Long-Term Effects of Repealing the National Maximum Speed Limit in the United States

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Objectives. We examined the long-term effects of the 1995 repeal of federal speed limit controls on road fatalities and injuries in fatal crashes.

Methods. We used a Poisson mixed-regression model to assess changes in the number of fatalities and injuries in fatal crashes between 1995 and 2005 on rural interstates, where all US states have raised speed limits since the repeal, as well as on urban interstates and noninterstate roads, where many states have raised speed limits.

Results. We found a 3.2% increase in road fatalities attributable to the raised speed limits on all road types in the United States. The highest increases were on rural interstates (9.1%) and urban interstates (4.0%). We estimated that 12 545 deaths (95% confidence interval [CI] = 8739, 16 352) and 36 583 injuries in fatal crashes (95% CI = 29 322, 43 844) were attributable to increases in speed limits across the United States.

Conclusions. Reduced speed limits and improved enforcement with speed camera networks could immediately reduce speeds and save lives, in addition to reducing gas consumption, cutting emissions of air pollutants, saving valuable years of productivity, and reducing the cost of motor vehicle crashes. (*Am J Public Health.* 2009;99:1626–1631. doi:10.2105/AJPH.2008.153726)

In 1974, the federal government passed the National Maximum Speed Law, which restricted the maximum permissible vehicle speed limit to 55 miles per hour (mph) on all interstate roads in the United States.[1] The law was a response to the 1973 oil embargo, and its intent was to reduce fuel consumption. In the year after the National Maximum Speed Law was enacted, road fatalities declined 16.4%, from 54 052 in 1973 to 45 196 in 1974.[2]

In April of 1987, Congress passed the Surface Transportation and Uniform Relocation Assistance Act, which permitted states to raise the legal speed limit on rural interstates to 65 mph.[3] Under this legislation, 41 states raised their posted speed limits to 65 mph on segments of rural interstates. On November 28, 1995, Congress passed the National Highway Designation Act, which officially removed all federal speed limit controls. Since 1995, all US states have raised their posted speed limits on rural interstates; many have also raised the posted speed limits on urban interstates and noninterstate roads.

Although many factors contribute to passenger injury during a vehicle crash, the kinetic energy transferred to the vehicle occupants is the causal agent.[4] An enormous literature exists on the application of Newtonian relationships between speed, kinetic energy, and road injury and death in occupants and pedestrians.[4–6] Researchers have demonstrated that lower travel speeds and death tolls usually follow lowering of speed limits,[2,6,7] and higher travel speeds and death tolls follow increases in speed limits.[4,8–17] Data show a 17% rise in deaths following a 4% rise in speeds on US interstates.[18] Furthermore, high-speed driving on highways induces higher travel speeds on connecting interurban roads and even urban roads, producing a spillover effect that may persist over long distances and time.[19,20] Yet some still express doubts about—or ignore—the effect of increased speed limits on vehicle passenger safety.[21–23]

Previous analyses on the effect of raised speed limits in the United States following the repeal of the National Maximum Speed Law in 1995 were restricted to short postintervention periods and a limited number of states.[18,24,25] These studies did not tell us whether the effects of increased speed limits on fatalities and injuries across the entire US road system persisted years after the policy change. We evaluated the long-term impact of repealing the National Maximum Speed Limit on fatalities and on injuries in fatal crashes through the end of 2005 and across the US road system.

METHODS

We collected monthly data on road deaths (occupant or nonmotorists who died within 30 days after a crash injury) and injuries in fatal crashes from the Fatality Analysis Reporting System (FARS).[26] Only injuries incurred in crashes that resulted in a death are reported to FARS. If a crash results in injuries but no one is killed, FARS does not collect the data. Injuries in fatal crashes are all the casualties incurred in the crash, excluding the fatal injury or injuries. No comprehensive census in the United States collects data on injuries that occur in all types of crashes—fatal and nonfatal.

