

Communities Mobilizing for Change on Alcohol: Outcomes from a Randomized Community Trial*

ALEXANDER C. WAGENAAR, PH.D., DAVID M. MURRAY, PH.D., JOHN P. GEHAN, M.P.A., M.A., MARK WOLFSON, PH.D., JEAN L. FORSTER, PH.D., TRACI L. TOOMEY, PH.D., CHERYL L. PERRY, PH.D., AND RHONDA JONES-WEBB, DR. P.H.

Division of Epidemiology, School of Public Health, University of Minnesota, 1300 South Second Street, Suite 300, Minneapolis, Minnesota 55454-1015

ABSTRACT. *Objective:* Communities Mobilizing for Change on Alcohol (CMCA) was a randomized 15-community trial of a community organizing intervention designed to reduce the accessibility of alcoholic beverages to youths under the legal drinking age. *Method:* Data were collected at baseline before random assignment of communities to intervention or control condition, and again at follow-up after a 2.5-year intervention. Data collection included in-school surveys of twelfth graders, telephone surveys of 18- to 20-year-olds and alcohol merchants, and direct testing of the propensity of alcohol outlets to sell to young buyers. Analyses were based on mixed-model regression, used the community as the unit of assignment, took into account the nesting of individual respondents or alcohol outlets within each community, and controlled for relevant covariates. *Results:* Results show

that the CMCA intervention significantly and favorably affected both the behavior of 18- to 20-year-olds (effect size = 0.76, $p < .01$) and the practices of on-sale alcohol establishments (effect size = 1.18, $p < .05$), may have favorably affected the practices of off-sale alcohol establishments (effect size = 0.32, $p = .08$), but had little effect on younger adolescents. Alcohol merchants appear to have increased age-identification checking and reduced propensity to sell to minors. Eighteen- to 20-year-olds reduced their propensity to provide alcohol to other teens and were less likely to try to buy alcohol, drink in a bar or consume alcohol. *Conclusions:* Community organizing is a useful intervention approach for mobilizing communities for institutional and policy change to improve the health of the population. (*J. Stud. Alcohol* 61: 85-94, 2000)

IN 1997, over half (53%) of U.S. high school seniors reported having drunk alcohol in the past 30 days, and 31% reported having consumed five or more drinks on at least one occasion in the previous 2 weeks (Johnston et al., 1997). Among college students, drinking rates are even higher (Wechsler et al., 1995). Use of alcoholic beverages by youths significantly increases risk for a range of health and social problems, including traffic crashes, assault, suicide, drowning, recreational injuries and early unprotected sex (Baker et al., 1992; Hayward et al., 1992; Leigh, 1990; Roizen, 1982, 1993; Stall et al., 1986). As a result, states and communities continue to seek ways to effectively prevent teenage drinking and its damaging sequelae.

Most programmatic interventions to reduce youth drinking and its consequences have focused on reducing the demand for alcohol by youths, traditionally through school-based programs. Programs from the 1960s to mid-1980s used information-based and affective-change strategies, and were found to be ineffective (Moskowitz, 1989). More recently, programs based on the social influences model have emerged, teaching specific drug use resistance skills or more

general life skills. Some of these programs have shown beneficial effects, although effects often decay after program implementation ends, and successful programs require intense implementation and dozens of sessions across multiple years (Botvin et al., 1995; Ellickson and Bell, 1990; Perry and Kelder, 1992). Widely disseminated programs currently in use throughout the country, such as DARE, are not effective (Clayton et al., 1996; Dukes et al., 1996; Ennett et al., 1994).

There is also a substantial literature on the effects of reducing the supply of alcohol. For example, increasing the legal age for purchase or consumption of alcohol from 18 to 21 significantly reduced youth drinking and alcohol-related casualties such as traffic crashes (Wagenaar, 1993). Reducing the availability of alcohol via increasing the excise tax, and thereby increasing retail prices, has a significant effect on alcohol consumption; this effect is particularly large for youths, given the high level of price elasticity among teenage drinkers (Chaloupka et al., 1998, in press; Grossman et al., 1994).

Recently, encouraging results have appeared for community-based alcohol interventions. Project Northland was a 28-community randomized trial with social-influences-model school curricula implemented in sixth through eighth grade, supplemented with peer leadership, parent education and community task forces (Perry et al., 1996). Results showed significantly lower prevalence of alcohol use after 3 years of intervention, with the effects most notable among

Received: September 23, 1997. Revision: June 23, 1998.

*The CMCA project was funded by the National Institute on Alcohol Abuse and Alcoholism and the Center for Substance Abuse Prevention under grant R01-AA90142 (Alexander C. Wagenaar, principal investigator).

those who were nonusers of alcohol at baseline. Effects decayed after the intervention was no longer active (Perry et al., 1998). Consequently, the second phase of Project Northland currently underway is focused more directly on community action to reduce the supply of alcohol to teenagers. Finally, a 5-year quasi-experimental prevention trial implemented in three communities has recently been completed. The goal of this effort was to specifically reduce alcohol-related injuries. Results indicate significant reductions in alcohol sales to minors and alcohol-involved traffic crashes, and no demonstrated effects on sales to intoxicated patrons or other broader measures of alcohol availability (Holder et al., 1997).

Intervention design and implementation

The Communities Mobilizing for Change on Alcohol (CMCA) project was a randomized community intervention trial testing a community organizing intervention designed to reduce youth access to alcohol. The project sought to reduce the number of alcohol outlets that sell to young people; reduce the availability of alcohol to youths from noncommercial sources such as parents, siblings and older peers; and reduce community tolerance of underage drinking and adult provision of alcohol to youths. The project organized for action through public institutions such as city councils, schools and enforcement agencies, and private institutions such as alcohol merchants, business associations and the media. Details on the theoretical foundations and design of the CMCA project are available elsewhere (see Wagenaar et al., 1994; Wagenaar and Perry, 1994).

