Dec 8, 1995	65	75	55	no change
California	Jan 7, 1996	65	70	55	65
Montana	Dec 8, 1995	65	none*	55	none*
Nevada	Dec 8, 1995	65	75	55	65
Oklahoma	Dec 15, 1995	65	70	55	60
	Aug 29, 1996		75		70
Texas	Dec 8, 1995	65	70	55	70
Wyoming	Dec 8, 1995	65	75	55	60
Feb-April Change					
Kansas	Mar 7, 1996	65	70	55	70
Mississippi	Feb 29, 1996	65	70	55	70
Missouri	Mar 13, 1996	65	70	55	60
South Dakota	Apr 1, 1996	65	75	55	65
Washington	Mar 15, 1996	65	70	55	60

*Montana requires "reasonable and prudent" daytime speeds; nighttime limits are 65 mph.

Table 2
Comparison States

Connecticut	Louisiana	Oregon
Delaware	Maine	South Carolina
District of Columbia	Minnesota	Tennessee
Indiana	New Hampshire	Vermont
Iowa	New Jersey	Virginia
Kentucky	Ohio	West Virginia

Data on motor vehicle occupant deaths for each year during 1990-96 were extracted from the Fatality Analysis Reporting System (FARS), a national census of fatal crashes on public roads. Data on vehicle miles of travel for each of the seven years were obtained from monthly estimates provided by the Federal Highway Administration.

Logarithms of fatality counts for each year during 1990-96 were modeled as a function of time and type of state (study or comparison). Both linear and quadratic components of time (defined as year of crash minus 1989) were included in the model, as well as an indicator variable equal to one in 1996 and zero in previous years. Estimation of model parameters and tests of hypotheses were accomplished using the General Linear Models (GLM) procedure of the SAS software (SAS Institute, 1990). In the model, the term for the interaction between state group and the 1996 indicator represents the difference between the pre-1996/1996 changes for the two state groups, after adjusting for the time trend. If the interaction is statistically significant, then it can be concluded that the 1996 departure from the time trend among the study states is different from that among the comparison states. The effect of the 1996 speed limit changes on annual fatalities was estimated as $100(e^A - 1)$, where A denotes the estimate of the interaction term.

Separate models were constructed for fatalities occurring on interstates and freeways (rural and urban combined; roadway function classes 1, 11, and 12 in FARS), fatalities occurring on other roads, and total motor vehicle occupant fatalities. Two sets of analyses were conducted. The first set, which includes all 12 study states, was restricted to fatal crashes that occurred between April 1 and December 31 of each year, months during which all 12 states had higher speed limits in 1996. A second set of analyses considered total annual fatalities, but the study group is restricted to the seven states that raised speed limits in December 1995 or early January 1996. This second set of analyses checks the robustness of the results from the first set. Analyses also were conducted on fatality rates per million vehicle miles traveled.

RESULTS

Motor vehicle occupant fatalities on interstates and freeways that occurred between April and December of each year during 1990-96 in the 12 study and 18 comparison states are plotted in Figure 1. Time trends for the two groups are similar, declining from 1990 to 1992 and then increasing to approximately 1990 levels by 1995. However, fatalities increased by 16 percent in the study group in 1996 and by only 4 percent in the comparison group.

Figure 1
Motor Vehicle Occupant Fatalities — Interstates/Freeways, April-Dec 1990-96

