

Reducing Alcohol-Impaired Driving in Massachusetts: The Saving Lives Program

ABSTRACT

Objectives. The purpose of this study was to assess whether a community program begun in March 1988 that organized multiple city departments and private citizens could reduce alcohol-impaired driving, related driving risks, and traffic deaths and injuries.

Methods. Trends in fatal crashes and injuries per 100 crashes were compared in Saving Lives Program cities and the rest of Massachusetts from March 1984 through February 1993. In annual roadside surveys conducted at randomly selected locations, safety belt use among occupants of 54 577 vehicles and travel speeds of 118 442 vehicles were observed. Four statewide telephone surveys ($n = 15\ 188$) monitored self-reported driving after drinking.

Results. In program cities relative to the rest of Massachusetts during the 5 program years in comparison with the previous 5 years, fatal crashes declined 25%, from 178 to 120, and fatal crashes involving alcohol decreased 42%, from 69 to 36. Visible injuries per 100 crashes declined 5%, from 21.1 to 16.6. The proportions of vehicles observed speeding and teenagers who drove after drinking were cut in half.

Conclusions. Interventions organized by multiple city departments and private citizens can reduce driving after drinking, related driving risks, and traffic deaths and injuries. (*Am J Public Health.* 1996;86:791-797)

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Introduction

In the United States in 1994, 16 589 persons died and 297 000 were injured in traffic crashes that involved alcohol.¹ Fatalities were 34% lower than in 1982, in part because groups such as Mothers Against Drunk Driving stimulated passage of more than 2000 new state laws (S. Hatos, written communication, January 1992, 1996).² The legal minimum drinking age is now 21 years in all 50 states. It is illegal per se to drive with a blood alcohol level above 0.10% in 36 states and above 0.08% in 12 states. In 38 states, the licenses of persons who drive above the legal limit can be administratively suspended. While research has linked each of these laws to fatal crash declines,³⁻⁸ sometimes postlaw declines are followed by a return to prelaw levels.⁹⁻¹²

Citing their long-term success with other public health problems, the National Academy of Sciences has recommended comprehensive multistrategy community interventions to reduce alcohol-related health problems.¹³ For example, comprehensive community programs have achieved some success in reducing cardiovascular mortality and risks such as fat intake, blood pressure, smoking, and cholesterol levels.^{14,15}

More recent community intervention studies, however, have produced mixed results. Community interventions have achieved minimal differential reductions in cardiovascular risks and prevalence of smoking^{16,17} but significant declines in unintentional childhood injury.¹⁸

Previous US community traffic safety interventions have focused solely on drunk driving enforcement and accompanying publicity.¹⁹⁻²⁴ In this study, we assessed whether a more comprehensive commu-

nity program, one that organizes multiple city departments and private citizens, can reduce alcohol-impaired driving, related driving risks, traffic deaths, and the proportion of crashes resulting in injury.

Methods

The Saving Lives Program

In 1987, the Massachusetts Governor's Highway Safety Bureau and the Commonwealth Fund of New York requested proposals from more than 50 Massachusetts communities for the funding of 6 communities (\$70 000 per community annually for 5 years) to undertake comprehensive multistrategy programs to reduce alcohol-impaired driving and related problems such as speeding, other moving violations, and failure to wear safety belts.²⁵⁻²⁷

Of 30 communities that submitted proposals, 11 qualified for funding. The 6 program communities selected for funding varied in population size and geographic location within the state. They were selected to be as similar as possible to the remaining 5 unfunded communities.

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Editor's Note. See related comment by Evans (p 784) in this issue.