During the first phase of the intervention period, the organizers completed a total of 1,518 one-on-one meetings with leaders and citizens from diverse sectors of the community. The one-on-ones were designed to help the organizers deepen their understanding of the community, its history, culture and networks of power and influence. They also helped build personal and political relationships with diverse citizens in the community; gain an understanding of individuals' commitments, interests and views; and identify individuals for recruitment into the core leadership group or a broader set of community activists. During this initial stage, the organizers also conducted a detailed review of extant alcohol control policies, procedures and enforcement practices in their communities. During the second phase, a local core leadership group, called a strategy team, and larger base of active citizens was developed, again reflecting diverse sectors of each community. As the organizers worked to build a base of support, media advocacy efforts (Wallack et al., 1993) resulted in rapid increases in media coverage of CMCA specifically (a total of 97 articles published), as well as increasing coverage of alcohol issues more generally (from 5,152 column inches in 1993 to 7,084 column inches in 1995). Finally, there were many changes in specific policies, procedures and practices in the CMCA communities during the intervention phase of the project. Intervention im-

plementation and intermediate outcomes are reported in Wagenaar et al., 1999.

Method

Research design

The CMCA project employed a randomized community trial design for most of its outcome measures and a multiple time-series design for the remainder (Wagenaar et al., 1994). Seven socially and geographically distinct upper midwestern communities were randomly assigned to receive the intervention, with eight others randomly assigned to serve as controls. Baseline surveys were conducted in each community among a number of targeted groups and repeated 3 years later. In addition, a multiple time-series design was superimposed on the community trial such that the outcomes for the multiple time-series design were collected from the same communities, but the outcome variables were measured at many more points in time both prior to and after the onset of the intervention program.

Description of communities

The community was defined based on geography, consisting of a city and its surrounding school district. All communities had a school district that included all the areas within the incorporated city plus surrounding areas outside the city limits. This unit was such a size that the intervention could feasibly be implemented in seven communities. In addition, the school district represented a cohesive social unit, especially for youths. Finally, secondary data of interest were available at the level of the school district, city and county.

All school districts in Minnesota and western Wisconsin were screened for: ninth-grade enrollments of at least 200, no participation in other major alcohol-related studies or programs, at least 25 miles distance from other eligible communities, and concentration of students in three or fewer municipalities. In addition, we excluded the Minneapolis-St. Paul metropolitan area and, importantly, excluded cities with preexisting projects or special efforts to address youth drinking (e.g., communities with CSAP Partnership grants). Twenty-four districts were identified that met these criteria and were invited to participate in the study. To participate, district officials had to agree to random assignment to the intervention or control condition and to allow access to ninth- and twelfth-grade students for the baseline and follow-up school surveys. Fifteen of the 24 eligible districts agreed to participate in the study; the most common reason for refusal was recent participation in another survey that included items on alcohol use. The 15 communities had an average population of 20,836 (range = 8,029 to 64,797). Three of the communities were home to a 4-year college and the average distance to the University of Minnesota was 90 miles (ranging from 18 to 240 miles). There were on average 35 on-sale

(bar and restaurant) outlets and 14 off-sale (liquor and convenience store) outlets in each community.

The 15 participating communities were matched on state, presence of a residential college or university, population size, and on the results of the baseline alcohol purchase attempt survey (described below). Given the odd number of sites, six pairs and one triplet were formed. One site from each pair or triplet was selected at random for allocation to Group A, and the remaining sites were assigned to Group B; thus, the two groups were structured so as to be similar at baseline on the matching factors. One of the two groups was then assigned at random to become the intervention group with the other becoming the control group.

The research design had important implications for the intervention. Because the study communities were selected randomly, they did not request the introduction of CMCA, and were, therefore, not necessarily ready to address the issue of underage drinking. In fact, communities that were already organized around the issue of underage drinking and participating in any other major funded projects were disqualified from consideration for CMCA. Not only were the selected communities not necessarily ready, but many of the communities had a strong alcohol culture and were actively resistant to defining youth drinking as a problem.

Data sources

Primary outcome data were collected using four independent survey operations implemented in each of the 15 communities at baseline and follow-up: (1) school-based surveys of ninth and twelfth graders at baseline and twelfth graders at follow-up; (2) telephone surveys of 18- to 20-year-olds; (3) alcohol purchase attempts by youths who appeared underage; and (4) telephone surveys of alcohol outlet owners and managers. All data collection protocols included approved provisions for the protection of human subjects. All subjects interviewed provided informed consent; in addition, parents of subjects under age 18 provided passive consent. All four data collection components were conducted in 1992 at baseline, before the community was organized for action on underage drinking, and were repeated in 1995 to measure any changes attributable to the intervention.

School surveys. The baseline survey of all high school students in grades nine and twelve enrolled in the participating school districts was conducted in the fall of 1992. In 1992, 4,506 twelfth graders and 5,885 ninth graders completed the survey, with participation rates of 89.3% and 92.8%, respectively. (In one community, one of two eligible schools declined our invitation to participate in the baseline survey; the participating school enrolled approximately half the eligible students in the community and their participation was comparable to that observed study-wide.) A follow-up of the 1992 ninth-grade cohort was conducted in the fall of 1995 when those students were in the twelfth grade; 3,694 (62.8%) completed the second survey as part of the 1995 survey of all

twelfth graders ($n = 4,487$; participation rate = 83.5%). The ninth graders seen in 1992 and the twelfth graders seen in 1995 define a single birth cohort and the twelfth graders seen in 1992 and 1995 define two different birth cohorts. Of the students who participated in the school surveys, 94% were white and 48% were male. We considered using a saliva test to increase the validity of the self-report data, but chose not to employ the test because our study of such "pipeline" effects indicated that disclosure of alcohol use by adolescents is not significantly enhanced by such testing procedures (Wagenaar et al., 1993). Findings from the baseline survey of high school students are available in Jones-Webb et al. (1997b), Lee et al. (1997) and Wagenaar et al. (1996).

