Traffic Injury Prevention, 3:266–274, 2002
1538-9588/02 $12.00 + .00
DOI: 10.1080/15389580290091929

Effectiveness of Sobriety Checkpoints for Reducing Alcohol-Involved Crashes

RANDY W. ELDER, RUTH A. SHULTS, and DAVID A. SLEET

Division of Unintentional Injury Prevention, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

JAMES L. NICHOLS

Formerly with Office of Research and Traffic Records, National Highway Traffic Safety Administration, Washington, DC, USA

STEPHANIE ZAZA

Division of Prevention Research and Analytic Methods, Epidemiology Program Office, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

ROBERT S. THOMPSON

Group Health Cooperative of Puget Sound, Seattle, Washington, USA

The goal of sobriety checkpoints is to deter drinking and driving by systematically stopping drivers for assessment of alcohol impairment, thus increasing the perceived risk of arrest for alcohol-impaired driving. This review examines the effectiveness of random breath testing (RBT) checkpoints, at which all drivers stopped are given breath tests for blood alcohol levels, and selective breath testing (SBT) checkpoints, at which police must have reason to suspect the driver has been drinking before demanding a breath test. A systematic review of the effectiveness of sobriety checkpoints in reducing alcohol-involved crashes and associated injuries and fatalities was conducted using the methodology developed for the Guide to Community Preventive Services (Community Guide). *Substantial reductions in crashes were observed for both checkpoint types across various outcome measures and time periods. Results suggest that both RBT and SBT checkpoints can play an important role in preventing alcohol-related crashes and associated injuries.*

Keywords Accident Prevention; Alcohol Drinking; Automobile Driving; Motor Vehicles; Review Literature; Traffic Accidents

Alcohol-impaired driving has long been recognized as a public health problem. Attempts to address this problem through law enforcement date back to New York's impaired driving law of 1910. Since their introduction in Scandinavia in the 1930s, sobriety checkpoints have gradually become a popular enforcement tool worldwide. At sobriety checkpoints, law enforcement officers systematically stop drivers to assess their degree of alcohol impairment using behavioral, physiological, or chemical tests.

Received 3 January 2002; accepted 7 March 2002.
Address correspondence to Randy W. Elder, Division of Unintentional Injury Prevention, Centers for Disease Control and Prevention, 4770 Buford Highway, Mailstop K-63, Atlanta, GA 30341, USA. E-mail: rfe3@cdc.gov

Procedures for conducting sobriety checkpoints vary in different countries. At random breath testing (RBT) checkpoints, which are used in Australia and several European countries, all drivers stopped are given breath tests for blood alcohol levels. Issues regarding the violation of constitutional protections against unreasonable search and seizure prevent the use of RBT checkpoints in the United States (NHTSA, 1990), where selective breath testing (SBT) checkpoints are used. At SBT checkpoints, police must have reason to suspect the driver has been drinking before they can demand that a driver take a breath test.

Although sobriety checkpoints remove some drinking drivers from the road, their primary goal is to deter driving after drinking by increasing the perceived risk of arrest. This perceived risk can be influenced by many factors in addition to the objective probability of arrest (Ross, 1992). High levels of paid and unpaid publicity increase the salience of checkpoint campaigns. Contact with checkpoints, either by being stopped or passing by, further reinforces perceptions of increased enforcement activity. Finally, checkpoints counter drinking drivers' beliefs that they can drive well enough to avoid attracting attention, as they can be pulled over regardless of their behavior (Ross, 1992).

Some drinking drivers believe that, even if they are stopped at an SBT checkpoint, they can avoid detection (Voas et al., 1985). There appears to be some basis for this belief, as a recent study found that 62% of drivers leaving a U.S. checkpoint with blood alcohol concentrations (BACs) above 0.08 g/dL passed through undetected (Wells et al., 1997). Given this problem, RBT checkpoints might be expected to be more effective than SBT checkpoints at increasing the perceived risks of drinking and driving, and thus be more effective deterrents (Homel, 1990).

Sobriety checkpoint programs vary in length and intensity. Many locales conduct checkpoint "blitzes" only during holiday periods, with the expectation of short-term effects. Others have incorporated checkpoints into their general law enforcement operations, and some have conducted regular checkpoint operations for decades. There has been some controversy over the sustainability of the impact of sobriety checkpoints on drinking and driving and alcohol-related crashes, however (Ross, 1984).

Previous reviews (Peek-Asa, 1999; Ross, 1992) have indicated that sobriety checkpoints appear to reduce injuries due to alcohol-related crashes. These reviews did not provide quantitative summaries of study results and evaluated a smaller evidence base than the present review. In this review, we examine the long-term effects of sobriety checkpoints and the relative effectiveness of RBT and SBT checkpoints in addition to estimating the effectiveness of sobriety checkpoints in general.

METHODS

This systematic review of studies of sobriety checkpoints was conducted for the *Guide to Community Preventive Services (Community Guide)*. Detailed methods have been described elsewhere (Briss et al., 2000; Shults et al., 2001; Zaza et al., 2001).

A comprehensive search was conducted for peer-reviewed journal articles, technical reports, and Association for the Advancement of Automobile Medicine proceedings to screen for inclusion in the review. To be included, a study had to: (a) be primary research published in English before June 30, 2000; (b) provide objective data on one or more outcomes related to alcohol-impaired driving (e.g., single-vehicle nighttime crashes); and (c) meet minimum research quality criteria (Briss et al., 2000). When multiple articles used similar methods to evaluate a specific intervention, only the article with the longest postintervention follow-up time was included in the review.

Calculating Summary Effect Measures

The literature reviewed uses a wide variety of crash-related measures to assess the effects of checkpoint programs. For the purpose of summarizing the data, we stratified crash outcome variables according to injury severity. We calculated separate summary effects for fatal crashes, fatal and nonfatal injury crashes, and property damage crashes (e.g., police-reported "had-been-drinking" crashes). Most of the included studies use proxy variables for alcohol-related crashes (e.g., single-vehicle nighttime fatal crashes). This produces effect measures that are biased toward the null. The degree of bias is more pronounced for proxies with weaker association with alcohol involvement.