TABLE 1—Baseline Characteristics of the Saving Lives Program Cities and the Rest of Massachusetts

	Saving Lives Cities	Rest of Massachusetts	5 Comparison Cities
1980 population	293 175	5 082 500	361 362
1990 population	318 974	5 318 785	378 666
White, %	90	90	89
College graduates, %	14	18	13
Welfare recipients, %	3	3	4
Employed, %	54	54	50
Living in poverty, %	10	8	13
Per capita income, \$	15 116	17 342	14 284
Fatality rate per 1000 population (1984–1987)	0.5	0.5	0.3
Visible injury rate per 1000 population (1984–1987)	56.8	58.3	68.0
Injury rates per 100 crashes	48.1	47.3	52.1
1987 traffic citation rate per 1000 population	167.4	164.1	163.4
1987 speeding citation rate per 1000 population	100.3	85.9	79.0
1987 driving while intoxicated rate per 1000 population	2.0	2.7	2.5

Note. The comparison cities are a subset of the rest of Massachusetts.

Source. Data on population, education, ethnicity, and income were derived from Horoner⁴⁹ (based on the US census).

In each program community, a full-time coordinator from the mayor's office or city manager's office organized a task force of concerned private citizens and organizations and officials representing various city departments (e.g., school, health, police, recreation). Each community received approximately \$1 per inhabitant annually in program funds. Half of the funds involved payment for the coordinator; 20% were designated for added police enforcement and the balance for program activities and educational materials. Voluntary effort was also a key factor. Active task force membership ranged from 20 to more than 100 persons. An average of 50 organizations participated in each city.

The communities, not state or federal agencies, developed most of the program initiatives. To reduce drunk driving and speeding, communities introduced media campaigns, business information programs, speeding and drunk driving awareness days, speed watch telephone hotlines, police training, high school peer-led education, Students Against Drunk Driving chapters, college prevention programs, alcohol-free prom nights, beer keg registration, and increased liquor outlet surveillance. To increase pedestrian safety and seat belt use, program communities undertook media campaigns and police checkpoints, posted crosswalk signs warn-

ing motorists of fines for failure to yield to pedestrians, added crosswalk guards, and offered preschool education programs and training for hospital and prenatal clinic staff.

Program Evaluation

A quasi-experimental evaluation compared Saving Lives cities with the rest of Massachusetts. Program cities were also compared with the other five cities that prepared high-quality proposals but were not funded. Evaluation data were provided to program communities to help target activities. The evaluation involved the components described in the following sections.

Fatal and injury crash monitoring. Using the US Department of Transportation Fatal Accident Reporting System, we examined fatal crashes from March 1983 through February 1993, 5 years preceding and 5 following the start of the program. A crash was labeled as involving alcohol if a driver had been drinking or police indicated that alcohol was a factor. In Massachusetts, more than 80% of fatally injured drivers are tested for blood alcohol levels. Speeding was noted if an officer issued a speeding ticket or cited speeding as a factor or if one of the vehicles exceeded posted limits by 10 or more miles per hour.

Data on traffic crashes and injuries were available from the Massachusetts Registry of Motor Vehicles from March 1984 to February 1993, 4 years preceding and 5 following the program. Because vehicle travel mileage data were unavailable on a community level, we used total crashes as a mileage proxy and monitored rates of injury per 100 crashes. The total number of traffic crashes over time statewide was highly correlated with miles driven ($r = .8$). Interventions designed to reduce drunk driving and speeding and to increase seat belt use should reduce the proportion of crashes that result in injury.