Surveys of 18- to 20-year-olds. We conducted a telephone survey of 3,095 18- to 20-year-olds in 1992 with a response rate of 92.5%. In 1995, we obtained completed interviews from a sample of 18- to 20-year-olds ($N = 1,721$) with a response rate of 93.9%. These respondents represent cross-sectional samples of 18- to 20-year-olds residing in study communities. The sample was 51% male, 96% white, and equally divided between 18-, 19- and 20-year-olds. State driver's license records were used to compile a list of all licensed 18- to 20-year-olds residing in the study communities supplemented by student lists provided by residential colleges. While the sampling frame was less than perfect, it provided the best available method to identify residents in the 18 to 20 age group. Independent random samples were selected from each community for the baseline and follow-up surveys. Additional data from the baseline survey of 18- to 20-year-olds are available in Braun et al. (1997) and Jones-Webb et al. (1997a).

Alcohol purchase attempts. We conducted a baseline survey of alcohol establishments in each community in 1992 and a follow-up survey in 1995. For each community, a complete list of licensed alcohol retail outlets was obtained from the relevant state departments immediately prior to each survey. All off-sale establishments (e.g., liquor stores, convenience stores, grocery stores) were surveyed, together with a random sample of 60% of on-sale establishments (e.g., bars, restaurants). In 1992, 273 off-sale outlets were surveyed, while 305 were surveyed in 1995; in 1992, 229 on-sale outlets were surveyed, while 251 were surveyed in 1995. The objective of the purchase attempts was to determine the proportion of on- and off-sale alcohol outlets that present barriers to alcohol purchase by those under the legal age. Because Minnesota and Wisconsin state laws prohibit purchase or possession of alcohol by persons under age 21, college students who were 21 years old but who appeared to be age 19 or younger were employed to make the alcohol purchase attempts. All purchasers were white women to standardize the stimulus and reduce purchaser effects. All potential purchasers were presented to a panel of judges who individually estimated each one's age. Those estimated to be between 17 and 19 years old, with little variance in estimated age, were selected as purchasers. Purchasers did not engage in

any illegal behaviors during collection of these data. To avoid recognition, purchasers were recruited from areas outside the cities where purchase attempts were made. Purchasers were instructed to state that they had no age identification with them if it was requested, and to state their correct age if asked. If purchasers successfully bought alcohol, they were strictly prohibited from consuming it and were subject to unannounced breath alcohol tests and dismissal for violating this procedure.

Before they were sent into the field, purchasers were carefully trained by research staff, including a number of practice purchase attempts. Purchasers worked in two-person teams for safety and to improve data quality. Both team members entered each on-sale establishment. A single purchaser entered each off-sale outlet while the partner, serving as driver, remained in the car. Two different teams visited each selected establishment at each survey, and teams were allocated at random to communities. Teams visited the establishments in a predetermined sequence, with the starting point balanced for the two teams so that each outlet was visited at two different times of day. All outlet survey work was conducted on Fridays between 6 PM and midnight and Saturdays between noon and midnight over a 6-week period, and the sequencing of communities over that period was determined by lot. Purchasers also completed a structured observation form, which included items related to the purchase attempt. Additional data from the baseline alcohol purchase attempts are available in Forster et al. (1995).

Alcohol merchant survey. We conducted a telephone survey of alcohol merchants in treatment and control communities at baseline and conducted a follow-up survey in 1995; participation rates were 87.6% and 91.5%, respectively. The sample for the merchant survey was identical to the sample of licensed alcohol retail outlets used in the purchase attempt survey (with a few minor exceptions). Outlets surveyed included private clubs, bars, restaurants, convenience stores, grocery stores and liquor stores. Interviews were conducted by telephone with either the owner or manager of each outlet. Two versions of the merchant questionnaire were developed, with language appropriate for either off-sale or on-sale outlets. Additional data from the baseline survey of alcohol merchants are available in Wolfson et al. (1996).

Variables and measures

The variables reported here represent multiple measures of the two central outcomes: (1) access to alcohol from commercial and social sources and (2) drinking behaviors. From the alcohol purchase attempts, we report the proportion of attempts that were successful and the proportion of attempts that resulted in a request for the buyer to show proof of age; these outcomes were analyzed separately for off-sale and on-sale outlets. From the survey of alcohol merchants, we report proportion stating they check age ID for all customers who appear under age 30, perceived likelihood of being cited for

sales to minors (on a 7-point scale), and proportion who said they would sell to a 21-year-old customer who is accompanied by a 19-year-old. All merchant survey results were stratified by on- versus off-sale outlets. From the school and 18- to 20-year-old surveys, we report the prevalence of attempting to purchase alcohol in the past month, the prevalence of providing alcohol to another minor in the past year, the prevalence of drinking any alcohol in the last month, the prevalence of consuming at least five drinks at a single occasion in the last two weeks, the log of the number of drinks consumed at the last drinking occasion, and the log of the number of drinking occasions in the last month. Reliabilities for survey measures are presented in Klepp et al. (1996).

Several variables were analyzed as possible covariates. Twelve covariates were considered for both on-sale and off-sale alcohol purchase attempt analyses. These include percent of revenue derived from alcohol (0-20% versus 20-80% versus 80-100%), number of part-time or full-time employees (0-5 versus 6-10 versus more than 10), whether the outlet is a chain, mean length of staff employment (less than 1 year versus more than 1 year), years with a liquor license (less than 10 years, more than 10 years), whether the outlet is in a town with a 4-year college, whether the outlet is a combination on-sale and off-sale establishment or strictly one or the other, maintenance of the exterior of the building (good versus fair versus poor), proximity to other outlets (next door versus same block versus within two blocks versus beyond two blocks), area of the community (downtown versus industrial versus perimeter retail versus residential versus rural or resort), and buyer ID. The measures of maintenance, proximity to other outlets, and area of community were measured by research staff observers. The age and gender of the server were recorded by the buyer after the buy attempt was made. All other measures were obtained through telephone interviews with outlet owners or managers. Two additional covariates were included that were specific to the type of outlet. For on-sale outlets we considered whether "happy hour" pricing existed and whether the outlet was a bar or another type of establishment. For off-sale outlets we considered whether the outlet sold single servings of alcohol and whether the outlet was a liquor store or another type of establishment.