States provide data to FARS. Each state employs FARS analysts who are responsible for obtaining required information and reporting it to FARS via a standardized reporting tool. State analysts use a variety of data sources to collect information on fatal crashes: police crash reports; prehospital emergency medical services records; hospital records; vital statistics records, such as death certificates, coroner or medical examiner records, and state vehicle and driver registration files; and state highway data.[27] Coroner and medical examiner records and death certificates are the primary documents used for recording fatalities.[28] Police reports are the primary data source for reporting injuries.[29] The National Center for Statistics and Analysis, part of the National Highway Traffic Safety Administration, manages the data and sets standards for data quality control.[27]

Data on speed limits and date of increases in speed limits were obtained from the Insurance Institute of Highway Safety.[30] We controlled for exposure density (vehicle miles traveled divided by miles of public roads) and vehicle density (number of cars per mile of road). Exposure density takes into account exposure as well as the effect of congestion on travel speeds. Congestion reduces travel speeds and the severity of injury. Vehicle density data from each state provided another measure of congestion. Data on the number of vehicle miles traveled, registered vehicles, and miles of public roads were obtained from the Bureau of Transportation Statistics.[31,32]

Road Types and Speed Limit Subgroups

We stratified data on fatalities and injuries in fatal crashes by functional road categories defined by the US Department of Transportation.[31] The 4 road types were rural interstate, rural noninterstate, urban interstate, and urban noninterstate.[31] We also stratified the data by posted speed limits in each state. Each state authorized different maximum legal speed limits after the National Maximum Speed Law was repealed on both rural and urban roads. We divided the states into the following 4 categories for our analysis of rural roads:

Expansion with no change. Ten states raised the speed limit to 65 mph from 1987 to 1988, but did not raise it any higher after the National Maximum Speed Law was repealed. These states only expanded the number of rural roads that would be included under the 65 mph limit. The term *expansion* refers to the inclusion of all roads within a functional road class (e.g., interstate roads) under the new speed limit, which was previously restricted to specific sections of the roads.

Increase of 10 mph only after November 1995. Seven states did not raise their legal speed limits before November 1995. After the National Maximum Speed Law was repealed, they raised the legal speed limit to 65 mph.

Expansion and 5 mph increase. Eighteen states raised the speed limit to 65 mph from 1987–1988 and instituted a further increase to 70 mph after the National Maximum Speed Law was repealed. In addition, these states expanded the number of rural roads with the 70 mph limit.

Expansion and 10 mph increase. Thirteen states raised the speed limit to 65 mph from 1987–1988, and further raised it to 75 mph after the National Maximum Speed Law was repealed. These states also expanded the number of rural roads with the 75 mph limit.

All urban interstate roads had a 55 mph legal speed limit prior to November 1995. Therefore, we stratified urban interstate roads into 3 groups by the legal speed limits after the National Maximum Speed Law was repealed: (1) 55 mph (n=14 states), (2) 60 to 65 mph (n=22 states), and (3) 70 to 75 mph (n=12 states).

Inclusion Criteria

All states and the District of Columbia were eligible for inclusion if they (1) had both rural and urban interstates, (2) did not change rural interstate speeds between 1990 (the starting point for our data collection) and November 1995, and (3) made changes to speed limits uniformly across the entire state's road system or within the state's functional road type.

The District of Columbia, Massachusetts, and Hawaii did not meet the inclusion criteria. The District of Columbia has no interstate highways. Massachusetts was the only state to change its rural interstate speed limits between 1990 and 1995, which affected our stratification by speed limits. Hawaii raised its rural interstate speed limits on only 2 sections of road (H-1 and H-3). In addition, these 2 sections in Hawaii had posted speed limits of 60 mph; all the other states had speed limits of 65 mph or higher on rural interstates. All the other interstates in Hawaii retained a maximum speed limit of 55 mph.

Statistical Analysis

We considered several aspects of the fatality data in choosing our statistical methods: (1) the data involved counts of absolute numbers rather than rates, (2) there was substantial variation between states in the dates when the legal speed limits were changed, (3) each state was a unique environment with unique influences, and (4) the preintervention period was not uniform across all the states (e.g., some retained a 55 mph speed limit on rural roads).

For studies of trends in road injuries, we had to take into account changes in speed limits that occurred at different times. We sought a model that considered the different starting points for the intervention (raised speed limits) and the differences between and within states. Therefore, we selected a mixed-regression model with a Poisson distribution. This statistical approach explicitly models a state's change across time by including random effects to account for the variation that occurred in each state separately. Unlike more traditional approaches, the mixed-regression model was much more flexible in handling repeated measures because it did not require the same number of observations for each state. More important, we were able to treat interventions as time-varying events, rather than as uniform for all states. Because the mixed-regression model allowed us to use the actual time changes, it provided a more accurate analysis of change associated with an intervention.

By using annual data instead of monthly counts, we removed the effects of seasonality and focused on long-term trends. We also included time as a variable in our model to control for overall trend. Because the speed limits changed at different times in different states, we coded time as described by Hedeker and Mermelstein.[33] For example, the year a change was implemented was coded 0, the years prior to the change were coded as negative integers starting at –1 in descending order, and the years after the change were coded as positive integers starting at 1 in ascending order.