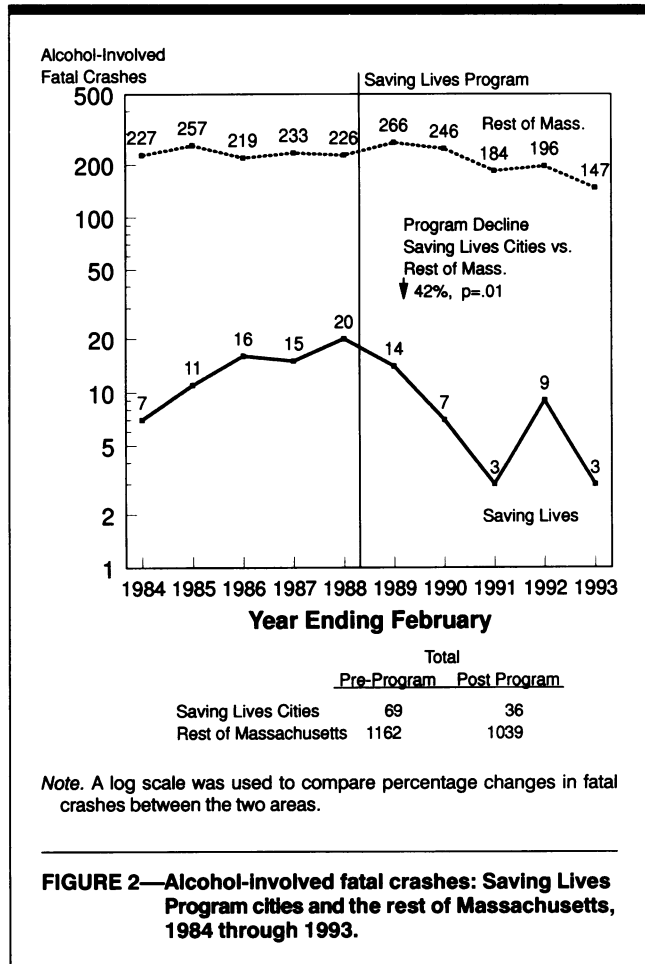
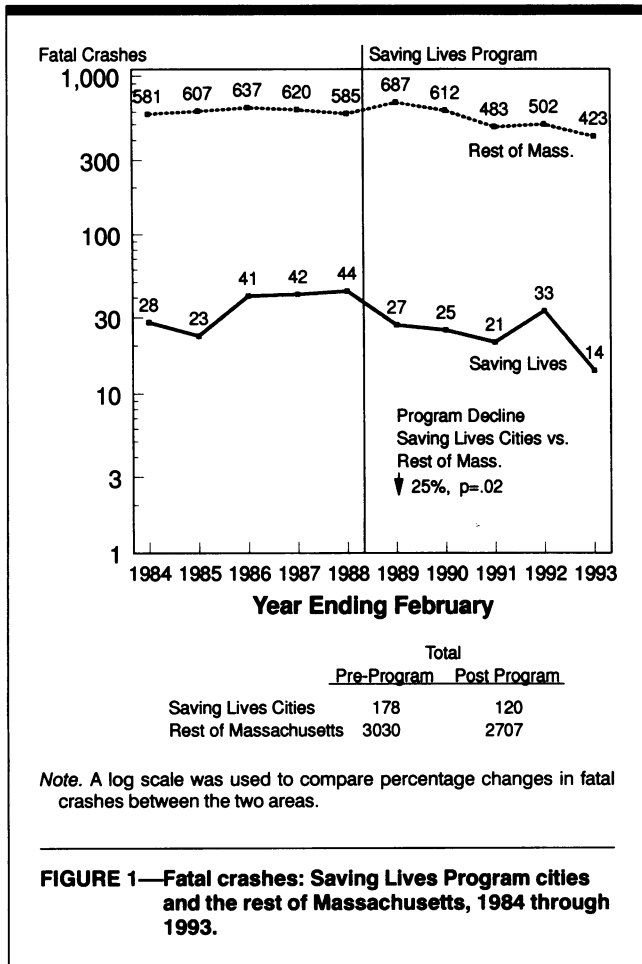
Direct observation of safety belt use and speeding. Five annual surveys of speeding and safety belt use were conducted from 1989 through 1993. Observers recorded data in both program and comparison areas and were not informed about which cities were involved in the program.

Radar from unmarked cars was used to record travel speeds of 69 940 vehicles at 64 randomly selected roadways in program cities and 48 502 vehicles at 45 sites in five comparison cities during day and evening hours. Traveling at 10 or more miles per hour over the posted limit was considered speeding.

In the seat belt surveys, we selected 200 signalized road intersections and freeway offramps statewide using a multi-stage, stratified random sampling procedure²⁸ including at least four sites in each program city. Belt use of each occupant was observed in 11 524 vehicles in program cities and 43 053 statewide.

