Effects of the Communities That Care System on Cross-Sectional Profiles of Adolescent Substance Use and Delinquency

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Introduction: Adolescent substance use and delinquency are major public health problems. Although community-based prevention strategies have been recommended to produce population-level reductions in rates of substance use and delinquency, few models show evidence of effectiveness.

Purpose: To test the efficacy of a community-based prevention system, Communities That Care (CTC), in reducing community rates of problem behaviors, particularly effects on specific profiles of adolescent substance use and delinquency in eighth- and tenth-graders.

Methods: Twenty-four communities were randomized to CTC intervention or control groups. Data were collected from 14,099 8th- and 10th-grade students in these communities using anonymous cross-sectional surveys in 2004 and 2010 and analyzed in 2012. Outcomes were four different profiles of self-reported substance use and delinquency in 8th grade and five profiles in 10th grade.

Results: In the cross-sectional 2010 data, there was no intervention effect on the probability of experimenting with substances or of substance use coupled with delinquent activities for either grade. However, tenth-graders in intervention communities were significantly less likely to be alcohol users than those in control communities (OR=0.69, CI=0.48, 1.00).

Conclusions: Cross-sectional population surveys showed evidence of CTC effects in reducing tenth-grade alcohol users but not experimenters. A community-wide reduction in adolescent alcohol use is important because alcohol is the most commonly used illicit substance during adolescence, and early initiation of alcohol use has been associated with alcohol-related disorders in adulthood. Failure to find hypothesized effects on experimenters qualifies these results.
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Introduction

Adolescence is marked by increasing involvement in risk-seeking behaviors such as substance use and delinquency.[1,2] Such behaviors can result in negative consequences such as poor academic performance, compromised health, and increased rates of victimization and physical injury.[3,4] Initiation of alcohol use during adolescence increases risk for alcohol and other drug disorders in adulthood,[5,6] and early initiation of delinquency predicts continued involvement in severe, violent offending.[7,8] The high financial costs of these problem behaviors are related to medical care, work loss, drug treatment programs, and correctional systems.[9–11]

Many interventions have been developed and demonstrated effective in preventing adolescent problem behaviors.[12] However, relatively few community-based preventive interventions have shown effectiveness, leading federal agencies to call for more development and evaluation of such approaches.[10,12-15] Compared with single interventions, community-based strategies have the potential to affect multiple outcomes across a larger population, given their focus on simultaneously addressing numerous risk and protective factors via the implementation of multiple, locally coordinated preventive interventions that are likely to affect the majority of residents in a community.[16,17]

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To date, only two community-based prevention systems have been found to impact adolescent delinquency and/or substance use.[18] The first is the Promoting School–Community–University Partnerships to Enhance Resilience (PROSPER) project, which relies on university staff, school district officials, and other community members to implement family-focused and school-based prevention services. This model has demonstrated reductions in the initiation, prevalence, and escalation of substance use during adolescence.[19] The second, Communities That Care (CTC),[20,21] relies on local coalitions to implement a range of services that reduce risk factors and strengthen protective factors experienced by youth. CTC has been shown to reduce the initiation of tobacco use, alcohol use, delinquency, and violence among a longitudinal panel of students followed from Grade 5 to 10.[22,23]

Previous tests of community-based prevention systems examine average effects on each behavioral outcome. However, etiologic evidence indicates that risk and protective factors predict numerous problem behaviors that often co-occur.[24,25] Thus, when evaluating intervention effects, it would be useful to examine the degree to which an intervention affects involvement in multiple problem behaviors, such as substance use and violence, as well as combinations of such behaviors. The current study investigates the degree to which CTC affects the probability that adolescents will engage in specific behavioral profiles of substance use, delinquency, and violence.

Although the methodology described in this paper could be applied to the evaluation of any type of preventive intervention, it is particularly relevant for comprehensive approaches that involve the implementation of multiple services targeting diverse predictors of related outcomes. In the CTC system, community coalitions receive training and technical assistance and follow structured protocols to prevent youth problem behaviors.

