Driver Education and Fatal Crash Involvement of Teenaged Drivers

LEON S. ROBERTSON, PHD, AND PAUL L. ZADOR, PHD

Abstract: Fatal crash involvement of teenagers per licensed driver and per population in 27 states was related to the proportions of teenagers who received high school driver education. Among 16–17 year olds, driver education was associated with a great increase in the number of licensed drivers, without a decrease in the fatal crash involvement per 10,000 licensed drivers. About 80 per cent of the 16–17 year olds who took high school driver education obtained licenses that they would not otherwise have obtained until age 18 or thereafter. The net effect is much higher death involvement rates per 10,000 population, on average, in states with greater proportions of 16–17 year olds receiving high school driver education. The data suggest that most teenagers would obtain licenses when they are 18–19 years old, irrespective of high school driver education, and indicate that differences among the states in fatal crash involvement rates per 10,000 licensed 18–19 year old drivers were not significantly related to either high school driver education or delayed licensure. (Am. J. Public Health 68:959–965, 1978.)

Teenagers in the United States often learn to operate motor vehicles in high school driver education courses. The number of students enrolled in these courses increased from about one million in the 1961–62 school year to 2.5 million in the 1972–73 school year.[1] Nonetheless, the effects of driver education on involvement in motor vehicle crashes remains a matter of dispute.

Proponents of driver education believe that such courses reduce the involvement in motor vehicle crashes of drivers who have had the course relative to other drivers.[1] Early studies compared crash records of drivers who had driver education with drivers who had not and found lower average crash rates in the former group.[2]

However, later studies found that factors other than driver education may have accounted for the differences. No controlled experiment of the effects of driver education has been done in U.S. high schools, but a number of studies found that, on average, students who chose to take driver education differed from those who did not. Those who took the course tended to have higher IQs, more intellectual interests, less aggressive or impulsive personalities, and—perhaps most important—they subsequently drove fewer miles per year than those who were licensed without having taken the course.[3–4]

In 1968, a committee advising the Secretary of the U.S. Department of Health, Education, and Welfare stated: "no one has yet produced clear proof that driver education, at least as presently constituted, has a significant favorable effect upon driver attitudes, motivations, performance or other achievements."[5] The following year, a review of driver education by the Highway Research Board of the National Academy of Sciences/National Academy of Engineering concluded "at the present time it is impossible to draw valid scientific inferences regarding the impact of driver education on subsequent driver behavior and performance, particularly as measured by accidents and traffic law violations."[6] A 1975 report to the Congress prepared by the National Highway Traffic Safety Administration drew similar conclusions.[7]

In the same year, the results of a large-scale, English experimental-control study of driver education given to selected students in their sixth form (16–17 year olds) were reported. Its author concluded that "we have, as yet, no evidence at all that driver education has been successful in reducing the accident rate per mile." However, she also reported that the total crash involvement per person among the group that had driver education was higher than among the untrained group because members of the trained group more often obtained driver's licenses. The author concluded

From the Insurance Institute for Highway Safety, Watergate Six Hundred, Washington, DC 20037. Address reprint requests to Dr. Robertson. This paper, submitted to the Journal October 21, 1977, was revised and accepted for publication May 15, 1978.

that the driver education "accelerated the decision to learn to drive in the short term."[8]

If driver education increases the number of drivers without reducing the crash incidence per driver, the total effect of driver education on crashes would be adverse. Driver education can only be considered an effective loss reduction measure if it reduces the crashes per driver and that reduction is large enough to more than offset any increase in crashes because of increased numbers of persons obtaining licenses and driving earlier than they would otherwise. Because of concern that the pattern observed in the British experiment may be occurring in the United States, particularly with respect to severe crashes, the present study was undertaken.

Data Sources and Methods

Participation in driver education courses in public and private high schools is not reported annually. However, reports from many states had been obtained systematically and published by the Insurance Institute for Highway Safety for the school years 1966–67 and 1967–68 as well as for a number of prior years.[9] In addition, the National Safety Council had continued that data collection and publication for the school years 1969–70, 1970–71, and 1972–73.[1] Neither organization had collected or published data for 1968–69 or 1971–72.