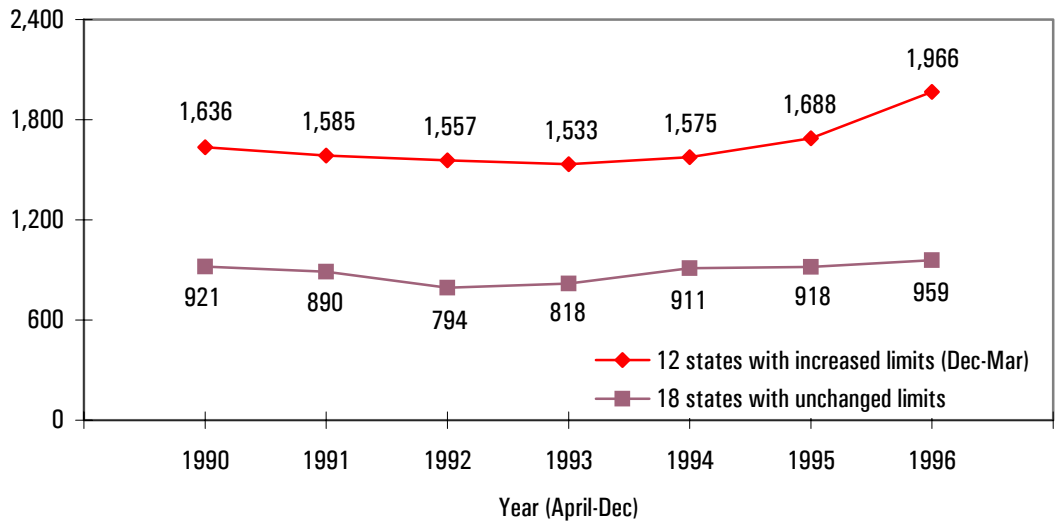


Table 3 is the analysis of variance table summarizing tests of the statistical model. Both linear and quadratic trends over time were significant, and, even after adjusting for the time trend, the 1996 change in fatalities was different for the two groups ($p = 0.0411$). The effect of the speed limit increases was an estimated $100(e^{0.1162} - 1) = 12$ percent increase in fatalities on interstates and freeways during the last 9 months of 1996.

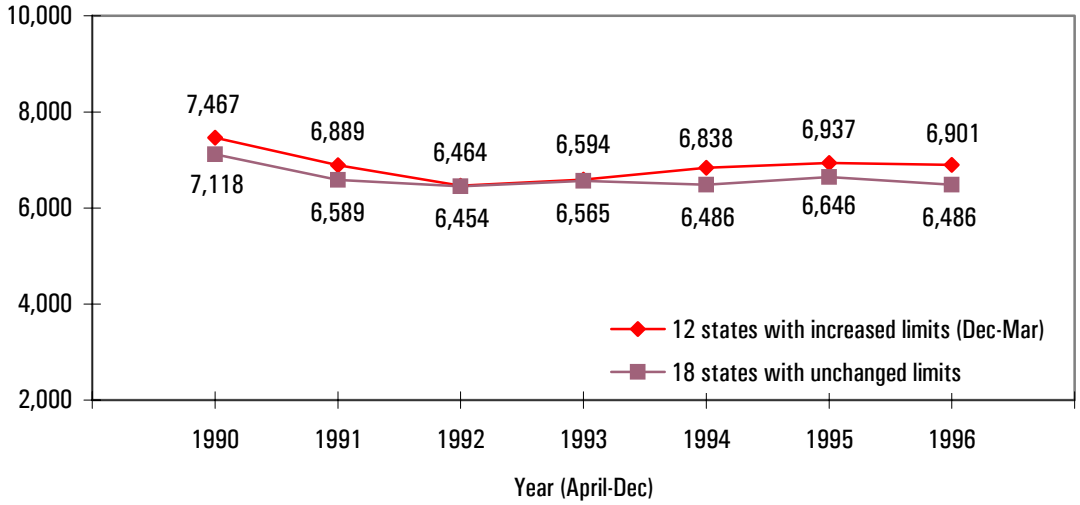
Table 3
Analysis of Variance for Logarithm of Motor Vehicle Occupant Fatalities — Interstates/Freeways, April-Dec 1990-96

Source	Degrees of Freedom	Mean Square (Type III)	F-Statistic	p-Value
Time (linear)	1	0.0172	17.5	0.0031
Time (quadratic)	1	0.0189	19.3	0.0023
1996 indicator	1	0.0000	0.0	0.8716
Group	1	0.7462	762.2	0.0001
Group x 1996 indicator	1	0.0058	5.9	0.0411
Residual	8	0.0010		