The intervention variable was coded as a binary variable (0, 1) because we were interested in the cumulative effect of the increased speed limits. The year the change occurred and all subsequent years were coded 1, and all previous years were coded as 0. Annual exposure density and vehicle density were calculated for each state. The final mixed-regression model included time (trend), intervention effect, exposure density, vehicle density, and rural speed limit. The rural speed limit was a categorical variable in which the expansion with no change states were the reference group. A random state effect was included to account for the state effect. We reported the parameter estimate for the intervention variable, which represented the mean change controlling for variance between states.

Statistical analyses were performed with MIXPREG version 1.0 (D.H., University of Illinois, Chicago, IL). A 2-sided *P* value less than .05 was considered statistically significant.

We also estimated the number of deaths and injuries attributable to the raised speed limits by multiplying the total number of cases after states raised their speed limits by the parameter estimate of the intervention variable in the model. The total number of cases was the number of deaths or injuries in fatal crashes occurring in each state after that state raised its speed limit on rural interstate roads. A total of 388 399 fatalities and 930 865 injuries in fatal crashes occurred on all roads in the United States after states raised their rural interstate speed limits.

RESULTS

On all road types combined, the average number of deaths annually in each state increased from 834.3 before the increases in rural interstate speed limits to 880.7 after (crude change=+5.6%). The crude average annual number of injuries in fatal crashes increased by 4.5% (from 2020.9 to 2110.8) across all road types.

Table 1 shows the percentage change attributable to increased speed limits by road type. According to our mixed-regression analysis, the increase in road fatalities in the United States attributable to the raised speed limits was 3.23% across all road types when we controlled for variation between states. The highest increase in fatalities was observed on rural interstates (9.10%) and urban interstates (3.98%). In addition, injuries in fatal crashes increased by 3.93% on all roads combined and 11.88% on rural interstates (Table 1).

TABLE 1—Percentage Change in Fatalities and Injuries in Fatal Crashes on US Roads After Repeal of the National Maximum Speed Law, by Road Type: 1990–2005

Road Type	% Change	P
Fatalities		
All road types	+3.23	<.001
Rural interstate	+9.10	<.001
Rural noninterstate	+1.60	.025
Urban interstate	+3.98	.030
Urban noninterstate	−1.78	.063
Injuries		
All road types	+3.93	<.001
Rural interstate	+11.88	<.001
Rural noninterstate	+4.60	<.001
Urban interstate	+5.62	<.001
Urban noninterstate	+5.71	<.001

Note. All Poisson mixed-regression models included a random intercept for the state effect and the following fixed effects: time trend, intervention effect, vehicle density, and rural interstate speed limit. Models included data for fatalities and injuries for 1990 to 2005. Massachusetts, Hawaii, and Washington, DC, were excluded.

Interstate Roads

When we stratified by change in speed limits, states that did not raise their speed limits after November 1995 showed a significant (−8.43%) decline in fatalities on rural interstates (Table 2). The highest observed increase in fatalities attributable to raised speed limits occurred in states that had 55-mph posted limits prior to 1995 and 65 mph later (Table 2). As with fatalities, states that retained the same speed limits (expansion with no change group) experienced a significant decline in injuries (−3.84%) on rural interstates. States in the other speed groups all had a greater than 10% increase in injuries.

Table 2 also shows the effect of changes to urban interstate speed limits. The only significant increase in deaths occurred in states that did not change their posted urban interstate speeds (12.88%).

Noninterstate Roads

As with rural interstates, deaths decreased on rural noninterstate roads in states that did not increase their speed limits after November 1995 (−15.64%; $P<.01$). States that raised speed limits on rural interstates experienced significant increases in injuries in fatal crashes on rural noninterstate roads.

On urban noninterstates, fatalities declined in states that raised their speed limits to 60 or 65 mph (−10.45%), but increased in states that raised speed limits by 15 mph or more (+4.26%). However, casualties in fatal crashes rose in all states, irrespective of the change in maximum permitted speed limits.

We calculated, from the parameter estimates for the intervention variable in the mixed-regression models, which controlled for variation between states, that approximately 12 545 deaths (95% confidence interval [CI]=8739, 16 352) and 36 583 injuries in fatal crashes (95% CI=29 322, 43 844) were attributable to the increase in speed limits across the entire United States.

DISCUSSION

Ours was the first evaluation of the sustained impact of raised speed limits across the United States following the repeal of the National Maximum Speed Law in 1995. We estimated that higher speed limits across the United States led to 12 545 excess deaths since the end of 1995.