Some crashes are not reported to police or insurance companies. Therefore, only involvement in fatal crashes, which are quite accurately reported to official agencies, was considered. Data on fatal crash involvement were obtained from reports of state police or motor vehicle administrations for each calendar year. States where these reports do not include the specific age distributions of drivers involved in fatal crashes were not used in the analysis.

The age distribution of licensed drivers in the states was obtained from an annual report compiled by the Federal Highway Administration.[10] However, the data on licensure prior to 1967 were not used since consultation with the Federal Highway Administration raised questions concerning the reliability of licensure data from some states prior to 1967. Age distributions of state populations were extrapolated from census data.[11]

Thus, data were available to relate the fatal crash involvement of 16–17 year olds per licensed driver and per population in the calendar years 1967, 1968, 1970, 1971 and 1973 to driver education in the preceding and overlapping school years in many states and for some of these years in a majority of states. States were eliminated from the study if data were not available for 16–17 year olds on any one of the variables of interest—fatal crash involvement, licensure, and high school driver education—in at least two consecutive study years. In total, 103 years of experience with driver education among 16–17 year olds in 27 states were studied. The states and years in which data were available are presented in Table 1.

The effects of high school driver education on fatal crash rates and licensure were considered separately for 16–17 year olds and 18–19 year olds. High school driver education of 18–19 year olds was estimated by the number of people who were enrolled in a given state when those 18–19 years old would have been 16–17 years old.* Since driver education enrollment was not available in the 1968–69 school year, fatal crash data for 18–19 year olds in the 1971 calendar year could not be related to the proportion of 18–19 year olds with driver education in that year and, therefore, data for that year were not used.

TABLE 1—Twenty-seven States and Years Included in the Study

State	1967	1968	1970	1971*	1973
Arizona			X	X	X
Arkansas			X	X	X
Connecticut	Y	Y	Y	Y	Y
Delaware			Y	Y	Y
Illinois	X	X	X	Y	Y
Indiana	X	X			
Iowa	Y	Y	Y	Y	Y
Kansas		X	X	X	X
Kentucky	X	X	X	X	X
Maine	Y	Y	Y	Y	Y
Maryland	Y	Y	Y	Y	Y
Massachusetts	X	X	X		
Michigan	Y	Y	Y		
Mississippi		X	X	X	X
Missouri	X	X	X		
Montana	X	X	X	X	X
Nevada			X	X	
New Jersey	X	X	X	X	
New York	Y	Y	Y	Y	Y
North Carolina	Y	Y	Y	Y	Y
Ohio	X	X			
Oregon				X	X
Pennsylvania	Y	Y	Y	Y	Y
South Carolina			X	X	X
Virginia	X	X	Y	Y	Y
Washington	Y	Y	Y	Y	Y
Wisconsin			Y	Y	

X Data available and no law requiring driver education to be licensed.
Y Laws require driver education to be licensed at age 16 or 17 with exemptions.
*Data were unavailable for 18–19 year olds in 1971.

Some states require driver education for licensure of persons less than 18 years of age, but most of these states allow exemptions or commercial driver training so that seldom have all licensed drivers under age 18 in a state had high school driver education. In most cases, these states raised their minimum age for licensure to 18 for persons who had not had driver education, but with exemptions. The years in which state laws required driver education for at least some licensees less than 18 years old are also indicated in Table 1.

The possible effect on fatal crash rates of factors other than driver education and licensure was controlled by introducing a composite variable—all motor vehicle deaths in a given state per 10,000 licensed drivers in the state in each year considered. The data were analyzed using an analysis of

*e.g., the proportion of 18–19 year old licensed drivers in 1973 who had high school driver education was estimated by the number of students who had such education in 1970 and 1971 divided by the number of 18–19 year old licensed drivers in 1973.

covariance that took into account the differences in law requiring driver education to be licensed among states, possible fluctuations in time, and the composite total motor vehicle death rate per 10,000 licensed drivers to control for factors contributing to interstate variations in fatal crash rates not associated with driver education and licensure of teenagers. The particular method used allows for the missing data in those states for which data were not available in every year.[12]