For analyses of high school seniors, we considered seven possible covariates, including gender, age, race/ethnicity (white versus other), whether someone over age 21 was at home after school, parents' education (at least one educated beyond high school versus neither educated beyond high school), existence of older or younger siblings, and weekly discretionary income. Covariates considered for the age 18-20 survey included the same covariates as were measured for the analyses of twelfth graders with the exception of the measure of whether an adult was home after school. Four additional covariates were considered in the analyses of 18- to 20-year-olds, including whether the respondent lived in a town with a 4-year college, whether the respondent

self-defined as primarily a student, whether the respondent had completed high school and the respondent's marital status (single versus other). Additional details on CMCA surveys and measures are available in Wagenaar et al. (1994).

Analysis methods

The CMCA project employed a randomized community trial design. Because observations taken in the same intact social group tend to be positively correlated, steps must be taken in the analysis to account for that intraclass correlation to avoid what can be substantial inflation in the Type I error rate (Zucker, 1990). The data collected from the cohort of ninth graders at baseline in each community come from what is termed a nested cohort design, wherein respondents in each identifiable group are followed over time as a cohort in order to assess the impact of the intervention (Murray, 1998). The cohort was in twelfth grade at follow-up. Because of the large proportion of the cohort lost to follow-up (almost 40% subject loss, due primarily to migration out of the community), we do not report the cohort results here. Data collected from repeated cross-sectional twelfth grade and 18- to 20-year-old surveys come from what is termed a nested cross-sectional design, wherein different respondents within each intact social group are sampled at each measurement occasion (Murray, 1998). The data collected from the merchant surveys come from a hybrid of those two designs, as there was considerable overlap in the off-sale outlets included in the two surveys but considerably less overlap in the on-sale outlets included in the two surveys (the latter were derived from two independent 40% samples). Data from the outlet surveys come from the same hybrid design, but with the added feature that each outlet was observed twice at baseline and twice at posttest.

The data were analyzed using mixed-model regression procedures and implemented using SAS PROC MIXED (Version 6.12; SAS Institute, 1997). Mixed-model regression is particularly well suited to analysis of data from complex nested designs, such as those employed in CMCA, and SAS PROC MIXED is a very flexible program for implementation of mixed-model regression analyses. For all analyses, the 1992 and 1995 data were analyzed together, in

a Condition \times Time analysis, based on methods described by Murray (1998). The intervention effect was represented by the Condition \times Time interaction and estimated as the difference over time between the two conditions. All analyses controlled for possible baseline differences between conditions. Community was included as a random effect nested within conditions; Time \times Community was included as another source of random variation. The intervention effect was assessed against the Time \times Community variation, with degrees of freedom based on the number of communities. For the outlet survey analyses, the repeated measures on each outlet at each year were also represented as a random effect. Details on estimates of intraclass correlations for many of the outcomes reported here have been published elsewhere (Murray and Short, 1995, 1996).

Eligible covariates for each outcome were included in an initial model. Nonsignificant covariates were then removed and the analyses rerun. A list of covariates included in each of the final analyses and the direction of their relationship to the outcome measures is provided in Table 1. Because we had a priori directional hypotheses for each of the outcomes, all tests were one-sided. Parameter estimates for the intervention effect were scaled in terms of absolute net difference (in percent or mean) between the intervention and control sites, controlling for covariates, and computed as $(I_{95} - I_{92}) - (C_{95} - C_{92})$. We also present results in terms of relative change to allow easy comparison of results across measures with widely different baseline levels. Relative change figures were calculated by dividing the estimate of the intervention effect by the baseline level in the intervention condition, and multiplying by 100. All effect estimates presented below are expressed as relative change.

A total of 26 outcome variables were assessed in this manner, grouped into four sets: off-sale establishment purchase attempt and survey variables, on-sale establishment purchase attempt and survey variables, age 18-20 survey variables and high school senior (twelfth-grade) survey variables. Results of these analyses presented a striking pattern in all four sets: intervention effects were in the direction predicted by the a priori hypotheses (Table 1, yes/no) for five of five off-sale establishment variables and five of five on-sale establishment variables (Table 3), seven of eight age 18-20 variables

TABLE 1. Significant covariates^a

Outcome	On-sale outlets	Off-sale outlets
Confederate buy (yes/no)	Small % revenue from alcohol College town Nonchain establishment Younger sales staff	Male sales staff
Checking age identification (yes/no)	Happy hour Older sales staff Bar Noncollege town Chain establishment	Female sales staff Older sales staff

(Continued)

TABLE 1. (continued)

Outcome	12th graders	18-20 year olds
Tried to buy alcohol in the last month (yes/no)	Male Younger No adults after school More spending money	Male Older More parent education College town Have an older sibling More spending money
Provided alcohol to another last year (yes/no)	Male No adults after school Less parent education No younger sibling More spending money	Male More parent education More spending money Never married Education <HS
Drank in the last 30 days (yes/no)	White No adults after school Less parent education Have an older sibling No younger sibling More spending money	Male Older White College town Not a college student Never married
Five or more drinks at a single occasion in the last 2 weeks (yes/no)	Male No adults after school Less parent education No younger sibling More spending money	Male Older White College town More spending money Never married
Number of drinks at last drinking event	Male White No adults after school Less parent education Have an older sibling No younger sibling More spending money	Male White College town Education <HS More spending money
Drove drunk or rode with drunk driver last month (yes/no)	No adults after school Less parent education Have an older sibling More spending money	Older More spending money
Any legal consequence from drinking in the last year (ticket, citation or accident) (yes/no)	Male Have older sibling More spending money	Male Never married Education <HS
Any social consequence from drinking in the last year (yes/no)	Female White No adults after school No younger sibling More spending money	Male Older White More parent education Never married Education <HS
Bought alcohol for last drinking event (yes/no)	Male Younger Nonwhite No adults after school Have older sibling More spending money	Male Older More parent education Education <HS More spending money
Got alcohol from a person 21+ for last event (yes/no)	Female White No adult after school Less parent education No younger sibling More spending money	Female White More spending money
Took or stole alcohol for last drinking event (yes/no)	Older White	More spending money

^aIndicated levels of the covariates were associated with a higher probability of the indicated outcome. For example, among on-sale outlets, the undesirable event of a successful confederate buy was more likely to occur in outlets that obtained a small percentage of their total revenue from alcohol, that were located in a college town, that were nonchain establishments and that employed younger sales staff. The desirable event of checking age identification was more likely to occur in outlets that had a happy hour, that employed an older sales staff, that were bars as opposed to other on-sale outlets, that were located in a noncollege town and that were chain establishments.