$R^2 = 0.9944$

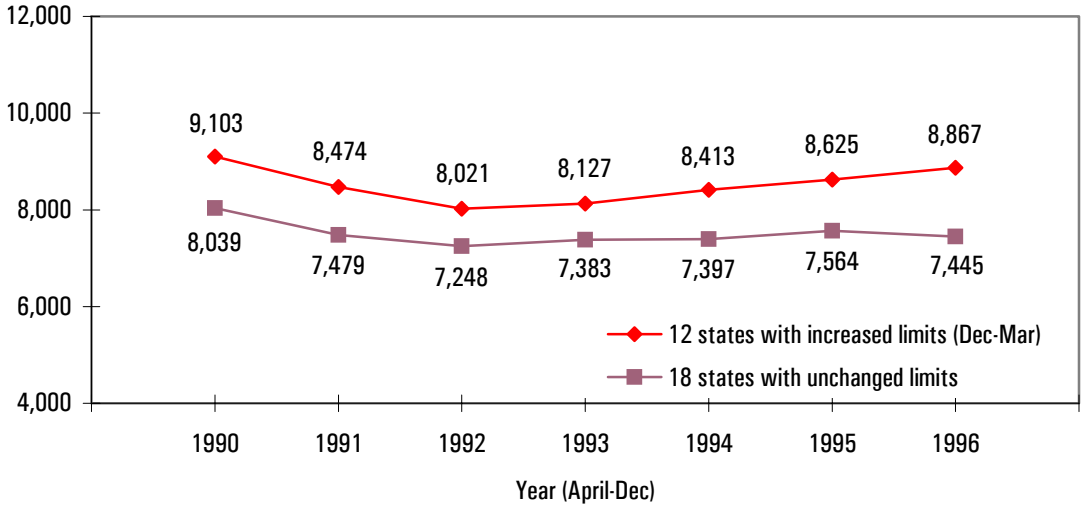
Motor vehicle occupant fatalities on all roads other than interstates and freeways in the study and comparison states are plotted in Figure 2. Time trends for the two groups are generally similar during the entire 1990-96 period. Fatalities declined by 1 percent in the study group in 1996 and by 2 percent in the comparison group. This difference was not significant (p = 0.3385).

Figure 2
Motor Vehicle Occupant Fatalities — Other Roads, April-Dec 1990-96



Motor vehicle occupant fatalities on all roads in the study and comparison states are plotted in Figure 3. Again, time trends for the two groups are similar during 1990-95 but differ in 1996. Fatalities increased by 3 percent in the study group in 1996 but declined by 2 percent in the comparison group. The 1996 increase was significantly different for the two groups (p = 0.0337), yielding an estimated 6 percent increase in total occupant fatalities associated with speed limit increases.

Figure 3
Motor Vehicle Occupant Fatalities — All Roads, April-Dec 1990-96



Analyses of occupant fatalities during the entire year in the seven study states that raised speed limits in December 1995 or early January 1996 yielded results similar to the 9-month analyses. These results are presented in Table 4 and Figures 4-6. The effects of speed limit increases in the seven study states during all of 1996 were an estimated 13 percent increase in fatalities on interstates and freeways, a nonsignificant 4 percent fatality increase on other types of roads, and a 7 percent increase on all roads.

Table 4
Effects of Speed Limit Changes on Fatalities

Roadway Type	Months Analyzed	Effect Size (percent)	95 Percent Confidence Interval for Effect Size
Interstates/freeways	April-Dec	12.3	(0.1, 25.4)
Other roads	April-Dec	3.0	(-3.7, 10.2)
All roads	April-Dec	5.9	(0.6, 11.5)
Interstates/freeways	Jan-Dec	13.2	(1.0, 26.9)
Other roads	Jan-Dec	4.0	(-3.5, 12.0)
All roads	Jan-Dec	7.1	(0.8, 13.8)