Analysis

Involvement Per Licensed Drivers. Averages and ranges of values of the principal variables are presented in Appendix 1. The relationships between high school driver education and the fatal crash involvement rate per 10,000 licensed drivers was estimated separately for the 16–17 year old population and the 18–19 year old population. In each age group, parameters were estimated for the equation:

(1) $y_{it} = a + b + c_t + \alpha f_{it} + \gamma u_{it} + r_{it}$

where y_{it} = fatal crash involvement per 10,000 licensed 16–17 year old drivers in state i in year t

a = constant

b = effect of requiring high school driver education for licenses

c_t = effect of fluctuations in time

f_{it} = number of students completing high school driver education in state i in year t per number of licensed drivers

u_{it} = all motor vehicle deaths per 10,000 licensed drivers in state i in year t

r_{it} = residual variation

In the analysis for 18–19 year olds, y_{it} and f_{it} each involved the appropriate 18–19 years old rather than 16–17 year olds. If α is no more or less than zero than would be expected from random fluctuation, there is no association between driver education and the fatal crash involvement rate per 10,000 licensed drivers. But, if the effect of driver education, α, is significantly negative, driver education is associated with reductions in the fatal crash involvement per licensed driver. If it is significantly positive, driver education is associated with increases in the fatal crash involvement rate.

Table 2 presents the coefficients fitted to equation 1 and measures of the effects of laws requiring driver education. The table also shows the 95 per cent confidence interval for each coefficient and the results of statistical tests for random fluctuation. Among 16–17 year olds, there was no statistically significant relationship between the proportion who took high school driver education and the involvement rate in fatal crashes. Both the estimates of effect of the laws requiring driver education and the estimated coefficients for the effect of the proportion of licensed drivers who took the course are well within the range that would be expected from random fluctuations in sampling. Among 18–19 year olds, similar results are also found. Polynomials of time are not presented in

TABLE 2—Relationship between High School Driver Education and Fatal Crash Involvement per 10,000 Licensed Drivers Controlling for Laws Requiring Driver Education and other Factors

16–17 Year Olds	Sum of Squares	df	F	p
Effect of Law	16.3	1	2.27	n.s.
Residual	667.3	95		
	683.6	96		
	Covariate Effects		t*	p
Proportion of 16–17 year old licensed drivers with driver education (α)	2.2 ± 1.2		1.82	n.s.
All deaths per 10,000 licensed drivers (γ)	1.4 ± 0.2		7.64	<0.001

*df = 95, two-tailed test

18–19 Year Olds	Sum of Squares	df	F	p
Effect of Law	2.7	1	0.61	n.s.
Residual	308.0	71		
Total	305.3	72		
	Covariate Effects		t*	p
Proportion of 18–19 year old licensed drivers with driver education (α)	−0.4 ± 0.9		0.45	n.s.
All deaths per 10,000 licensed drivers	1.7 ± 0.2		9.63	<0.001

*df = 71, two-tailed test

TABLE 3—Relationships between the Proportion of the Population with High School Driver Education and the Proportion of the Population Licensed without Driver Education Controlling for Laws Requiring Driver Education

16–17 Year Olds	Sum of Squares	df	F	p
Effect of Law	0.1	1	5.17	<0.05
Residual	1.3	97		
Total	1.4	98		

	Covariate Effect	t*	p
Proportion of the population with driver education	−0.2 ± 0.1	2.00	<0.05

*df = 97, two-tailed test

18–19 Year Olds	Sum of Squares	df	F	p
Effect of Law	0.0	1	0.09	n.s.
Residual	1.7	72		
Total	1.7	73		

	Covariate Effect	t*	p
Proportion of the population with driver education	−0.8 ± 0.1	9.48	<0.001

*df =72, two-tailed test

this and subsequent tables because they were not significantly related to any of the factors involved, indicating that it is very unlikely that the results were due to consistent secular variations among the states. The highly significant coefficients for all motor vehicle deaths per 10,000 licensed drivers of all ages indicate that the fatal crash involvement rate per 10,000 licensed 16–19 year old drivers in each state is strongly related to the total fatal crash rate per 10,000 licensed drivers.