TABLE 2. Overall effects of the CMCA project

Target group	Intervention		Control		Net difference	SE	df	<i>t</i>	<i>p</i>	Effect size ^a
Alcohol merchants: On-sale	-0.04	-2.02	0.59	1.21	-2.6	1.41	13	-1.84	.04	1.18
Alcohol merchants: Off-sale	0.31	-0.55	-0.46	0.66	-2.0	1.32	13	-1.50	.08	0.317
18- to 20-year-olds	1.83	-1.64	-0.50	0.34	-4.33	1.62	13	-2.68	.01	0.760
High school seniors	2.62	-0.85	0.42	1.97	-1.07	2.92	13	-0.37	.36	0.192

^aMagnitude of intervention effect in standard deviation units, commonly referred to as *d*.

(Table 4) and six of eight high school senior variables (Table 5). As a result, additional analyses were conducted to determine whether this pattern was likely due to chance, quite apart from the analysis of each individual outcome. First, variables were reverse coded as needed so that all had a net decline as the predicted effect. Second, adjusted City \times Year means were generated using the same covariates as used in the primary analyses, but omitting condition and Time \times Condition from the model. Third, the means for each variable were standardized to a mean of zero and variance of one. Fourth, the standardized variables were summed within each set to create a single sum score representing the collection of outcome variables in each set. Finally, those sum scores were analyzed using a traditional repeated measures ANOVA, with condition, time and Time \times Condition as fixed effects and with city and Time \times City as random effects. Intervention effects were estimated as in the primary analyses as $(I_{95} - I_{92}) - (C_{95} - C_{92})$. For each sum score, we report the intervention effect and a one-tailed test of that effect.

Results

Analyses of the sum scores assessing overall treatment effects across the four intervention target groups show significant effects on 18- to 20-year-olds and on-sale alcohol establishments, a marginally significant effect on off-sale alcohol establishments ($p = .08$) and no effect on high school seniors (Table 2). The intervention had the largest effect on on-sale alcohol establishments ($d = 1.18$), and also had substantial effects on 18- to 20-year-olds ($d = 0.76$). We now turn to patterns of results across individual outcome measures.

Access to alcohol

A key objective of the CMCA intervention was to reduce the accessibility of alcohol to youths from commercial sellers and servers of alcohol. Thus, we sought to increase the proportion of alcohol outlets that request age ID from our confederate buyers, and decrease the propensity of outlets to sell to our underage-appearing buyers. Among on-sale alcohol outlets (e.g., bars, restaurants), the intervention communities experienced a 17% increase in the proportion checking age identification ($p = .06$; see Table 3); among off-sale outlets (e.g., liquor and convenience stores), the increase was 15% ($p = .17$). Effects were seen uniformly across the seven intervention sites.

The CMCA intervention also sought to reduce the propensity of outlets to sell to buyers who appear underage. Among on-sale outlets in the intervention communities, there was a decrease of 24% ($p = .06$; see Table 3) in the proportion selling to our confederate buyers, and among off-sale outlets the decrease was 8% ($p = .29$). Effects again were seen across all seven intervention communities.

Surveys of owners and managers assessed other dimensions of youth access to alcohol. Merchants were asked whether they check age ID for all customers who appear under age 30. There was no evidence of an intervention effect in either on-sale or off-sale establishments. In addition, we assessed merchants' perceived likelihood of being cited, if they were to sell or serve to minors. One objective of the intervention was to deter merchants from selling to minors by increasing the perceived chances of getting caught and receiving a consequence. Managers of on-sale establishments in the intervention communities showed an increase in perceived likelihood of being cited of 5% ($p = .28$); in off-sale outlets the increase was 12% ($p = .13$). Finally, a measure of merchants' care in preventing access to alcohol by minors is the degree to which they refuse sales to a 21-year-old who comes into the outlet accompanied by an underage person (with whom they might share the alcohol). The proportion of on-sale outlets reporting they would sell in such situations decreased 17% ($p = .25$), and in off-sale outlets decreased 25% ($p = .20$).

In contrast to many previous alcohol prevention trials, where the objective is to reduce initiation and use of alcohol by pre- and early-teenagers, the CMCA project focused primarily on reducing access to alcohol among older teenagers. Surveys of 18- to 20-year-olds revealed a decrease of 25% ($p = .06$) in the proportion of older teenagers who tried to buy alcoholic beverages (Table 4). The 18- to 20-year-olds (Table 4) also reported increased difficulty in getting alcohol from outlets ($p = .07$). In contrast to 18- to 20-year-olds, high school seniors reported an increase of 30% in the proportion who tried to buy alcoholic beverages. However, high school seniors also report increased difficulty in getting alcohol from outlets after the intervention ($p = .12$).

Teenagers acquire alcohol not only by purchasing directly from a commercial outlet, but also from siblings, friends and others (Short et al., submitted for publication; Wagenaar et al., 1996). Younger teens often obtain alcohol from older teens who purchase from outlets. Therefore, the intervention also worked to reduce provision of alcohol to younger teenagers by older teenagers. We surveyed 18- to 20-year-

TABLE 3. Net effects of the CMCA project on alcohol merchants: Results from mixed-model regressions^a