Figure 4
Motor Vehicle Occupant Fatalities — Interstates/Freeways, 1990-96

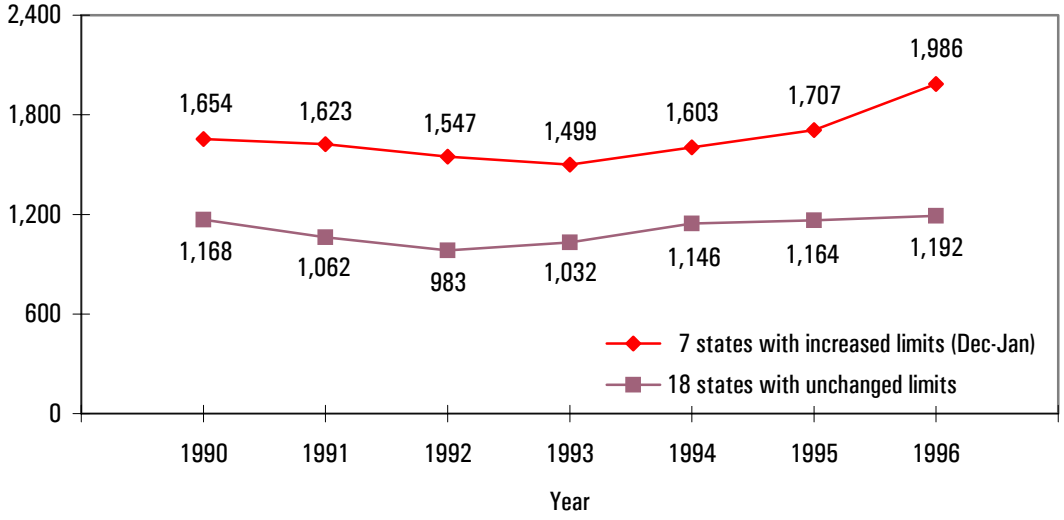


Figure 5
Motor Vehicle Occupant Fatalities — Other Roads, 1990-96

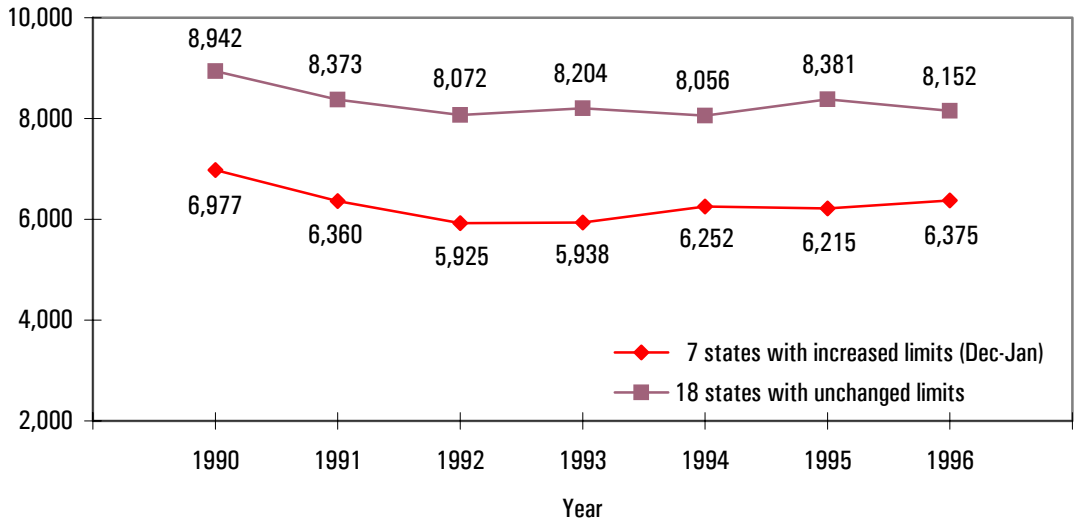
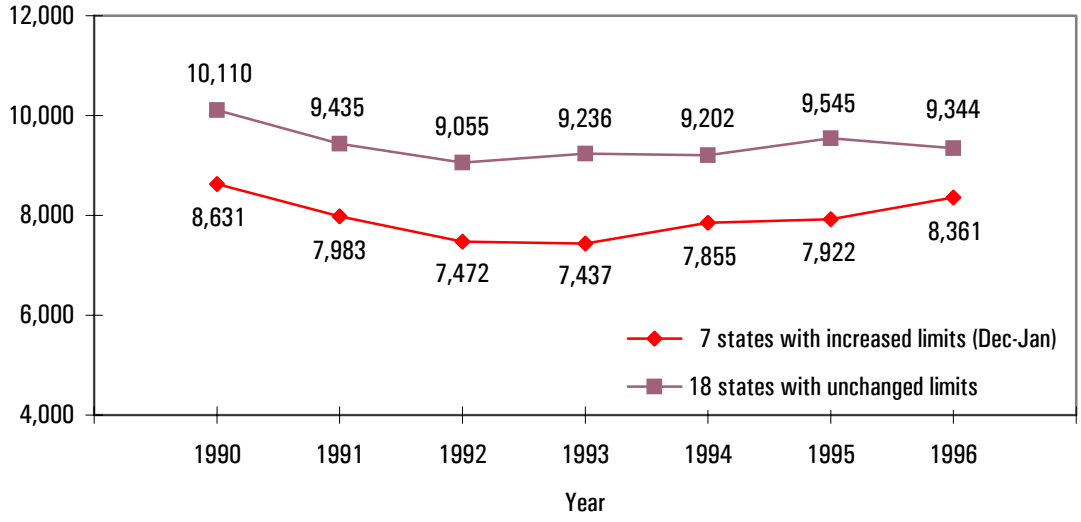