Telephone surveys. Four independent, anonymous, cross-sectional random-digit dialing^{29,30} telephone surveys of persons 16 to 19 years of age and 20 years of age or older in program cities and the rest of the state between 1988 and 1993 assessed program awareness, beliefs about police enforcement, and frequency of driving after drinking. In total, 15 188 persons were surveyed (a response rate of 74% based on the total number of eligible households with phones). Response rates did not change differentially between program cities and the rest of Massachusetts over time. Interviewers were not aware of whether respondents resided in program cities.

Monitoring of traffic citations. Each city's traffic violations were monitored by type, as reported by the Massachusetts Merit Rating Board from 1987 through 1992.



Data Analysis

Tests of statistical significance assessed changes in the yearly number of fatal crashes and trends in quarterly injury rates per 100 crashes, as well as the proportions of vehicles speeding and motor vehicle occupants who used safety belts in the program cities in comparison with the rest of the state.

The number of fatal crashes was analyzed through a Poisson log-linear regression.^{31,33} This model assumed that there were no differential changes in the at-risk populations between the program communities and the rest of Massachusetts. Independent variables consisted of indicators that represented area (Saving Lives Program cities vs rest of state), the 10 study years, and the Saving Lives Program (coded 1 for program communities during the program years and coded 0 otherwise). The model acknowledged that the yearly number of fatal crashes may have varied as a result of forces other than the program but assumed that the ratio of fatal crashes in the program communities to the rest of the state remained constant

in the preprogram years. Preliminary analysis verified that there was no significant change in this ratio over the pre program years. The relative risk (RR) associated with the program variable represented the percentage change in fatal crashes in the Saving Lives cities relative to the rest of Massachusetts.

Since injuries are more numerous than fatal crashes, we analyzed injury rates per 100 crashes in the Saving Lives cities on a quarterly basis using Poisson log-linear regression. We examined visible injuries (those involving broken bones, bleeding, or bruises), pedestrian injuries, and total injuries. Independent variables included indicators for area, year, and the Saving Lives Program. The dependent variable was the injury rate per 100 crashes in each quarter, modeled as a function of year (to account for net secular trends), season (coded as a four-way categorical variable), and intervention period before and after the program. The relative risk associated with the Saving Lives Program measured the reduction in injury per 100 crashes that corre-

sponded with implementation of the Saving Lives Program.

We analyzed the significance of shifts in program relative to comparison areas in the proportions of vehicles speeding and occupants who wore seat belts in 1989 and subsequent years, as well as differential shifts in telephone survey response, by means of logistic regression with indicator variables for area, year, and program. We present results from logistic regression analyses by reporting odds ratios (ORs) and confidence intervals (CIs).

A parallel set of analyses tested for differential shifts in fatal crash trends and trends in injuries per 100 crashes in the Saving Lives cities and the five comparison cities during the program years.

Results

Baseline Comparisons

At baseline, Saving Lives cities were slightly less affluent than the rest of Massachusetts but otherwise had similar demographic characteristics, rates of traffic citations, and rates of fatal crashes