When available, we selected effect measures that compared alcohol-related crash outcomes to non-alcohol-related outcomes (e.g., comparing single-vehicle nighttime crashes to multivehicle daytime crashes). These effect measures help control for both the long-term downward trend in total crashes and other factors that influence the total number of crashes, such as safety characteristics of vehicles and highways, weather, economic conditions, and vehicle miles traveled (Hingson et al., 1996). To further address potential confounding, when possible we also selected effect measures that incorporated a concurrent comparison group such as drivers in communities without checkpoints. For studies incorporating comparison groups, results are reported in the form of the net change, reflecting the difference between the percent change for the intervention group and the comparison group. For studies using interrupted time series or other regression-based designs, results are reported in terms of the percent change estimated from the model. In addition to reporting results from individual studies, we calculated medians and interquartile ranges to summarize outcomes for the three levels of injury severity. For each study, we also calculated the mean effect across levels of injury severity to evaluate whether the intervention's effect varied by the type of checkpoint (RBT vs. SBT) or by follow-up time.

RESULTS

The literature search identified 17 studies of the effectiveness of RBT checkpoints that evaluated outcomes of interest (four of these studies were reported in one article, Henstridge et al., 1997 [1–4]) (Armour et al., 1985; Armstrong & Howell, 1988; Arthurson, 1985; Cameron et al., 1992, 1997; Dunbar et al., 1987; Hardes et al., 1985; Hendrie et al., 1998; Henstridge et al., 1997; Homel et al., 1988; McCaul & McLean, 1990; McLean et al., 1984; Paciullo, 1983; Ross et al., 1981). Of these, five failed to meet quality criteria and were excluded from the review (Armstrong & Howell, 1988; Dunbar et al., 1987; Hendrie et al., 1998; Henstridge et al., 1997 [4]; Paciullo, 1983). Two additional articles provided information regarding an already included study (Homel, 1983, 1994). Details of the included studies are presented in Table I and Figure 1. For RBT checkpoints, median decreases were 22% (interquartile range (IQR): −35%, −14%) for fatal crashes and 16% (IQR: −20%,

Table I Studies evaluating the effectiveness of RBT checkpoints for decreasing crashes

Author, year (study period), study design, intervention setting, follow-up period	Intervention/comparison details	Results/other information	Summary outcome(s)
Ross et al., 1981 (1/1973–10/1980, monthly) Interrupted time series France 27 months	Change in laws authorizing RBT as well as license sanctions; .08 BAC limit; 335,449 stops from inception to 1/31/1979; extensive unpaid publicity Comparison to preintervention time series	Crash-related deaths decreased 14% from series mean of 1,111 ($p < .05$) Crash-related injuries decreased 12.5% from series mean of 29,468 ($p < .05$) Time series models suggest these effects are temporary, returning to baseline after about 1 year Low detection rate relative to expectations from BAC surveys suggests lax implementation of RBT	Fatal crashes: −14% Injury crashes: −12%
McLean et al., 1984 (1/1979–12/1982) Before/after with concurrent comparison South Australia 13 months	RBT implemented 10/15/1981; limited information provided on levels of enforcement and publicity Comparison of late night crashes to those during the remainder of the day	Late night serious injury crashes showed: Net decrease of 6% in metropolitan Adelaide ($n = 817$) Net increase of 6% in rural South Australia ($n = 566$) Net decrease of 1% statewide ($n = 1{,}383$) Roadside survey results and observation of drivers approaching checkpoints suggest that many drinking drivers successfully avoided checkpoints	Injury crashes: −1%
Hardes et al., 1985 (1977–1983, yearly) Time series Hunter Health Region, New South Wales 12 months	RBT implemented 121/17/1982 Hospital admissions following intervention compared to prior trend	Crash-related admissions decreased 19% from extrapolation of trend from 1977 (1,373 observed vs. 1,697 expected); p-values not provided; $N > 1{,}000$/year Decline in admissions was 31% for males, 8% for females	Injury crashes: −19%
Armour et al., 1985 (10/24–12/31, 1981–1983) Before/after with concurrent comparison Melbourne, Australia 2 months	RBT blitz campaign; enforcement increased by ~140 man-hours/week and backed by A$166,000 mass media campaign Comparison to similar period in previous two years adjusted for daytime crashes	Nighttime injury crashes decreased 18% from mean of 262.5 (net change = −18%, $\chi^2 = 3.97$, $p < .01$) Weekend nighttime injury crashes decreased 25% from mean of 162 (net change = −24%, $\chi^2 = 5.21$, $p < .01$) Authors present suggestive evidence that afternoon/early evening operations are as effective as those conducted late at night	Injury crashes: −18%
Arthurson, 1985 (1/1981–12/1984) Before/after with concurrent comparison New South Wales 24 months	RBT implemented 12/1982; 1 in 3 drivers tested yearly; >A$1 million/year publicity campaign Comparison to other mainland Australian states	Fatal crashes decreased 21% following RBT (net change = −13%) Net change significant at $p < .05$ for 3 of 4 comparisons to individual states Number of observations not specified	Fatal crashes: −13%
Homel et al., 1988 (1977–1987, weekly) Interrupted time series New South Wales 60 months	RBT implemented 121/17/1982; 1 in 3 licensed drivers tested; extensive publicity campaign Comparison to preintervention time series	Drivers killed with BAC >.05 decreased 36% from weekly mean of 4.36 ($p < .05$) "Classic" alcohol-related crashes decreased 35% from weekly mean of 13.43 ($p < .05$) Total fatal crashes decreased 22% from weekly mean of 22.12 ($p < .05$) Public support for RBT increased from 64% in 1982 to 97% in 1987 86% of drinkers endorsed "higher" chances of being arrested following implementation of RBT	Fatal crashes: −36% Injury crashes: −35%
McCaul & McLean, 1990 (7-week periods before/after Easter, 1987, 1983)	RBT blitz campaign implemented immediately after Easter, 1987; 96% increase in stops accompanied by an extensive media campaign	Proportion of drivers with BACs above: .00 g/dL decreased 20.3% (95% CI: −27.4, −13.1) from baseline of .25 (net change = −13.4%) .08 g/dL decreased 34.4% (95% CI: −50.0, −18.8) from baseline of .05 (net change = −24.3%)	NA