Figure 6
Motor Vehicle Occupant Fatalities — All Roads, 1990-96



Sizes of effects estimated from analyses of occupant fatality rates per million vehicle miles traveled are listed in Table 5. The estimated effects on these fatality rates are similar to the effects on the number of fatalities. For example, the effects of speed limit increases in the 12 study states were an estimated 17 percent increase in fatality rates on interstates/freeways and a 6 percent increase on all roads during the last 9 months of 1996.

Table 5
Effects of Speed Limit Changes on Fatality Rates

Roadway Type	Months Analyzed	Effect Size (percent)	95 Percent Confidence Interval for Effect Size
Interstates/freeways	April-Dec	16.9	(5.0, 30.1)
Other roads	April-Dec	2.0	(-3.6, 7.8)
All roads	April-Dec	6.1	(0.9, 11.7)
Interstates/freeways	Jan-Dec	17.5	(5.2, 31.4)
Other roads	Jan-Dec	1.2	(-3.9, 6.7)
All roads	Jan-Dec	6.2	(1.5, 11.0)

An attempt was made to separate the effect of speed limit increases on interstates and freeways into rural and urban components. These analyses suggested similar effects in rural and urban areas, although the year-to-year variability of the fatality numbers made the urban estimate uncertain. Table 6 lists occupant fatalities during the last 9 months of each year during 1990-96 separately for rural interstates and urban interstates/freeways. The effect of speed limit increases on rural interstates in the 12 study states was a statistically significant 11 percent increase in fatalities during the last 9 months of 1996, with lower and upper 95 percent confidence limits of 4 and 18 percent, respectively. The effect of speed limit increases on urban interstates and freeways in the 11 study states (excluding Arizona where speed limits increased only on rural interstates) was a nonsignificant 11 percent increase in fatalities during the last 9 months of 1996, with lower and upper 95 percent confidence limits of -10 and 37 percent, respectively.

Table 6
Motor Vehicle Occupant Fatalities
on Interstates/Freeways, April-Dec 1990-96

		Year						
Roadway Type	State Group	1990	1991	1992	1993	1994	1995	1996
Rural interstates	Study group	768	737	698	712	746	780	851
	Comparison group	488	488	457	458	485	497	497
Urban interstates/freeways	Study group (exc. Arizona)	853	836	845	802	813	874	1,085
	Comparison group	433	402	337	360	426	421	462

DISCUSSION

In the 12 states that raised maximum speed limits by April 1, 1996, there were 12 percent more fatalities on interstates and freeways during the subsequent 9 months than would have been expected under the lower speed limits. After adjusting for increases in vehicle miles of travel, the estimated effect of raising speed limits is even greater.

On roads other than interstates and freeways in the states that raised speed limits, there were approximately 3 percent more fatalities during the last 9 months of 1996 than otherwise would have been expected. Although this change was not statistically significant, it is clear that the increased risk on expressways has not made other roads safer, as some argued when speed limits increased on rural interstates in the 1980s (see Lave and Elias, 1994). Some of the study states also raised speed limits on selected roads other than expressways. For example, Texas posted 70 mph speed limits even on many rural undivided state highways. Travel patterns do not appear to have changed with this round of speed increases. Vehicle miles traveled on roads other than interstates and freeways increased by 2 percent during 1996, consistent with both the trend during 1990-95 and increases in the comparison states.

On all roads combined, there were 6 percent more fatalities in the 12 study states during the last 9 months of 1996 than otherwise would have been expected. This translates to approximately 500 additional deaths. Although they cannot be estimated precisely from this study, the effects of speed limit increases occurring later in 1996 are probably similar.