Licensure. The lack of significant relationship between driver education and the fatal crash involvement rate per licensed driver does not necessarily mean that driver education is unrelated to the number of fatal crashes. To measure the possible relationships between driver education and licensure, the parameters of the following equation were estimated:

(2) $v_{it} = a + b + c_t + \beta d_{it} + r_{it}$

where v_{it} = proportion of population age group licensed without high school driver education

d_{it} = proportion of the population age group who had high school driver education

and a, b, c_t and r_{it} are the same as in equation 1.

If $\beta = -1$, the people who had licenses who had had driver education can plausibly be assumed to be the same as those who would have obtained licenses without driver education. In other words, the availability of driver education would not increase the number of licensed drivers. To the degree that β is greater than -1, driver education is associated with increased numbers of licensed drivers.

The estimated coefficients for equation 2 are presented in Table 3. Among 16–17 year olds, the coefficient for the proportion of that aged population with driver education is −0.2, only 20 per cent of −1. In other words, there is a reduction of only two 16–17 year olds licensed without high school driver education for every increase of ten 16–17 year olds licensed with high school driver education. This indicates that as much as 80 per cent of 16–17 year olds who took high school driver education obtained licenses that they would not otherwise have obtained until they were at least 18 years old. The coefficient for 18–19 year olds is −0.8, much nearer to −1, indicating that 80 per cent of those who had high school driver education would have been licensed when they were 18–19 irrespective of whether they had high school driver education.

The laws that required driver education to be licensed also had some effect, that is, the average proportion of 16–17 year olds licensed without driver education was smaller in states with such laws than in those without them (0.16 and 0.24 respectively). The relationships between the proportion of the population licensed without driver education and the proportions of the population age group with driver education, however, were not affected by the laws. Separate analyses of the data for the states with and without such laws produced coefficients that were essentially the same.

One assumption implicit in equation 2 is that all of the people who take high school driver education also obtained driver licenses. However, one study found only 70 per cent licensed within two years after completing the course.[14] This difference is compensated for, at least in part, by the fact

that in the present study too few 16–17 year olds were counted as licensed with driver education because those licensed at 16 years of age would be in the 16–17 year old age group at least part of the subsequent year. A sensitivity analysis of the effect of these two possibilities on the estimated effect of driver education on licensure indicated that each offsets the other.*

Involvement Per Population. Since it is very clear from the data that driver education is associated with increased licensure but not with fatal crash involvement rate per 10,000 licensed drivers, the relationship between driver education and the fatal crash involvement rate per 10,000 population should be adverse.

To determine whether this was so, the relationship between driver education and fatal crash involvement per 10,000 population was estimated in the equation:

$$(3)\quad z_{it} = a + b + c_t + \delta d_{it} + \theta v_{it} + \gamma u_{it} + r_{it}$$

where z_{it} = fatal crash involvement per 10,000 population in the age group

d_{it} = proportion of the population age group with driver education

v_{it} = proportion of the population age group licensed without driver education

and a, b, c_t, u_{it}, and r_{it} are the same as in equation (1).

The estimated effects of laws requiring driver education, and the coefficients for equation 3 are presented in Table 4. Among 16–17 year olds and among 18–19 year olds, the coefficient relating driver education per population and motor vehicle deaths per 10,000 population was about the same magnitude as the coefficient for those licensed without driver education. Thus, given increases in the proportion of the population licensed with driver education are associated with increases in the fatal crash involvement per 10,000 population to about the same extent as changes in the proportion licensed without driver education. These relationships are in addition to the effects of the composite variable, motor vehicle deaths per 10,000 drivers, which adjusts for other factors that affect interstate variations in death rates.