Outcome measure	Intervention		Control		Net difference ^b	SE	df	<i>t</i>	<i>p</i>	% Change ^c
	1992	1995	1992	1995						
Alcohol merchants: Observed behavior										
ID checking: On-sale	60.2%	78.1%	49.1%	56.5%	10.50	6.25	12	1.68	.06	17.40
ID checking: Off-sale	50.6%	64.5%	57.6%	64.1%	7.33	7.46	13	0.98	.17	14.50
Buy rate: On-sale	42.6%	29.0%	53.0%	49.6%	-10.20	6.24	12	-1.63	.06	-23.90
Buy rate: Off-sale	55.8%	44.0%	48.3%	41.0%	-4.57	8.17	13	-0.56	.29	-8.20
Alcohol merchants: Self-reported perceptions and behavior										
ID check for all who appear under 30: On-sale	36.3%	36.2%	37.2%	36.9%	0.25	8.09	13	0.03	.47	0.69
ID check for all who appear under 30: Off-sale	49.4%	46.7%	38.8%	35.6%	0.53	8.81	12	0.06	.47	1.07
Perceived likelihood of being cited: On-sale ^d	4.02	4.46	3.73	3.96	0.22	0.36	13	0.59	.28	5.47
Perceived likelihood of being cited: Off-sale ^d	4.02	4.26	3.99	3.76	0.47	0.40	13	1.17	.13	11.69
Sell to 21-year-old accompanied by 19-year-old: On-sale	45.1%	55.4%	43.4%	61.4%	-7.71	11.06	13	-0.70	.25	-17.10
Sell to 21-year-old accompanied by 19-year-old: Off-sale	36.8%	55.0%	33.3%	60.7%	-9.11	10.53	13	-0.87	.20	-24.76

^aCovariates included in each model are listed in Table 1.

^bNet difference: (I₉₅ - I₉₂) - (C₉₅ - C₉₂).

^cEquals net difference divided by mean of the seven intervention communities at baseline.

^dMeans on a 7-point scale.

olds regarding their providing behavior, and found that the intervention resulted in a 17% ($p = .01$; see Table 4) decline in the proportion that provide alcohol to youth.

Drinking behavior

The ultimate outcome of interest was drinking behavior of youths. The proportion of 18- to 20-year-olds who drank alcohol in the past 30 days decreased 7% in the intervention

versus the control communities ($p = .07$; see Table 4). Similarly, the number of drinking occasions in the past month decreased 4% ($p = .19$), and the number of drinks on the last drinking occasion decreased 2% ($p = .16$; see Table 4). The prevalence of episodic heavy drinking was not affected. Among high school seniors, all four drinking measures showed decreases after the intervention, with the largest estimated decrease in the number of drinking occasions in the past month ($-7%$, $p = .14$; see Table 5).

TABLE 4. Net effects of the CMCA project on 18- to 20-year-olds: Results from mixed-model regressions^a

Outcome measure	Intervention		Control		Net difference ^b	SE	df	<i>t</i>	<i>p</i>	% Change ^c
	1992	1995	1992	1995						
Access to alcohol										
Tried to buy alcohol	10.4%	7.5%	10.9%	10.7%	-2.61	1.53	12	-1.70	.06	-25.10
Provided alcohol to youth	35.4%	26.1%	34.9%	31.5%	-6.00	2.30	13	-2.61	.01	-16.95
Last drinking occasion in bar/tavern	9.1%	7.3%	7.8%	7.3%	-1.33	1.33	13	-1.00	.17	-14.62
Reported difficulty getting alcohol from outlets ^d	4.40	4.48	4.51	4.47	0.13	0.08	13	1.54	.07	2.95
Drinking behavior										
30-day drinking prevalence	56.3%	59.5%	55.7%	62.5%	-3.69	2.28	12	-1.61	.07	-6.55
Episodic heavy drinking prevalence	31.2%	31.1%	32.7%	31.9%	0.77	2.83	12	0.27	.60	2.47
Number of drinks on last occasion ^e	1.68	1.66	1.63	1.64	-0.03	0.03	12	-1.02	.16	-1.79
Number of drinking occasions in last month ^e	1.02	1.02	1.04	1.09	-0.04	0.05	12	-0.92	.19	-3.92

^aCovariates included in each model are listed in Table 1.

^bNet difference: (I₉₅ - I₉₂) - (C₉₅ - C₉₂).

^cEquals net difference divided by mean of the seven intervention communities at baseline.

^dMeans on a 7-point scale.

^eTransformed prior to analysis: $y^1 = \log(y + 1)$.

TABLE 5. Net effects of the CMCA project on 12th-grade students: Results from mixed-model regressions^a

Outcome measure	Intervention		Control		Net difference ^b	SE	df	<i>t</i>	<i>p</i>	% Change ^c
	1992	1995	1992	1995						
Access to alcohol										
Tried to buy alcohol	4.9%	4.1%	6.3%	4.0%	1.48	1.13	13	1.31	.89	30.20
Provided alcohol to youth	49.6%	46.5%	46.3%	44.7%	-1.51	2.71	13	-0.56	.29	-3.04
Last drinking occasion in bar/tavern	3.4%	3.6%	4.0%	3.3%	0.89	0.85	13	1.05	.84	26.18
Reported difficulty getting alcohol from outlets ^d	4.80	5.08	4.77	4.89	0.16	0.13	13	1.25	.12	3.33
Drinking behavior										
30-day drinking prevalence	56.1%	55.4%	53.8%	53.9%	-0.85	2.49	13	-0.34	.37	-1.52
Episodic heavy drinking prevalence	31.1%	32.1%	29.1%	31.6%	-1.49	2.39	13	-0.62	.27	-4.79
Number of drinks on last occasion ^e	1.51	1.42	1.41	1.35	-0.02	0.04	13	-0.56	.29	-1.32
Number of drinking occasions in last month ^e	1.12	1.08	1.02	1.05	-0.08	0.07	13	-1.11	.14	-7.14

^aCovariates included in each model are listed in Table 1.

^bNet difference: $(I_{95} - I_{92}) - (C_{95} - C_{92})$.

^cEquals net difference divided by mean of the seven intervention communities at baseline.

^dMeans on a 7-point scale.

^eTransformed prior to analysis: $y^l = \log(y + 1)$.

Discussion

Results from tests of overall treatment effects showed the CMCA community organizing intervention significantly and favorably affected 18- to 20-year-olds and on-sale alcohol establishments, apparently affected off-sale alcohol establishments, and did not significantly affect high school seniors. The size of these effects is large, with the change in 18- to 20-year-olds representing three-quarters of a standard deviation, and the change in on-sale alcohol establishments representing more than a standard deviation. Such effect sizes are larger than those typically seen in trials of school-based interventions (Tobler, 1998). Analyses of individual outcome measures showed a striking consistency of effects: intervention effects were in the direction predicted by a priori hypotheses for five of five on-sale establishment measures, five of five off-sale establishment measures, seven of eight age 18-20 measures, and six of eight high school senior variables. Results indicate alcohol merchants increased age-ID checking and reduced their propensity to sell to minors, particularly in on-sale establishments. Eighteen- to 20-year-olds reduced their propensity to provide alcohol to other teens, were less likely to try to buy alcohol, reported more difficulty getting alcohol from establishments and were less likely to drink within the past 30 days.