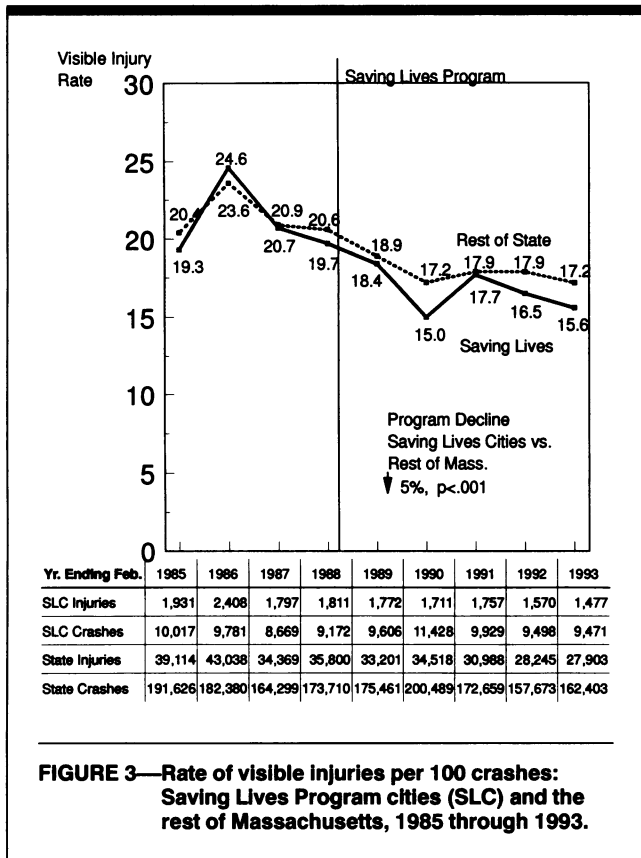


FIGURE 3—Rate of visible injuries per 100 crashes: Saving Lives Program cities (SLC) and the rest of Massachusetts, 1985 through 1993.

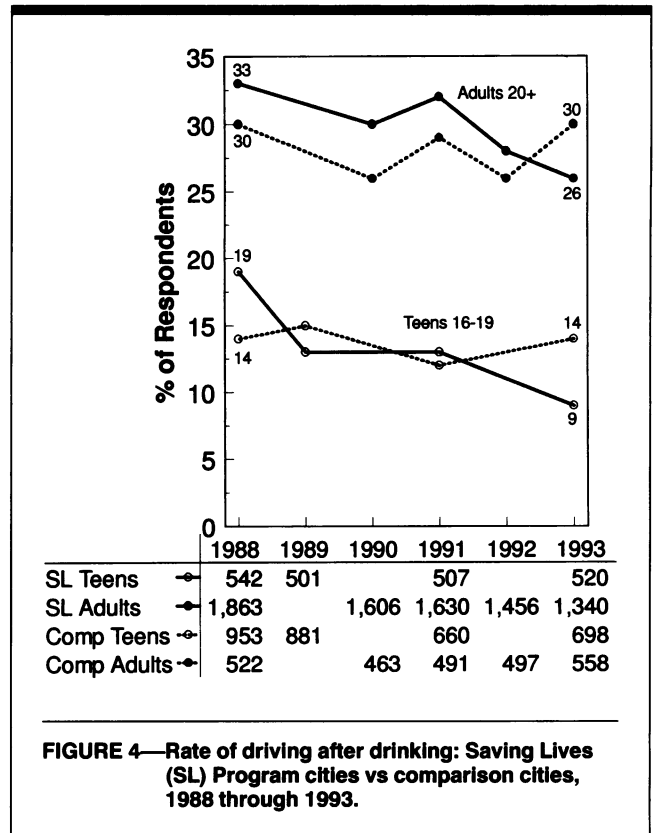


FIGURE 4—Rate of driving after drinking: Saving Lives (SL) Program cities vs comparison cities, 1988 through 1993.

(Table 1). Although injury rates per population were slightly lower in program cities, trends in the rates of total injuries per 100 crashes and fatal crashes during the preprogram years did not differ. Relative to Saving Lives cities, comparison cities were less affluent, had higher pre-program injury rates, and had lower fatality rates; preprogram trends in fatal crashes did not differ significantly. From 1980 to 1990, according to the census, the population increased 9% in program cities and 5% in comparison cities and the rest of the state.

Program Results: Saving Lives Cities vs the Rest of Massachusetts

Fatal crashes. In Saving Lives cities, fatal crashes declined from a total of 178 during the 5 preprogram years to 120 during the 5 program years (Figure 1). Poisson regression revealed that the estimated relative risk associated with the program variable was 0.75 ($P = .02$, 95% CI = 0.60, 0.96). This implies that the program cities experienced a 25% fatal crash reduction during program years relative to the rest of Massachusetts.