(Continued on next page)

Table I Studies evaluating the effectiveness of RBT checkpoints for decreasing crashes *(Continued)*

Author, year (study period), study design, intervention setting, follow-up period	Intervention/comparison details	Results/other information	Summary outcome(s)
Before/after with comparison Adelaide, South Australia 2 months	Comparison to immediately preceding period and similar period in 1983	Authors speculate that publicity regarding enforcement was primarily responsible for the observed effect	
Cameron et al., 1992 (1/1983–12/1991, monthly)	Transition to bus-based RBT operations beginning late 1989 and continuing through November 1990; >100% increase in drivers tested (∼70,000 tests/month); multimillion-dollar publicity campaign promoted transition	Injury crashes during "high alcohol times": Decreased 30% in 1990 (net change = −18%; 90% CI: −24.1, −10.9) Decreased 41.3% in 1991 (net change = −24%; 90% CI: −35.5, −11.2)	Injury crashes: −21%
Interrupted time series with concurrent comparison Victoria, Australia 24 months	Comparison to New South Wales	Similar results obtained for separate analyses of metropolitan and rural areas	
Henstridge et al., 1997 (1) (1980–1992, daily)	RBT implemented 12/1988; evaluated in a log-linear model with numerous covariates	RBT associated with: 35% reduction in fatal crashes 19% reduction in serious injury crashes	Fatal crashes: −35%
Interrupted time series Queensland 49 months	Comparison to preintervention time series	Authors modeled the impact of a .05 BAC law and SBT checkpoints implemented prior to RBT checkpoints as well as seasonal factors, road usage, weather, and economic factors	Injury crashes: −19%
Henstridge et al., 1997 (2) (1980–1992, daily)	RBT implemented 10/1988; evaluated in a log-linear model with numerous covariates	RBT associated with: 28% reduction in fatal crashes 13% reduction in serious injury crashes 26% reduction in single-vehicle nighttime crashes	Fatal crashes: −28%
Interrupted time series Western Australia 51 months	Comparison to preintervention time series	Authors modeled the impact of SBT checkpoints implemented prior to RBT checkpoints as well as seasonal factors, road usage, weather, and economic factors	Injury crashes: −13% Property damage crashes: −26%
Henstridge et al., 1997 (3) (1976–1992, daily)	RBT implemented 12/17/1982; evaluated in a log-linear model with numerous covariates	RBT associated with a median: 15% reduction in fatal crashes 7% reduction in serious injury crashes 15% reduction in single-vehicle nighttime crashes	Fatal crashes: −15%
Interrupted time series New South Wales 120 months	Comparison to preintervention time series	Authors modeled the impact of a .05 BAC law implemented prior to RBT as well as seasonal factors, road usage, weather, and economic factors	Injury crashes: −7% Property damage crashes: −15%
Cameron et al., 1997 (11/1993–12/1994)	Increased RBT enforcement beginning 11/1993; 74% increase in stops	Injury crashes during "high alcohol times" decreased 9% (95% CI: −17.71, −0.42; net change = −15%)	Injury crashes: −15%
Interrupted time series with concurrent comparison Rural Victoria 14 months	Comparison to rural New South Wales	Comparison of regions of RBT activity vs. inactivity also indicated significant intervention effect	

Abbreviations: RBT, random breath testing; BAC, blood alcohol concentration; NA, not available; SBT, selective breath testing.

−11%) for fatal and nonfatal injury crashes. The two RBT checkpoint studies evaluating property damage crashes estimated decreases of 15% and 26%.

A single study assessed the effect of RBT checkpoints on the observed incidence of drinking and driving. This study found that, during an RBT checkpoint program, the proportion of drivers with any detectable BAC level decreased 13% and the proportion of drivers who were above the legal limit of 0.08 g/dL decreased 24% from prior levels (McCaul & McLean, 1990).

Four studies evaluating the implementation of RBT checkpoints in New South Wales, Australia, were included in this review (Arthurson, 1985; Hardes et al., 1985; Henstridge et al., 1997; Homel et al., 1988). These studies all evaluated a single intervention and cannot be viewed as independent. However, none were excluded from the review because each used unique outcome measures, comparison groups, or analytic methods. A secondary analysis reveals that aggregating the results of these nonindependent studies into a single data point left both the median and interquartile range for RBT checkpoints unchanged (median = −18%, IQR: −22%, −13%).

Our search identified 15 studies of the effectiveness of SBT checkpoints (Castle et al., 1995; Jones et al., 1995; Lacey & Jones, 1991; Lacey et al., 1986, 1988, 1999; Levy et al., 1989, 1990; Mercer, 1985; Mercer et al., 1996; Stuster & Blowers, 1995; Vingilis & Salutin, 1980; Voas et al., 1985, 1997; Wells et al., 1992). Of these, four failed to meet quality criteria and

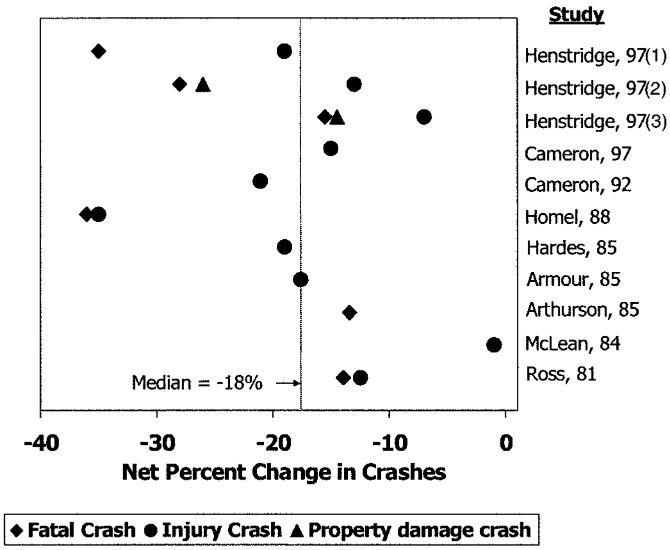

Figure 1 Percent change in crashes likely to involve alcohol after implementing random breath testing checkpoint programs.