The CMCA project clearly demonstrated the feasibility of randomly selecting communities that were not necessarily interested or ready to address youth drinking, and mobilizing those communities to take action to address this issue. Numerous activities were implemented by the communities, of which many, but not all, were specifically targeted at reducing youth access to alcohol. We showed that local community residents with no previous organizing experience

could be hired, trained and developed into community organizers. We also experienced common complexities of large-scale community-change projects, including turnover in organizing staff, community resistance to defining underage drinking as a problem, and the substantial period of time needed to introduce the project into the communities, develop local leadership, and move local teams to action on specific strategies.

The CMCA project was successfully implemented in randomly selected communities that paid little previous attention to youth drinking and related issues, and produced results that indicate beneficial effects on three of the four key target populations. As a result, we believe continued development and study is warranted of community organizing as a tool for changing community and social environments that foster or exacerbate leading public health problems.

Acknowledgments

A project of this scope over a 6-year period involves the contributions of hundreds of individuals. Warm thanks to all the investigators, coordinators, community organizers, interviewers, research assistants, support staff, and the citizens of the participating communities for their efforts on behalf of the CMCA project.

References

- BAKER, S.P., O'NEILL, B., GINSBURG, M.J. AND LI, G. The Injury Fact Book, 2nd Edition, New York: Oxford Univ. Press, 1992.
- BOTVIN, G.J., BAKER, E., DUSENBURY, L., BOTVIN, E.M. AND DIAZ, T. Long-term follow-up results of a randomized drug abuse prevention trial in a white middle-class population. *JAMA* **273**: 1106-1112, 1995.
- BRAUN, B.L., WOLFSON, M., JONES-WEBB, R. AND WAGENAAR, A.C. Civic participation by 18- to 20-year-olds as a predictor of support for alcohol