During the same period, fatal crashes that involved alcohol in program cities dropped from 69 to 36, a 42% decline (based on Poisson regression) relative to

the rest of the state ($P = .01$, RR = 0.58, 95% CI = 0.39, 0.88) (Figure 2). The number of fatally injured drivers with positive blood alcohol levels showed a relative decline of 47% in program cities, from 49 to 24 ($P = .01$, RR = 0.53, 95% CI = 0.32, 0.87). Furthermore, the number of fatal crashes involving drivers 15 to 25 years of age declined from 98 to 45, a 39% drop relative to the rest of Massachusetts ($P < .01$, RR = 0.61, 95% CI = 0.43, 0.88).

Of note, on local roadways in program cities, the number of fatal crashes declined from 155 to 100, a 27% drop relative to the rest of Massachusetts ($P = .02$, RR = 0.73, 95% CI = 0.56, 0.94). In contrast, there was very little change on superhighways that run through program cities in comparison with superhighways in the rest of Massachusetts.

The number of fatal crashes that involved speeding drivers dropped from 68 to 33 in program cities, and the number of pedestrian fatalities declined from 45 to 33. The declines were, respectively, 27% and 18% greater than elsewhere in Massachusetts but were not statistically significant.

Injuries. During the 5 program years relative to the previous 4 years, the rate of visible injuries declined from 21.1 to 16.6

per 100 crashes, a 5% greater decline than in the rest of Massachusetts ($P < .001$, RR = 0.95, 95% CI = 0.92, 0.98) (Figure 3). Pedestrian injuries per 100 crashes dropped from 2.0 to 1.5, a suggestive 10% decline relative to the rest of the state ($P = .06$, RR = 0.90, 95% CI = 0.82, 1.01). Total injuries per 100 crashes declined from 48.2 to 47.3, a 3% drop relative to the rest of the state ($P < .003$, RR = 0.97, 95% CI = 0.95, 0.99).

Behavior changes. Safety belt use increased in program cities, from 22% in 1989 to 29% in subsequent years, a rate 17% proportionately greater than that of the rest of the state ($P < .01$, OR = 1.17, 95% CI = 1.06, 1.29). In contrast, the proportion of vehicles observed traveling at 10 or more miles over the speed limit declined from 19% in program cities in 1989 to 9% in subsequent years, a 43% greater decline than in comparison areas ($P < .001$, OR = 0.57, 95% CI = 0.51, 0.63). The proportion of 16- to 19-year-olds who reported driving after drinking in the month prior to the interview declined from 19% in 1988 to 9% in 1993 in program cities, a 40% decline relative to the rest of Massachusetts ($P < .01$, OR = 0.60, 95% CI = 0.42, 0.86) (Figure 4).

Program awareness. By the end of the fifth program year, 54% of 16- to 19-year-

old respondents and 40% of adults in program cities were aware of the Saving Lives Program. These rates were significantly higher than those observed in the rest of Massachusetts (8% to 10%).

Perceptions of enforcement. In program cities, the proportion of adults who believed that police would stop drunk drivers and speeders did not significantly increase. However, among teenagers, the proportion who believed that the license of a person caught driving after drinking could be suspended before a trial increased from 61% to 76%, while there was no change statewide ($P < .0001$). This law preceded the program. Also, the proportion of program teenagers who believed that speeders would be stopped and fined more than \$100 jumped from 5% to 45%, an increase higher than that observed in the rest of Massachusetts (9% to 42%; $P < .01$). State speeding fines were increased in the first program year.

Police traffic citations. In program cities, combined police traffic citations declined 12%, from 53 410 in 1987 (before the program) to an annual average of 46 776 from 1988 to 1992. Speeding citations declined 14%, from 31 992 to 27 421, and drunk driving citations declined 13%, from 646 to 513. Elsewhere in Massachusetts, total traffic citations declined 6%, from 934 777 to 874 301; speeding citations declined 8%, from 489 522 to 450 872; and drunk driving citations declined 16%, from 15 419 to 12 973.