Delayed Licensure. Although high school driver education is associated with the proportion of the population licensed and the population motor vehicle death rates among 16–17 year olds, but not with changes in motor vehicle deaths per 10,000 such drivers, the possibility that those who delay licensure are more involved after their subsequent licensure because of inexperience must be considered. If newly licensed 18–19 year olds have higher fatal crash involvement than those licensed at a younger age, the states that have a higher proportion of 18–19 year olds that were licensed at age 16–17 should have lower fatal crash in-

TABLE 4—Relationships between High School Driver Education, Licensure without Driver Education and Fatal Crash Involvement per 10,000 Population Controlling for Laws Requiring Driver Education for Licensure and other Factors

16–17 Year Olds	Sum of Squares	df	F	p
Effect of Law	0.2	1	0.17	n.s.
Residual	127.7	94		
Total	127.9	95		
	Covariate Effects		t*	p
Proportion with driver education (δ)	5.6 ± 1.1		5.21	<0.001
Proportion licensed without driver education (θ)	5.9 ± 1.0		6.02	<0.001
All deaths per 10,000 licensed drivers (γ)	0.6 ± 0.1		8.10	<0.001

*df = 93, two-tailed test

18–19 Year Olds	Sum of Squares	df	F	p
Effect of Law	0.35	1	0.16	n.s.
Residual	153.30	70		
Total	153.65	71		
	Covariate Effects		t*	p
Proportion with driver education (δ)	7.0 ± 1.2		6.02	<0.001
Proportion licensed without driver education (θ)	6.4 ± 1.1		5.62	<0.001
All deaths per 10,000 licensed drivers (γ)	1.2 ± 0.1		9.62	<0.001

*df = 70, two-tailed test

*Details are available from the authors.

volvement of 18–19 year olds than those with lower proportions that were licensed at age 16–17.

To examine this, the possible relationships between delayed licensure and fatal crash involvement per 10,000 licensed 18–19 year old drivers were estimated in the equation:

$$(4)\quad g_{it} = a + \rho h_{it} + \gamma u_{it} + r_{it}$$

where g_{it} = fatal crash involvement per 10,000 licensed 18–19 year old drivers in state i at time t

h_{it} = proportion of licensed 18–19 year olds that were licensed at age 16–17

and a, u_{it}, and r_{it} are the same as in equation 1.

In Table 5, the coefficients for equation 4 are presented. The relationship between the proportion of licensed 18–19 year olds who were licensed at age 16–17 and the fatal crash involvement per 10,000 18–19 year old licensed drivers is well within the bounds expected from random fluctuations in sampling. There is no evidence that delayed licensure was associated with increased fatal crash involvement of 18–19 year olds.

In additional analyses, regression coefficients were estimated separately for the states with and without laws requiring driver education to be licensed. The coefficients indicate parallel relationships among driver education, licensure, and motor vehicle death involvement per licensed driver and per population in states both with and without such laws. The basic conclusions of the study were supported by the results of these analyses.*

Discussion

This study finds that high school driver education is associated with substantial increases in the number of drivers licensed among persons 16–17 years old, but is not associated with reductions in the fatal crash involvement rate per licensed driver of that age. The net result is that high school driver education is associated with substantial increase in death involvement per 10,000 population, particularly in the 16–17 year old population. These results are consistent with those found regarding total crash involvement in the large-scale, controlled experiment in England referred to earlier.[8] Based on these two studies, it seems reasonable to conclude that the relationship between driver education and licensure is causal. Both the data and straightforward logic indicate that when more people are trained to do something, more of them do it.

The data from the 27 states analyzed in this report indicate that most teenagers who had high school driver education would not have obtained licenses until they were 18 or 19 if the education had not been available. In addition, the fatal crash rate per 10,000 licensed drivers among 18–19 year olds was unaffected by driver education. Delay of licensure from age 16–17 to age 18–19 also had no effect on fatal crash rate per 10,000 18–19 year old licensed drivers.