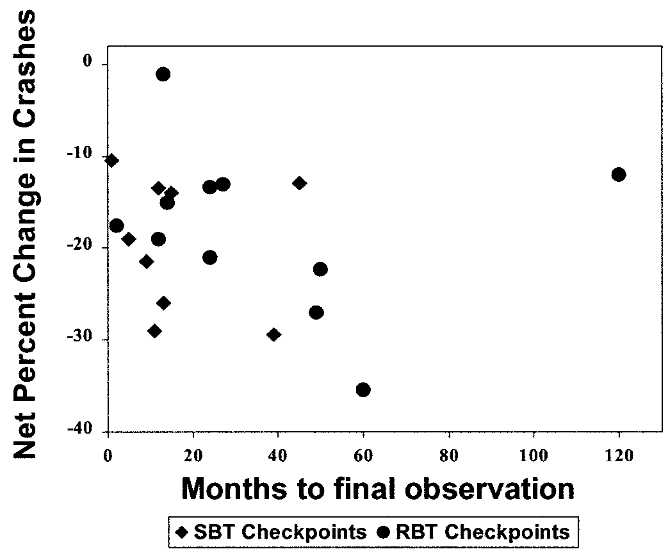

Figure 3 Percent change in crashes likely to involve alcohol by follow-up time. SBT, selective breath testing; RBT, random breath testing.

were excluded from the review (Lacey & Jones, 1991; Lacey et al., 1988; Levy et al., 1989; Vingilis & Salutin, 1980). Two additional articles provided more information regarding an already included study (Levy, 1988; Vingilis et al., 1979), and one presented data in a form that could not be converted to our summary effect measure (Voas et al., 1997). Details of the included studies are presented in Table II and Figure 2. SBT checkpoints were associated with decreases in fatal crashes of 20% and 26% in the two studies reporting this outcome. Median decreases were 20% (IQR: −23%, −9%) for fatal and nonfatal injury crashes and 24% (IQR: −32%, −14%) for property damage crashes.

Aggregating across all crash types, median decreases were 18% (IQR: −22%, −13%) for RBT checkpoints and 20% (IQR: −27%, −13%) for SBT checkpoints. Length of time from initiation of the checkpoint program to the end of follow-up ranged from 1 to 120 months (median = 14 months; IQR: 10 months, 42 months), and was not related to the extent to which crashes decreased ($r = -.14$, $p > .05$). The distribution of aggregated study outcomes by follow-up time is presented in Figure 3.

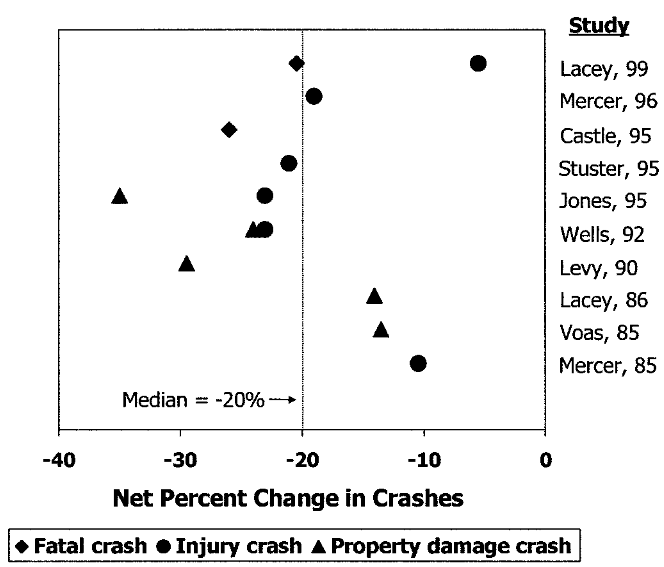

Figure 2 Percent change in crashes likely to involve alcohol after implementing selective breath testing checkpoint programs.

DISCUSSION

These results provide strong evidence that both RBT and SBT sobriety checkpoints are effective in reducing alcohol-related crashes and associated fatal and nonfatal injuries. The greater sensitivity of RBT checkpoints in detecting drinking drivers might lead one to expect a stronger deterrent effect leading to improved effectiveness in reducing alcohol-related crashes relative to SBT checkpoints (Homel et al., 1988). The results of this review did not provide evidence of such differential effectiveness. None of the studies reviewed directly compared RBT and SBT checkpoints, however, so these results should be interpreted cautiously.

Despite differences across studies in design, period of observation, and outcome measures evaluated, the results were generally consistent in direction and size. The consistency of the results obtained was further supported by stratified analyses, in which similar beneficial effects were obtained for crashes of varying levels of severity and for both short-term and long-term checkpoint programs.