Program Results: Saving Lives vs Comparison Cities

During the 5 program years relative to the previous 5 years, the program cities experienced a 33% decline in fatal crashes, from 178 to 120; in comparison cities, the number of such crashes increased from 120 to 121 ($P < .02$, RR = 0.67, 95% CI = 0.48, 0.94). The decline in alcohol-related fatal crashes was 42% greater in Saving Lives cities than in comparison cities ($P = .08$, RR = 0.58, 95% CI = 0.32, 1.08). These trends were similar to those observed when we compared Saving Lives cities with the rest of the state.

Note, however, that during the program years, the decline in the rate of visible, pedestrian, and total injuries per 100 crashes in Saving Lives cities did not differ significantly from that of the five comparison cities. Both program and comparison cities experienced small but significant declines in the number of visible and total injuries per 100 crashes relative to the remainder of the state.

Discussion

During the Saving Lives Program, Massachusetts had the lowest traffic fatality rate per vehicle miles driven of any state in the United States.^{32,34} Nonetheless, during the 5 program years, there was a 25% greater decline in fatal crashes in the Saving Lives cities than in the rest of Massachusetts. Had the entire state experienced the same decline, there would have been 681 fewer fatal crashes.

Although the small numbers of fatal crashes in the study warrant guarded interpretation, it appears that this community program that addressed drunk driving, speeding, safety belts, and pedestrian safety produced declines in fatal crashes greater than those typically achieved by individual state-level legal countermeasures. Major drunk driving laws in the 1980s (e.g., administrative license revocation laws) were associated with declines of 5% to 9% in nighttime fatal crashes,^{8,35} and drinking age increases were associated with declines of 10% to 15% in such crashes among 18- to 20-year-olds. Mandatory safety belt laws have been credited with initial 7% declines in occupant deaths.^{36,37} Massachusetts had neither administrative license revocation nor mandatory safety belt legislation during the study period.

According to the US Department of Transportation, a motor vehicle fatality typically costs society \$6000 in hospital and medical expenses and \$748 000 in lost productivity (adjusted for Massachusetts cost levels based on personal income per capita in Massachusetts relative to the nation).^{38,39} Accordingly, the fatality reductions that accompanied the Saving Lives Program could prevent the loss of more than \$33 million, a 10-fold to 15-fold savings relative to program expenditures.

Laws designed to reduce traffic deaths are most effective when accompanied by active education and enforcement at the local level.⁴⁰⁻⁴² During the program, speeding fines were increased in Massachusetts, and program cities experienced more marked reductions in the proportion of vehicles observed speeding than did comparison areas. The results also suggest that community programs can have an important independent effect in reducing alcohol-related fatal crashes as well.

Several issues need assessment in interpreting the study results. First, to assess the effects of community motivation, we compared the program cities not only with the rest of Massachusetts but

also with five other cities that had prepared comparably strong program applications. Although none of the comparison cities organized comprehensive community traffic safety programs, they undertook police enforcement and school-based programs concerning traffic safety and drunk driving. Also, during the program period, each comparison community secured federal grants from the Center for Substance Abuse Prevention to develop community coalitions to reduce alcohol and other drug use and related health problems.

While the decline in injuries per 100 crashes in Saving Lives cities during the program was not significantly greater than that in the comparison cities, the decline in fatal crashes was significantly greater in Saving Lives cities than in both the comparison cities and the rest of Massachusetts. This suggests that the program reduced fatal crashes independent of underlying community motivation.

Perhaps the fatal crash declines were more marked than the injury declines in program cities because two of the major foci of the program, alcohol-impaired driving and speeding, are more likely to be factors in fatal crashes than in injury crashes.^{43,44} For example, alcohol is a factor in nearly 50% of traffic fatalities but in only 20% of moderate to severe injuries and 10% of all traffic injuries.^{1,43}

Also, belt use, another major program focus, increased only 7% in program cities and 4% statewide. Part of the reason was that, at the study's end, Massachusetts was one of only five states without legislation requiring adults to wear seat belts.⁴⁵ Whether the Saving Lives Program approach would further increase belt use and reduce injuries in states with seat belt laws warrants exploration.