TABLE 5—Relationship between Licensure at Age 16–17 and Fatal Crash Involvement at Age 18–19

	Effect	t*	p
Proportion of 18–19 year olds licensed at 16–17 (α)	0.9 ± 2.6	0.35	n.s.
All deaths per 10,000 licensed drivers (γ)	1.5 ± 0.2	6.90	<0.001

*df = 33, two-tailed test

In 1975, some 4,000 drivers under 18 years of age were involved in fatal crashes in the United States.[13] In each of about one-half of those crashes, only one vehicle was involved. Either the occupants of that vehicle or pedestrians were killed. Thus, removing drivers under age 18 from the roads would prevent at least 2,000 fatal crashes per year in the United States. Where other vehicles and their drivers were involved, many of the multiple-vehicle fatal crashes would also not have occurred if the involved teenager had not been driving. For this reason, the estimate of 2,000 fatal crashes that would be prevented if persons under age 18 were not driving is a conservative, minimum estimate.

If the age at which people are first allowed to drive were raised to age 18, the effect of high school driver education in early licensure would be removed. However, the results of the analyses presented in this paper also suggests that such education per se would not thereby be of benefit in reducing fatal crash involvement of those who received the education. It may be that there are sufficient societal reasons to justify allowing people as young as age 16 to operate motor vehicles but the burden of competent proof must rest on those who take this position. Moreover, society must understand the consequences of such a decision, one of which is that large numbers of such teenage drivers would continue to be involved in motor vehicle crashes fatal to themselves and others.

Although there is no apparent aggregate effect of high school driver education on the fatal crash involvement per licensed drivers among states, it is possible that some programs have small effects, positive or negative, that are not detectable by aggregated statistics. However, since high school driver education would have to reduce fatal crash involvement per licensed driver at least 60 per cent merely to offset its effect of increasing licensure among 16 and 17 year olds, it is doubtful that any such program could produce a net reduction in fatal crash involvement unless the minimum licensing age were 18. Studies of commercial schools of driver training[14] and of practice driving on multiple-range driving courses[15] have found resultant crash rates similar to those of students who learned to drive in high school driver education courses. There is no competent research evidence that "advanced" driver education has any effect on crash involvement.

Proposals to increase motorcyclist education in high schools, if implemented, would likely worsen the present situation substantially. Motorcycles and mopeds (small motorcycles with pedals) have death rates per vehicle substantially

*Details are available from the authors.

in excess of those of cars.[16] If motorcyclist education in high schools increased the use of these vehicles without reducing fatal crash involvement to the substantial extent necesssary to offset the effect of increased licensure, as driver education has done, death rates would soar.

There is also some evidence that motorcycle training may increase crashes and injuries. An English study found a greater average of crashes per mile among persons who had formal motorcyclist education compared with motorcyclists who had learned to ride by other means.[17] In addition, a comparison of motorcylists who had medically treated injuries with a sample of owners of registered cycles in a California county found a greater proportion who acknowledged training in the injured group.[18]

It should be emphasized that the conclusions of the present study apply to fatal motor vehicle crashes. Since the characteristics of motor vehicle crashes involving serious injury are generally similar to those of fatal crashes, it seems likely that these crashes are similarly affected. Run-of-the-mill crashes involving only property damage or minor injuries tend to have quite different characteristics, however, and therefore it is not safe to assume that the conclusions apply to such crashes. Nevertheless, the English study of driver education[8] that found similar results did include all crashes.

It is obvious that no one should operate a motor vehicle on public roads without first learning to drive. Most of the basic skills involved in vehicle operation are usually learned easily but the role of attitudes, peer pressures, and physical and emotional maturity as factors in crash involvements are not well understood. The lack of effect of presently used driver education programs should not deter the search for ways to help young people cope with motor vehicles while at the same time minimizing damage to themselves and society as a whole.

As with any preventive measure to reduce pathology, programs aimed at such improvement should be demonstrated to be effective in scientifically well-designed experiments before they are adopted for widespread use. Clearly, if driver education is to be expected to reduce the fatal crash involvement of young drivers, it must be thoroughly researched to determine whether improvements are possible, and the best ways to implement them. Any educational or other program that has the potential for increasing exposure to hazards should be evaluated on the basis of total reduction of injury, not just injury per exposure as is commonly done. Programs that increase confidence that risk has been reduced, when in fact it has not, are worse than no programs at all.

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