Some authors have suggested that there may be thresholds for enforcement and publicity below which sobriety checkpoints are relatively ineffective at deterring drinking and driving (Homel, 1990; Ross, 1992). This review cannot adequately address this hypothesis because the included studies primarily evaluated checkpoint programs that were well funded and implemented

Table II Studies evaluating the effectiveness of SBT checkpoints for decreasing crashes

Author, year (study period), study design, intervention setting, follow-up period	Intervention/comparison details	Results/other information	Summary outcome(s)
Voas et al., 1985 (1981–1984, monthly) Interrupted time series with concurrent comparison Charlottesville, VA 12 months	Sobriety checkpoints operated from 12/30/1983 to 12/31/1984; 94 total operations with 23,615 stops in an area with ∼116,000 inhabitants; passive alcohol sensors used intermittently starting 9/1984 Comparison to daytime and non-alcohol-involved crashes	Had-been-drinking crashes decreased by 15% ($p <$ .05) from monthly mean of 16.1 (net change = −14%, $p < .01$) Nighttime crashes decreased by 8% ($p > .05$) from monthly mean of 30.5 (net change = −13%, $p >$ .05) Use of passive alcohol sensors increased arrest rate from 1.05% to 3.21%	Property damage crashes: −13%
Mercer, 1985 (1/1980–6/1984) Interrupted time series British Columbia, Canada 1 month	Sobriety checkpoints implemented 4/20–5/21/1984; ∼60,000 vehicles stopped; limited media coverage Comparison to preintervention time series	Observed alcohol-related injury crashes in May 10% below expected value ($N = 251$, $p > .05$) Follow-up period extended 10 days beyond intervention Author conducted evaluation of media impact on crashes, suggesting that a newspaper strike contributed to the nonsignificant results reported	Injury crashes: −10%
Lacey et al., 1986 (1/1980–12/1984, monthly) Interrupted time series with concurrent comparison Clearwater/Largo, FL 15 months	Sobriety checkpoint program implemented 10/1983–10/1984 with increased police training and procedural changes; 12 operations in project period; $75,000 media campaign Comparison to nointervention sites	Change in proportion of crashes in intervention cities relative to combined intervention and comparison cities (Int/Int + Comp): Nighttime crashes decreased by 8% ($N = 8{,}298$, $p < .0001$) Had-been-drinking crashes decreased by 20% ($N = 3{,}844$, $p < .0005$) Similar results obtained by contingency table analysis on pre- and post-data	Property damage crashes: −14%
Levy et al., 1990 (2/1983–7/1986, monthly) Interrupted time series Bergen County, NJ 39 months	Sobriety checkpoint program implemented 5/1983 with ∼40,000 stops/year; impact of 2 publicity campaigns also estimated Comparison to preintervention time series	Overall reduction of 29% in single-vehicle nighttime crashes attributed to checkpoint activity ($p < .05$) Significant reduction in single-vehicle nighttime fatal crashes (no effect size given, $p < .05$) Model has serious problems of colinearity between checkpoints and publicity campaigns	Property damage crashes: −29%
Wells et al., 1992 (11/1986–8/1990) Before/after with comparison Binghamton, NY NA (multiple waves)	Sobriety checkpoints with use of passive alcohol sensors; 6 waves totaling 72 checkpoints over 2 years; supported by multimedia publicity campaign Comparison to periods between checkpoints	Injury crashes decreased 16% from 298, $p < .05$ (net change = −23%) Late-night crashes decreased 21% from 315, $p < .01$ (net change = −24%) Total crashes decreased 6% from 2,802, $p < .05$ (net change = −1%) Checkpoint/no checkpoint period comparison suggests that effects dissipate rapidly in the absence of checkpoint activity	Injury crashes: −23% Property damage crashes: −24%
Castle et al., 1995 (1/1983–12/1994) Time series with concurrent comparison New Mexico 13 months	Sobriety checkpoints initiated statewide in 12/1993 with target of 50% of 15 to 34 year-old drivers passing through per year; a comprehensive set of other DUI reforms also implemented in 1993 Comparison to all fatal crashes	For months during which checkpoints were active, alcohol-involved fatal crashes decreased 21% from a baseline of 18/month; relative to all fatal crashes the net change was −26% ($t = 2.03$, $p < .05$) Perceptions that drunk drivers were at greater risk of being stopped "in the past year" increased by 1 percentage point among men and 22 percentage points among women	Fatal crashes: −26%

(Continued on next page)

Table II Studies evaluating the effectiveness of SBT checkpoints for decreasing crashes

Author, year (study period), study design, intervention setting, follow-up period	Intervention/comparison details	Results/other information	Summary outcome(s)
Stuster and Blower, 1995 (1987–1993, monthly) Interrupted time series with concurrent comparison	Sobriety checkpoints evaluated in 4 cities; 18 operations per city in 9-month period; staffing level and mobility varied; all intervention communities implemented publicity campaigns	Changes in injury crashes involving alcohol: Modesto, decline of 9.3% from baseline of 11.70 per month ($p = .008$; net change = −21.5%) Ventura, decline of 39.7% from baseline of 6.66 per month ($p = .014$; net change = −31.6%) Visalia, decline of 14.7% from baseline of 6.28 per month ($p = .018$; net change = −17.5%) Across these three cities, median net change = −21.5%	Injury crashes: −21%
Four California cities 9 months	Comparison to no-intervention site and to crashes not involving alcohol	In Santa Rosa, the proportion of injury crashes that were alcohol involved decreased 19%, but insufficient data were available for time series analysis Well-publicized roving patrols in a fifth city produced similar effects to checkpoints (net change = −13.4%)	
Jones et al., 1995 (1/1988–7/1992, monthly)	Sobriety checkpoints and saturation patrols with multimedia publicity within a program targeting speeding, safety belt use, and DUI implemented 9/1991; degree of change in checkpoint activity not reported	Nighttime single-vehicle injury crashes decreased 23% (from 30/month, $p < .05$)	Injury crashes: −23%
Interrupted time series Wichita, KS 11 months	Comparison to preintervention time series	Nighttime single-vehicle crashes decreased 35% (from 69/month, $p < .05$) 48% of adults surveyed ($n = 635$) reported a perceived increase in DUI enforcement postintervention vs. 44% preintervention ($p = .18$)	Property damage crashes: −35%
Mercer et al., 1996 (7/6/1995–12/7/1995)	Sobriety checkpoints operated 7/6 to 12/7/1995; 21% of the driving population tested per month	Proportion of insurance claims for single-vehicle injury crashes involving male drivers age 21 to 40 years decreased by 10% (net change = −19%)	Injury crashes: −19%
British Columbia (urban areas) 5 months	Comparison to areas surrounding the enforcement jurisdictions	Percentage of drivers surveyed with BACs >.08 decreased from 3.2% to 1.1% ($p < .01$)	
Voas et al., 1997 (7/1991–12/1995, quarterly)	Sobriety checkpoints initiated as part of a comprehensive community alcohol-related trauma project. Intensity and timing of checkpoints varied by community. Media advocacy training was provided to increase free publicity, but minimal advertising was purchased	Checkpoints were associated with an overall reduction in single-vehicle nighttime crashes across the 3 communities ($p < .05$)	NA
Time series with concurrent comparison Three communities in NC, SC, and CA 24 months	Comparison to matched communities	Each 10% increase in checkpoint intensity was estimated to result in a .71% decrease in single-vehicle nighttime crashes Results are confounded due to overlap in media markets across intervention and comparison communities and checkpoint activities in comparison communities. A zero tolerance law for young drivers was implemented in CA during the intervention period	
Lacey et al., 1999 (1/1988–12/1996, monthly)	Sobriety checkpoint campaign conducted 4/1994–3/1995; 882 checkpoints with 144,299 drivers stopped; intensive multimedia publicity campaign	Alcohol-related fatal crashes (BAC > .10) decreased by 20% (9 crashes/month, $p < .05$)	Fatal crashes: −20%
Interrupted time series with concurrent comparison Tennessee 45 months	Comparison to adjacent states	Nighttime single-vehicle injury crashes decreased 5% ($p < .05$) Self-reported drinking/driving decreased over program period from 8.6% to 6.0% of survey sample Survey data indicate >90% public support for checkpoints	Injury crashes: −5%