There are as yet insufficient data to analyze the effects of speed limit increases separately for each state. However, on interstates and freeways, the results are reasonably consistent across states. Occupant fatalities in Texas increased from 455 during the last 9 months of 1995 to 566 during corresponding months in 1996. Occupant fatalities in California increased from 583 during the last 9 months of 1995 to 622 during corresponding months in 1996. In fact, every study state except Wyoming had more occupant fatalities on interstates/freeways during the last 9 months of 1996 than during corresponding months in any year since 1991. The same was true for only 6 of the 18 comparison states (Delaware, Kentucky, New Jersey, South Carolina, Tennessee, and West Virginia).

High travel speed, rather than the posted speed limit, is the factor that contributes to both the likelihood and severity of a motor vehicle crash (Bowie and Walz, 1994; Moore et al., 1995; NHTSA, 1997). Therefore, it is important to know whether drivers actually respond to higher speed limits by driving faster. Speeds were sampled on urban freeways in Riverside, California and Houston, Texas just prior to the speed limit increases of December 1995 and again three months later (Retting and Greene, 1997). The percentage of drivers exceeding 70 mph increased during the three months from 29 to 40 percent in Riverside and from 15 to 33 percent in Houston. At the end of 1996, speeds were measured

again at these same locations. The percentage of drivers exceeding 70 mph had leveled off at 41 percent in Riverside but increased further to 50 percent in Houston.

This study is necessarily limited to a somewhat short period of time after the 1996 speed limit increases. However, it is clear that the new limits have resulted in many drivers increasing their speeds, and the result has been a significant increase in fatality risk. Furthermore, research shows that travel speeds continue to escalate during the years following speed limit increases (Freedman and Esterlitz, 1990). Thus, the cost (lives lost) of the current round of speed limit changes could increase in future years.

REFERENCES

Baum, H.M.; Wells, J.K.; and Lund, A.K. 1991. The fatality consequences of the 65 mph speed limits. *Journal of Safety Research* 22:171-77.

Bowie, N.N. and Walz, M. 1994. Data analysis of the speed-related crash issue. *Auto and Traffic Safety* 1:31-38. Washington, DC: National Highway Traffic Safety Administration.

Chang, G.L.; Carter, E.C.; and Chen, C.H. 1991. Safety impacts of the 65 mph speed limit on interstate highways. Washington, DC: AAA Foundation for Traffic Safety.

Freedman, M. and Esterlitz, J.R. 1990. Effect of the 65-mph speed limit on speeds in three states. *Transportation Research Record* 1281:52-61. Washington, DC: National Research Council.

Garber, S. and Graham, J.D. 1990. The effects of the new 65 mile-per-hour speed limit on rural highway fatalities: a state-by-state analysis. *Accident Analysis and Prevention* 22:137-49

Lave, C. and Elias, P. 1994. Did the 65 mph speed limit save lives? *Accident Analysis and Prevention* 26:49-62.

Lund, A.K. and Rauch, W.J. 1992. On the contrary! A comment on Lave and Elias's question, "Did the 65 mph speed limit save lives?" Arlington, VA: Insurance Institute for Highway Safety.

McKnight, A.J.; Klein, T.M.; and Tippetts, A.S. 1989. The effect of the 65 mph limit on speeds and accidents (DOT-HS-807-463). Washington, DC: National Highway Traffic Safety Administration.

Moore, V.M.; Dolinis, J.; and Woodward, A.J. 1995. Vehicle speed and risk of a severe crash. *Epidemiology* 6:258-62.

National Highway Traffic Safety Administration. 1992. The effects of the 65 mph speed limit through 1990: a report to Congress (DOT-HS-807-840). Washington, DC: U.S. Department of Transportation.

National Highway Traffic Safety Administration. 1997. Traffic safety facts 1996. Washington, DC: U.S. Department of Transportation.

Rauch, W.J. and Zador, P.L. 1992. Response to "Safety impacts of the 65 mph speed limit on interstate highways" by Chang, Carter, and Chen. Arlington, VA: Insurance Institute for Highway Safety.

Retting, R.A. and Greene, M.A. 1997. Traffic speeds following repeal of the national maximum speed limit. *ITE Journal* 67:42-46.

SAS Institute Inc. 1990. SAS/STAT User's Guide, Version 6, Fourth Edition. Cary, NC: SAS Institute Inc.

Transportation Research Board. 1984. 55: a decade of experience (Special Report 204). Washington, DC: National Research Council.