An alternative explanation for our findings would require major changes in driving under the influence, reductions in seat belt use, major failures in trauma care (which have been recognized to affect case fatality) as well as changes in other variables such as age, education, and income to account for the Newtonian relationship between speed and road deaths.

However, during the period of our study, 1995 to 2005, we observed implementation of numerous protective countermeasures that may have reduced the overall effect of the rise in speed limits, including increased seat belt use,[34,35] more rigorous child restraint laws and increased child restraint use,[36] mandatory dual front air bag laws passed in 1998,[37,38] and enforcement of driving while intoxicated laws, which led to minor declines in the number of drunk drivers involved in fatal crashes.[39] Improved vehicle and road designs may also have helped to offset the overall effect of increased speed limits on fatalities and injuries in fatal crashes.[4]

The largest increases in both fatalities and injuries in fatal crashes occurred on rural and urban interstate roads. These road types were the main locus of raised speed limits, although some states raised speed limits on segments of rural noninterstate roads as well. The small but significant increases in fatalities and injuries on all rural noninterstate roads were most plausibly attributable to the higher speed limits instituted on these roads as well as spillover from rural interstates. However, the true direction of the change in deaths on rural noninterstate roads was uncertain. The model that did not control for the interaction of road type and speed limit change (Table 1) showed a significant increase in fatalities on rural noninterstate roads (+1.60%). But when we

TABLE 2—Percentage Change in Fatalities and Injuries in Fatal Crashes on US Roads After Repeal of the National Maximum Speed Law, by Speed Limits: 1990–2005

	No. of States	% Change	P
Rural interstate[a]			
Fatalities			
Expansion with no change (65 mph)	10	−8.43	.002
Increased 10 mph only after 1995–1996 (65 mph)	7	+15.68	.001
Expansion and 5 mph increase (70 mph)	18	+8.25	.001
Expansion and 10 mph increase (75 mph)	13	+13.58	.001
Injuries			
Expansion with no change (65 mph)	10	−3.84	.027
Increased 10 mph only after 1995–1996 (65 mph)	7	+15.25	.001
Expansion and 5 mph increase (70 mph)	18	+17.17	.001
Expansion and 10 mph increase (75 mph)	13	+11.89	.001
Rural noninterstate[a]			
Fatalities			
Expansion with no change (65 mph)	10	−15.64	.001
Increased 10 mph only after 1995–1996 (65 mph)	7	−0.32	.889
Expansion and 5 mph increase (70 mph)	18	−1.57	.100
Expansion and 10 mph increase (75 mph)	13	+2.35	.179
Injuries			
Expansion with no change (65 mph)	10	−9.17	.001
Increased 10 mph only after 1995–1996 (65 mph)	7	+17.23	.001
Expansion and 5 mph increase (70 mph)	18	+2.65	.001
Expansion and 10 mph increase (75 mph)	13	+3.24	.006
Urban interstate[b]			
Fatalities			
55 mph	14	+12.88	.001
60–65 mph	22	−2.14	.338
70–75 mph	12	+5.64	.084
Injuries			
55 mph	14	+10.48	.001
60–65 mph	22	−3.80	.038
70–75 mph	12	+18.02	.001
Urban noninterstate[b]			
Fatalities			
55 mph	14	−1.07	.510
60–65 mph	22	−10.45	.001
70–75 mph	12	+4.26	.022
Injuries			
55 mph	14	+2.13	.038
60–65 mph	22	+2.52	.010
70–75 mph	12	+12.86	.001

Note. Mph = miles per hour. All Poisson mixed-regression models included time trend, intervention, exposure density, and vehicle density as fixed effects and a random intercept for the state effect; models were calculated separately for each speed group. Models included data for fatalities and injuries for 1990 to 2005. Massachusetts, Hawaii, and Washington, DC, were excluded.

[a]Expansion states had previously raised speed limits on limited sections of rural interstate roads from 1987–1988, but after 1995 and the repeal of National Maximum Speed Law, the permissible higher speed limits on rural interstate roads were expanded to include all or most sections of rural interstate roads.

[b]All urban interstate roads had a 55 mph legal speed limit prior to November 1995. Therefore, we stratified urban interstate roads into 3 groups by the legal speed limits after the National Maximum Speed Law was repealed.

stratified by speed (Table 2), we found no significant increase in fatalities. The only significant change was a substantial decline in states that made no change to their speed limits.