- control policies: The Communities Mobilizing for Change on Alcohol project. *Contemp. Drug Probl.* **24**: 39-56, 1997.
- CHALOUPKA, F.J., GROSSMAN, M. AND SAFFER, H. The effects of price on the consequences of alcohol use and abuse. In: GALANTER, M. (Ed.) *Recent Developments in Alcoholism*, Vol. 14: The Consequences of Alcoholism, New York: Plenum Press, 1998, pp. 331-346.
- CHALOUPKA, F.J., GROSSMAN, M. AND SAFFER, H. The effects of price on alcohol consumption. *Alcohol Hlth Res. World*, in press.
- CLAYTON, R.R., CATTARELLO, A.M. AND JOHNSTONE, B.M. The effectiveness of drug abuse resistance education (Project DARE): 5 year follow up results. *Prev. Med.* **25**: 307-318, 1996.
- DUKES, R.L., ULLMAN, J.B. AND STEIN, J.A. Three-year follow-up of drug abuse resistance education (D.A.R.E.). *Eval. Rev.* **20**: 49-66, 1996.
- ELLICKSON, P.L. AND BELL, R.M. Drug prevention in junior high: A multi-site longitudinal test. *Science* **247**: 1299-1305, 1990.
- ENNETT, S.T., TOBLER, N.S., RINGWALT, C.L. AND FLEWELLING, R.L. How effective is drug abuse resistance education? A meta-analysis of Project DARE outcome evaluations. *Amer. J. Publ. Hlth* **84**: 1394-1401, 1994.
- FORSTER, J.L., MURRAY, D.M., WOLFSON, M. AND WAGENAAR, A.C. Commercial availability of alcohol to young people: Results of alcohol purchase attempts. *Prev. Med.* **24**: 342-347, 1995.
- GROSSMAN, M., CHALOUPKA, F.J., SAFFER, H. AND LAIXUTHIA, A. Effects of alcohol price policy on youth: A summary of economic research. *J. Res. Adolesc.* **4**: 347-364, 1994.
- HAYWARD, L., ZUBRICK, S.R. AND SILBURN, S. Blood alcohol levels in suicide cases. *J. Epidemiol. Commun. Hlth* **46**: 256-260, 1992.
- HOLDER, H.D. (Ed.) *A Community Prevention Trial to Reduce Alcohol-Involved Trauma*. *Addiction* **92** (Suppl. No. 2), 1997.
- JOHNSTON, L.D., O'MALLEY, P.M. AND BACHMAN, J.G. *National Survey Results on Drug Use from the Monitoring the Future Study, 1975-1995*, Vol. 2, NIH Publication No. 98-4140, Washington: Government Printing Office, 1997.
- JONES-WEBB, R., SHORT, B., WAGENAAR, A., TOOMEY, T., MURRAY, D., WOLFSON, M. AND FORSTER, J. Environmental predictors of drinking and drinking-related problems in young adults. *J. Drug Educ.* **27**: 67-82, 1997a.
- JONES-WEBB, R., TOOMEY, T.L., SHORT, B., MURRAY, D.M., WAGENAAR, A. AND WOLFSON, M. Relationships among alcohol availability, drinking location, alcohol consumption and drinking problems, in adolescents. *Subst. Use Misuse* **32**: 1261-1285, 1997b.
- KLEPP, K.-I., JONES-WEBB, R., WAGENAAR, A.C., SHORT, B., MURRAY, D.M. AND FORSTER, J.L. Measurement of alcohol and tobacco availability to underage students. *Addict. Behav.* **21**: 585-595, 1996.
- LEE, J.A., JONES-WEBB, R.J., SHORT, B.J. AND WAGENAAR, A.C. Drinking location and risk of alcohol-impaired driving among high school seniors. *Addict. Behav.* **22**: 387-393, 1997.
- LEIGH, B.C. The relationship of substance use during sex to high-risk sexual behavior. *J. Sex Res.* **27**: 199-213, 1990.
- MOSKOWITZ, J.M. The primary prevention of alcohol problems: A critical review of the research literature. *J. Stud. Alcohol* **50**: 54-88, 1989.
- MURRAY, D.M. *Design and Analysis of Group-Randomized Trials*, New York: Oxford Univ. Press, 1998.
- MURRAY, D.M. AND SHORT, B. Intra-class correlation among measures related to alcohol use by young adults: Estimates, correlates and applications in intervention studies. *J. Stud. Alcohol* **56**: 681-694, 1995.
- MURRAY, D.M. AND SHORT, B. Intra-class correlation among measures related to alcohol use by school aged adolescents: Estimates, correlates and applications in intervention studies. *J. Drug Educ.* **26**: 207-230, 1996.
- PERRY, C.L. AND KELDER, S.H. Models for effective prevention. *J. Adolesc. Hlth* **13**: 355-363, 1992.
- PERRY, C.L., WILLIAMS, C.L., KOMRO, K.A., VELEN-MORTENSON, S., FORSTER, J.L., BERNSTEIN-LACHTER, R., PRATT, L.K., MUNSON, K.A. AND FARBAKHSH, K. Project Northland-Phase II: Community action to reduce adolescent alcohol use. Presented at the 1998 Kettl Bruun Society Thematic Meeting: Fourth Symposium on Community Action Research and the Prevention of Alcohol and Other Drug Problems, Russell, Bay of Islands, New Zealand, February 8-13, 1998.
- PERRY, C.L., WILLIAMS, C.L., VELEN-MORTENSON, S., TOOMEY, T.L., KOMRO, K.A., ANSTINE, P.S., MCGOVERN, P.G., FINNEGAN, J.R., FORSTER, J.L., WAGENAAR, A.C. AND WOLFSON, M. Project Northland: Outcomes of a communitywide alcohol use prevention program during early adolescence. *Amer. J. Publ. Hlth* **86**: 956-965, 1996.
- ROIZEN, J. Estimating alcohol involvement in serious events. In: National Institute on Alcohol Abuse and Alcoholism. *Alcohol Consumption and Related Problems*. Alcohol and Health Monograph No. 1, DHHS Publication No. (ADM) 82-1190, Washington: Government Printing Office, 1982, pp. 179-219.
- ROIZEN, J. Issues in the epidemiology of alcohol and violence. In: MARTIN, S.E. (Ed.) *Alcohol and Interpersonal Violence: Fostering Multidisciplinary Perspectives*. NIAAA Research Monograph No. 24, NIH Publication No. 93-3496, Rockville, MD: Department of Health and Human Services, 1993, pp. 3-36.
- SAS INSTITUTE, INC. *SAS/STAT Software: Changes and Enhancements through Release 6.12*, Cary, NC: SAS Institute, Inc., 1997.
- SHORT, B.J., WOLFSON, M., TOOMEY, T., WAGENAAR, A.C. AND FORSTER, J. Youth who provide alcohol to their peers. *J. Stud. Alcohol*, submitted for publication.
- STALL, R., MCKUSICK, L., WILEY, J., COATES, T.J. AND OSTROW, D.G. Alcohol and drug use during sexual activity and compliance with safe sex guidelines for AIDS: The AIDS Behavioral Research Project. *Hlth Educ. Q.* **13**: 359-371, 1986.
- TOBLER, N. Updated meta-analysis of school-based drug prevention programs. Presented at the Sixth Annual Meeting of the Society for Prevention Research: Advances and Challenges in Prevention Science for the 21st Century, Park City, UT, June 4-7, 1998.
- WAGENAAR, A.C. Minimum drinking age and alcohol availability to youth: Issues and research needs. In: HILTON, M.E. AND BLOSS, G. (Eds.) *Economics and the Prevention of Alcohol-Related Problems*. NIAAA Research Monograph No. 25, NIH Publication No. 93-3513, Rockville, MD: Department of Health and Human Services, 1993, pp. 175-200.
- WAGENAAR, A.C., GEHAN, J.P., JONES-WEBB, R., WOLFSON, M., TOOMEY, T.L., FORSTER, J.L. AND MURRAY, D.M. Communities mobilizing for change on alcohol: Lessons and results from a 15-community randomized trial. *J. Commun. Psychol.* **27**: 315-326, 1999.
- WAGENAAR, A.C., KOMRO, K.A., MCGOVERN, P., WILLIAMS, C.L. AND PERRY, C.L. Effects of a saliva test pipeline procedure on adolescent self-reported alcohol use. *Addiction* **88**: 199-208, 1993.
- WAGENAAR, A.C., MURRAY, D.M., WOLFSON, M., FORSTER, J.L. AND FINNEGAN, J.R. Communities mobilizing for change on alcohol: Design of a randomized community trial. *J. Commun. Psychol. CSAP Special Issue*: 79-101, 1994.
- WAGENAAR, A.C. AND PERRY, C.L. Community strategies for the reduction of youth drinking: Theory and application. *J. Res. Adolesc.* **4**: 319-345, 1994.
- WAGENAAR, A.C., TOOMEY, T.L., MURRAY, D.M., SHORT, B.J., WOLFSON, M. AND JONES-WEBB, R. Sources of alcohol for underage drinkers. *J. Stud. Alcohol* **57**: 325-333, 1996.
- WALLACK, L., DORFMAN, L., JERNIGAN, D. AND THEMBA, M. *Media Advocacy and Public Health: Power for Prevention*, Thousand Oaks, CA: Sage, 1993.
- WECHSLER, H., DOWDALL, G.W., DAVENPORT, A. AND CASTILLO, S. Correlates of college student binge drinking. *Amer. J. Publ. Hlth* **85**: 921-926, 1995.
- WOLFSON, M., TOOMEY, T.L., MURRAY, D.M., FORSTER, J.L., SHORT, B.J. AND WAGENAAR, A.C. Alcohol outlet policies and practices concerning sales to underage people. *Addiction* **91**: 589-602, 1996.
- ZUCKER, D.M. An analysis of variance pitfall: The fixed effects analysis in a nested design. *Educ. Psychol. Meas.* **50**: 731-738, 1990.