Second, some recent community interventions involving multiple communities^{16,17} have used each city as the unit of analysis. To assess the effects of this approach, we conducted a repeated measures analysis of variance on our key outcomes (i.e., fatal crashes and alcohol-related fatal crashes). This analysis examined each community and accounted for year, intervention status, and initiation of the Saving Lives Program. Results were similar to those obtained when the six program cities were examined as a group. In Saving Lives cities during the 5 program years relative to the previous 5 years, fatal crashes declined 20% more than in the rest of the state ($P = .07$) and 36% more than in comparison cities ($P = .002$).

Alcohol-related fatal crashes declined 24% more than in the rest of the state ($P < .001$) and 31% more than in comparison cities ($P = .05$).

Third, when the program started, a greater proportion of drivers were observed speeding and safety belt use was lower in program cities than in the rest of the state. While one might consider a regression to the mean effect as a reason, note that these behavioral differences were erased or reversed during the program period.

Another way to determine whether there is a regression to the mean effect is to extend analyses over a larger number of years. Relative to the previous 10 years, the program communities still experienced a 19% greater decline in annual fatal crashes during the 5 program years than the rest of Massachusetts ($P < .05$).

Fourth, we found little evidence that the program's effects resulted from increased police enforcement and resultant general deterrence. The proportions of drivers who believed that drunk drivers would be stopped by police increased only slightly in program cities. Citations for this offense actually declined both statewide and in program areas, perhaps because an economic recession prompted the Saving Lives cities and many other Massachusetts cities to reduce their full-time police forces.

The perceived likelihood of police apprehension is only one of many factors that can reduce driving after drinking and fatal crashes. Annual statewide telephone surveys conducted in Massachusetts from 1981 to 1993 indicate that the proportion of adults who believe that police are likely to stop drunk drivers has remained constant, while the proportion of respondents reporting driving after five or more drinks has been cut in half and fatal crashes involving alcohol have dropped by 47%.⁴⁶ Nationally, drunk driving arrests have declined 18% since 1983; during the same period, alcohol-related traffic deaths have declined 26%.^{47,48} The Saving Lives Program may have heightened or reminded drinkers of existing social disapproval of driving after drinking.

Finally, although interventions varied somewhat by community, all six program communities had greater declines in fatal crashes than comparison cities or the rest of the state. This suggests that the overall organization of the community program was more important than any specific initiative in contributing to the program's success.

Implications

On balance, the Saving Lives Program provided a community organizational structure that enabled private citizens and public officials from multiple city departments to develop their own innovative initiatives that markedly reduced drunk driving and speeding as well as related fatal crashes, particularly among young drivers. This type of intervention is financially within the means of most communities and can enhance existing traffic safety laws. □

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48. *Traffic Safety Facts 1993, a Compilation of Motor Vehicle Crash Data from the Fatal Accident Reporting System and the General Estimates System.* Washington, DC: US Dept of Transportation; 1994.
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Call for Abstracts for Injury Control Late-Breaker Session

The Injury Control and Emergency Health Services Section of the American Public Health Association will again feature a late-breaker session during the 1996 APHA annual meeting in New York, NY. The session will be held on Thursday, November 21, at 8:30 AM and will feature work completed within the last few months, after the deadline for consideration in the regular symposia of the APHA annual meeting.

Abstracts of 250 words or fewer will be accepted by the section until *September 10, 1996*. No special form is required.

Please mail or fax the abstract, title of paper, author's name, address, and telephone and fax numbers to Joe Sniezek, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Mail Stop F-41, 4770 Buford Hwy, NE, Chamblee, GA 30341-3724; tel (770) 488-4031; fax (770) 488-4338. All submitters will be notified of the decision by fax by October 11.