States that made no change to their posted speed limits but expanded the number of rural interstate roads included under the preexisting 65-mph speed limits (expansion with no change group) experienced significant declines in fatalities and injuries. We suggest that the de facto travel speeds were already 65 mph across all rural interstates roads in these states prior to the legal change. These states are in fact the control group for the experiment of raised speed limits, and it is plausible that the decline in deaths observed in the no change states would have been mirrored in all other states had those states not increased their speed limits.

Similar disparities between posted limits and de facto travel speeds were observed after rural interstate speeds increased from 1987–1988 from 55 to 65 mph. Travel speeds after that change increased on average only 2 to 3 mph despite a 10-mph increase in the legal limit.[40–44] In addition, the disparity between posted speed limits and actual travel speeds likely explains the difference between states that raised their speed limits from 55 to 65 mph and those that raised their speed limits from 65 to 70 mph or higher. Although the posted speed limits were higher in the latter states, the actual change in travel speeds was probably greater in the states that raised speed limits from 55 to 65 mph.

Nilsson found a fourth-power relationship between increases in travel speeds and increases in deaths[5]; from this we estimated that travel speeds on rural interstates increased by 3.7% in states that raised their speed limits from 55 to 65 mph but only by 2.0% and 3.2%, respectively, in the states that had posted speeds of 70 and 75 mph. We suggest that the lower overall change in fatalities and injuries on the higher-speed roads means not that higher travel speeds are safer but that the relative increase in travel speeds was less extreme on these roads.

Speed adaptation and spillover effects occur when drivers coming off high-speed roads continue to drive faster than those already on the same road.[19,20] We found that the largest increases in fatalities on urban interstates occurred in states that maintained a 55-mph speed limit. Speed spillover from higher-speed roads is a plausible explanation for this finding.

Australia, France, and the United Kingdom are countries with posted highway speed limits that are higher than those in many US states, but European Union countries have national speed management policies, enforce lower speeds, and maintain separate lanes for heavy vehicles.[4] All 3 countries experienced immediate and sustained reductions in death tolls by some 40% to 50% when they enforced the posted speed limits on urban highways with the help of national speed camera networks.[4,50] It is reasonable to surmise that were these countries to lower the posted enforced speed limits on their highways, death tolls would fall even more.

Limitations

The FARS database has several limitations. FARS does not collect information on crashes occurring on private property, such as private roads. FARS also only reports deaths that occur within 30 days of an accident. Furthermore, information on injuries occurring in fatal crashes is gathered predominately from police reports, which have been shown to be flawed in identifying severity of injury and to underreport injuries.[45–48] We did not stratify the injury data by severity because of these limitations.

Our data included only injuries occurring in fatal crashes. Nearly all injuries resulting from motor vehicle crashes occur in crashes that do not result in a death.[49] Our analysis did not provide information on the effect of increased speed limits on nonfatal injuries occurring in motor vehicle crashes that did not cause fatalities. All of these limitations would contribute to an underestimation of the true effect of higher speed limits.

Because of their uniqueness, we excluded Massachusetts and Hawaii from our analysis. Neither state's roads fit within our 4 interstate categories. Furthermore, a random state effect was included in the mixed-regression model to account for the state effect. A class variable with only 1 state would not be appropriate for mixed-regression modeling and would require an alternative modeling procedure. It is probable that excluding Massachusetts and Hawaii resulted in a underestimation of the effect of raised speed limits on the traffic death toll in the United States.

Conclusions

The failed policy of increased speed limits accounted for the deaths of an estimated 12 545 Americans over 10 years of follow-up. The repeal of the National Maximum Speed Law and its aftermath show that policy decisions that appear harmless can have long-term repercussions. Our data support reinstating lower speed limits on rural and urban highways. Reduced speed limits would save lives; they would also reduce gas consumption, cut emissions of air pollutants, save valuable years of productivity, and reduce the societal cost of motor vehicle crashes.

The Department of Transportation estimated in 2002 that the comprehensive cost of each fatality was $977 000 and the cost for each critically injured person was $1.1 million,[49] which means that the 10-year cumulative cost of repealing the 55 mph speed limit for fatalities alone was approximately $12 billion. Lower legal speed limits and improved enforcement through the use of speed cameras could reduce travel speeds and fatalities immediately.[6,7,51,52] ■

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This article was accepted December 29, 2008.

Contributors

L.S. Friedman helped to design the study, acquired the data, drafted the article, performed statistical analyses, and provided administrative, technical, and material support. D. Hedeker performed statistical analyses. E.D. Richter helped to design the study. All authors analyzed and interpreted the data and revised the article. L.S. Friedman and E.D. Richter had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Human Participant Protection

No protocol approval was needed for this study.

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