Abbreviations: SBI, selective breath testing; DUI, driving under the influence; BAC, blood alcohol concentration; NA, not available.

on a large scale. Smaller-scale programs appear to be underrepresented due to two factors. First, the commitment of resources to the evaluation and subsequent publication of results may be more likely for larger programs than smaller ones. Second, studies of smaller-scale programs had a greater tendency to be excluded from our review due to quality limitations.

The checkpoint programs included in this review were implemented in a variety of settings. The checkpoints were operated at the city (Armour et al., 1985; Jones et al., 1995; Lacey et al., 1986; McCaul & McLean, 1990; Stuster & Blowers, 1995; Voas et al., 1985; Wells et al., 1992), county (Levy et al., 1989), state (Arthurson, 1985; Cameron et al., 1992; Castle et al., 1995; Hardes et al., 1985; Henstridge et al., 1997; Homel et al., 1988; Lacey et al., 1999; McLean et al., 1984; Mercer, 1985; Mercer et al., 1996), and national level (Ross et al., 1981) and their outcomes were evaluated in rural areas (Cameron et al., 1997; McLean et al., 1984), urban areas (Armour et al., 1985; Jones et al., 1995; Lacey et al., 1986; McCaul & McLean, 1990; McLean et al., 1984; Stuster & Blowers, 1995; Voas et al., 1985; Wells et al., 1992), and mixed rural and urban areas (Arthurson, 1985; Cameron et al., 1992; Castle et al., 1995; Hardes et al., 1985; Henstridge et al., 1997; Homel et al., 1988; Lacey et al., 1999; Mercer, 1985; Mercer et al., 1996).

Despite their widespread applicability, several factors limit the use of sobriety checkpoints in certain locales. Checkpoints entail some inconvenience and intrusion on driver privacy. According to the U.S. Supreme Court in *Michigan Department of State Police v. Sitz* (496 U.S. 444, 1990), the negative effect of the brief intrusion of a properly conducted sobriety checkpoint is justified in the interest of reducing alcohol-impaired driving. Some civil libertarian groups also have supported sobriety checkpoints in the interest of the greater public good (Homel et al., 1988). Nonetheless, some states prohibit sobriety checkpoints based on their supreme courts' interpretations of state constitutions (Fell et al., 2001). Some others prohibit sobriety checkpoints by statute.

Financial issues may also pose barriers to the implementation of sobriety checkpoints. Checkpoints result in substantial savings relative to costs on a societal basis (Mercer et al., 1996; Shults et al., 2001). However, these savings generally accrue to different sectors of society than those that expend resources to initiate and maintain the checkpoint programs. Strong public support for drinking and driving enforcement can help to ensure that law enforcement agencies have adequate funds to devote to checkpoint programs. Such support tends to increase to high levels following the introduction of checkpoint programs (Homel et al., 1988; Lacey et al., 1999).

Police frustration over the low arrest rate associated with sobriety checkpoints also can be an important barrier (Lacey & Jones, 1991). Informing police officers about the general deterrence benefit of their efforts and providing them with regular feedback linking these efforts to crash prevention may decrease this frustration (Castle et al., 1995; Hendrie et al., 1998). In addition to the benefits of preventing crashes, sobriety checkpoints often result in the arrest of drivers for other offenses such as driving with a suspended license or while carrying weapons (Lacey et al., 1999; Mercer et al., 1996; Stuster & Blowers, 1995; Voas et al., 1985).

The results of this review are broadly consistent with previous reviews of the sobriety checkpoint literature (Peek-Asa, 1999; Ross, 1992). In addition to corroborating these results using a more extensive evidence base, the present review provides evidence that sobriety checkpoints maintain their effectiveness over time. Some authors have suggested that aggressive enforcement using sobriety checkpoints could eventually result in permanent changes in social norms regarding the acceptability of drinking and driving (Homel, 1990; Ross, 1992). The degree to which changes in social norms have contributed to the long-term maintenance of the beneficial effects of sobriety checkpoints is unclear.

Several questions remain regarding potential methods for improving the effectiveness and efficiency of sobriety checkpoints. For instance, although passive alcohol sensors have been shown to improve the detection of alcohol-impaired drivers at checkpoints (Lund & Jones, 1987; Voas et al., 1985), any resulting improvement in the deterrent effects of checkpoints has yet to be evaluated. Further research into the optimal configurations of checkpoints (e.g., number of officers, timing) and the optimal overall level of enforcement and publicity to sustain their deterrent effects is also needed.

REFERENCES

Armour, M., Monk, K., South, D., Chomiak, G. (1985) "Evaluation of the 1983 Melbourne Random Breath Testing Campaign: Interim Report, Casualty Accident Analysis," Report N8-85 for Victoria Road Traffic Authority, Melbourne, Australia.

Armstrong, B. K., Howell, C. M. (1988) Trends in Injury and Death in Motor Vehicle Accidents in Australia in Relation to the Introduction of Random Breath Testing, *Aust. Drug Alcohol Rev.*, Vol. 7, pp. 251–259.

Arthurson, R. M. (1985) "Evaluation of Random Breath Testing," Report RN 10/85 for Traffic Authority of New South Wales, Sydney, Australia.

Briss, P. A., Zaza, S., Pappaioanou, M., Fielding, J., Wright-De Agüero, L., Truman, B. I., Hopkins, D. P., Mullen, P. D., Thompson, R. S., Woolf, S. H., Carande-Kulis, V. G., Anderson, L., Hinman, A. R., McQueen, D. V., Teutsch, S. M., Harris, J. R., and The Task Force on Community Preventive Services. (2000) Developing an Evidence-Based *Guide to Community Preventive Services*—Methods, *Am. J. Prev. Med.*, Vol. 18(1S), pp. 35–43.

Cameron, M., Diamantopolou, K., Mullan, N., Dyte, D., Gantzer, S. (1997) "Evaluation of the Country Random Breath Testing and Publicity Program in Victoria, 1993–1994," Report 126 for Monash University Accident Research Centre, Melbourne, Australia.

Cameron, M. H., Cavallo, A., Sullivan, G. (1992) "Evaluation of the Random Breath Testing Initiative in Victoria, 1989–1991: Multivariate Time Series Approach," Report 38 for Monash University Accident Research Centre, Melbourne, Australia.

Castle, S. P., Thompson, J. D., Spataro, J. A., Sewell, C.M., Flint, S., Scirmer, J., Justice, M., Lacey, J. (1995) Early Evaluation of a Statewide Sobriety Checkpoint Program, *Proc. 39th Annual AAAM*, pp. 65–78.

Dunbar, J. A., Penttila, A., Pikkarainen, J. (1987) Drinking and Driving: Success of Random Breath Testing in Finland, *BMJ*, Vol. 295, pp. 101–103.

Fell, J. C., Ferguson, S. A., Williams, A. F., Fields, M. (2001) Why Aren't Sobriety Checkpoints Widely Adopted as an Enforcement Strategy in the United States? *Proc. 45th Annual AAAM*, pp. 425–428.

Hardes, G., Gibberd, R. W., Lam, P., Callcott, R., Dobson, A. J., Leeder, S. R. (1985) Effects of Random Breath Testing on Hospital Admissions of Traffic-Accident Casualties in the Hunter Health Region, *Med. J. Aust.*, Vol. 142, pp. 625–626.

Hendrie, D., Cooper, L., Ryan, G., Kirov, C. (1998) "Review of the Random Breath Testing Program in Western Australia in 1996/1997," Report RR67 for Road Accident Prevention Research Unit, Department of Public Health, the University of Western Australia, Nedlands, Western Australia.

Henstridge, J., Homel, R., Mackay, P. (1997) "The Long-Term Effects of Random Breath Testing in Four Australian States: A Time Series Analysis," Report CR 162 for Federal Office of Road Safety, Canberra, Australia.

Hingson, R., Heeren, T., Winter, M. (1996) Lowering State Legal Blood Alcohol Limits to 0.08%: The Effect on Fatal Motor Vehicle Crashes, *Am. J. Public Health*, Vol. 86, pp. 1297–1299.

Homel, R. (1983) The Impact of Random Breath Testing in New South Wales, December 1982 to February 1983, *Med. J. Aust.*, Vol. 1, pp. 616–619.

Homel, R. (1990) Random Breath Testing and Random Stopping Programs in Australia, in *Drinking and Driving: Advances in Research and Prevention*, Eds. R. J. Wilson, R. E. Mann, Guilford Press, New York, pp. 159–202.

Homel, R. (1994) Drink-Driving Law Enforcement and the Legal Blood Alcohol Limit in New South Wales, *Accid. Anal. Prev.*, Vol. 26, pp. 147–155.

Homel, R., Carseldine, D., Kearns, I. (1988) Drink-Driving Countermeasures in Australia, *Alcohol, Drugs Driving*, Vol. 4, pp. 113–144.

Jones, R., Joksch, H., Lacey, J., Wiliszowski, C., Marchetti, L. (1995) "Site Report: Wichita, Kansas Field Test of Combined Speed, Alcohol, and Safety Belt Enforcement Strategies," Report DOT HS 808 244 for National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, DC.

Lacey, J. H., Jones, R. K. (1991) "Assessment of Changes in DWI Enforcement/Level: Final Report," Report DOT HS 807 690 for National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, DC.

Lacey, J. H., Jones, R. K., Smith, R. G. (1999) "Evaluation of Checkpoint Tennessee: Tennessee's Statewide Sobriety Checkpoint Program," Report DOT HS 808 841 for National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, DC.

Lacey, J. H., Marchetti, L. M., Stewart, J. R., Popkin, C. L., Murphy, P. V., Lucke, R. K., Rushmann, P. A. (1988) "Enforcement and Public Information Strategies for DWI General Deterrence: The Indianapolis, Indiana Experience," Report DOT HS 807 434 for National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, DC.

Lacey, J. H., Stewart, J. R., Marchetti, L. M., Popkin, C. K., Murphy, P. V. (1986) "Enforcement and Public Information Strategies for DWI (Driving-While-Intoxicated) General Deterrence: ARREST DRUNK DRIVING—the Clearwater and Largo, Florida Experience," Report for University of North Carolina Highway Safety Research Center, Chapel Hill, NC.

Levy, D. (1988) Methodologies for the Evaluation of Local Traffic Safety Programs: With An Application to New Jersey DWI Programs, *Eval. Program Plann.*, Vol. 11, pp. 255—266.

Levy, D., Shea, D., Asch, P. (1989) Traffic Safety Effects of Sobriety Checkpoints and Other Local DWI Programs in New Jersey, *Am. J. Public Health*, Vol. 79, pp. 291–293.

Levy, D. T., Asch, P., Shea, D. (1990) An Assessment of County Programs to Reduce Driving while Intoxicated, *Health Educ. Res.*, Vol. 5, pp. 247–256.

Lund, A. K., Jones, I. S. (1987) Detection of Impaired Drivers With a Passive Alcohol Sensor, *Proc. 10th Int. Conf. on Alcohol, Drugs and Traffic Safety*, pp. 379–382.

McCaul, K. A., McLean, A. J. (1990) Publicity, Police Resources and the Effectiveness of Random Breath Testing, *Med. J. Aust.*, Vol. 152, pp. 284–286.

McLean, A. J., Clark, M. S., Dorsch, M. M., Holubowycz, O. T., McCaul, K. A. (1984) "Random Breath Testing in South Australia: Effects on Drink-Driving," Report HS 038 357 for NHMRC Road Accident Research Unit, University of Adelaide, Adelaide, South Australia.

Mercer, G. W. (1985) The Relationships Among Driving while Impaired Charges, Police Drinking-Driving Roadcheck Activity, Media Coverage and Alcohol-Related Casualty Traffic Accidents, *Accid. Anal. Prev.*, Vol. 17, pp. 467–474.

Mercer, G. W., Cooper, P. J., Kristiansen, L. A. (1996) A Cost/Benefit Analysis of a 5-Month Intensive Alcohol-Impaired Driving Road Check Campaign, *Proc. 40th Annual AAAM*, pp. 283–292.

National Highway Traffic Safety Administration (NHTSA). (1990) "The Use of Sobriety Checkpoints for Impaired Driving Enforcement," Report DOT HS 807 656 for National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, DC.

Paciullo, G. (1983) Random Breath Testing in New South Wales, *Med. J. Aust.*, Vol. 1, pp. 620–621.

Peek-Asa, C. (1999) The Effect of Random Alcohol Screening in Reducing Motor Vehicle Crash Injuries, *Am. J. Prev. Med.*, Vol. 16(1S), pp. 57–67.

Ross, H. L. (1984) *Deterring the Drinking Driver: Legal Policy and Social Control*, D.C. Heath, Lexington, MA.

Ross, H. L. (1992) "The Deterrent Capability of Sobriety Checkpoints: Summary of the American Literature," Report DOT HS 807 862 for National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, DC.

Ross, H. L., McCleary, R., Epperlein, T. (1981) Deterrence of Drinking and Driving in France: An Evaluation of the Law of July 12, 1978, *Law Soc. Rev.*, Vol. 16, pp. 345–374.

Shults, R. A., Elder, R. W., Sleet, D. A., Nichols, J. L., Alao, M. A., Carande-Kulis, V. G., Zaza, S., Sosin D. M., Thompson, R. S. (Task Force on Community Preventive Services). (2001) Reviews of Evidence Regarding Interventions to Reduce Alcohol-Impaired Driving, *Am. J. Prev. Med.*, Vol. 21(4S), pp. 66–88.

Stuster, J. W., Blowers, P. A. (1995) "Experimental Evaluation of Sobriety Checkpoint Programs," Report DOT HS 808 287 for National Highway Safety Traffic Administration, U.S. Department of Transportation, Washington, DC.

Vingilis, E., Salutin, L. (1980) A Prevention Programme for Drinking and Driving, *Accid. Anal. Prev.*, Vol. 12, pp. 267–274.

Vingilis, E., Salutin, L., Chan, G. (1979) "R.I.D.E. (Reduce Impaired Driving in Etobicoke): A Driving-while-Impaired Countermeasure Programme, One-Year Evaluation" for Addiction Research Foundation, Toronto, Canada.

Voas, R. B., Holder, H. D., Gruenewald, P. J. (1997) The Effect of Drinking and Driving Interventions on Alcohol-Involved Traffic Crashes within a Comprehensive Community Trial, *Addiction*, Vol. 92, pp. S221–S236.

Voas, R. B., Rhodenizer, E., Lynn, C. (1985) "Evaluation of Charlottesville Checkpoint Operation: Final Report, December 30, 1983 to December 31, 1984," Report on U.S. DOT Contract no. DTNH 22-83-C-05088 for National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, DC.

Wells, J. K., Greene, M. A., Foss, R. D., Ferguson, S. A., Williams, A. F. (1997) Drinking Drivers Missed at Sobriety Checkpoints, *J. Stud. Alcohol*, Vol. 58, pp. 513–517.

Wells, J. K., Preusser, D. F., Williams, A. F. (1992) Enforcing Alcohol-Impaired Driving and Seat Belt Use Laws, Binghamton, NY, *J. Safety Res.*, Vol. 23, pp. 63–71.

Zaza, S., Carande-Kulis, V. G., Sleet, D. A., Sosin, D. M., Elder, R. W., Shults, R. A., Dinh-Zarr, T. B., Nichols, J. L., Thompson, R. S. (2001) Methods for Conducting Systematic Reviews of the Evidence of Effectiveness and Economic Efficiency of Interventions to Reduce Injuries to Motor Vehicle Occupants, *Am. J. Prev. Med.*, Vol. 21(4S), pp. 23–30.