Based on a public health framework, CTC assists communities in conducting population surveys of public secondary school students to identify locally elevated risk factors and suppressed protective factors and in implementing tested and effective preventive interventions that target these factors. Thus, the interventions are specific to the needs of each community and include one or more types of services such as school-based curricula and organizational change models, afterschool services (e.g., tutoring and mentoring programs), and family-focused interventions such as parenting workshops.

Coalitions are encouraged to deliver an array of preventive interventions, which target to change multiple risk and protective factors in as many participants as possible, so long as the interventions are implemented with fidelity and in a coordinated fashion to minimize duplication of services. Although communities may implement interventions targeting higher-risk youth (i.e., selective or indicated prevention programs), CTC emphasizes the delivery of services to the general population. Therefore, the CTC system can be considered a universal prevention approach intended to reduce community-wide problem behaviors.

The CTC theory of change posits that this system will produce reductions in the overall prevalence of health problems with similar effects across individuals. However, the effects of CTC could be specific to certain groups. For example, evaluations of other universal interventions have reported stronger or weaker impacts on problem behaviors according to demographic status (e.g., sex or race/ethnicity) or for higher- versus lower-risk youth.[26–32]

The current study examines outcomes in a different manner. Rather than assessing the degree to which the intervention has produced changes in a single behavior for groups of individuals defined according to demographic characteristics or risk status, we investigate the degree to which the CTC system affects the probability that adolescents engage in specific behavioral profiles of substance use, delinquency, and violence.

This approach is based on prior examination of cross-sectional data from the CTC study, which identified exclusive profiles of multiple problem behaviors.[33] Students in the *abstainer* profile had very low probabilities of reporting any substance use, delinquency, or violence; *experimenters* reported some lifetime substance use but little recent use, and were very unlikely to have engaged in delinquent behaviors; students in the *drug use* profile were very likely to report current drug use but less likely to engage in delinquent behaviors; and *problem students* were very likely to report substance use and delinquent activities.

There was also evidence for a fifth profile: a group of students characterized as *alcohol users*, who were very likely to engage in current alcohol use but had limited involvement with other substances or delinquency, and primarily came from the experimenter profile when only four profiles were estimated. Evidence that students engage in different combinations of problem behaviors provides the foundation for this more nuanced evaluation of how CTC can effect changes in communities.

Investigating the degree to which CTC or any intervention impacts profiles of co-occurring behaviors can better illuminate the ways in which the intervention achieves change and better specify where the strongest intervention effects occur, although the methods are limited by the assumption that the profiles are stable across samples and across time. This approach jointly

tests intervention effects on the probability that study participants are in each of the identified categories while also allowing tests of specific hypotheses about the impacted groups.

Research Aims

Although effects of CTC have been shown in a longitudinal panel, they have not been demonstrated with cross-sectional data and groups of students most affected by the intervention have not been identified. The current paper uses repeated cross-sectional data to examine the probability of 8th- and 10th-grade students in intervention and control communities engaging in different profiles of problem behaviors.

Prior analyses have shown that in 2004, before implementation of preventive interventions selected through the CTC process, there was no difference in profiles among 8th-grade students.[33] This paper shows evidence for the comparability of these profiles in 2004 surveys of tenth-graders. The primary aim of this study was to examine effects of the CTC intervention on cross-sectional profiles of problem behaviors in 2010, or 6 years after the intervention communities began targeted prevention services.

Given that CTC generally advocates for implementation of universal preventive interventions, we previously hypothesized that the greatest preventive impact would be localized to youth engaging in more common and less serious problem behaviors.[33] We test the hypothesis that in contrast to students in control communities, students in the CTC intervention communities will have a reduced likelihood of being an experimenter or alcohol user compared to being an abstainer, assuming that these classes are replicated.

Methods

Data were obtained from students in the Community Youth Development Study (CYDS),[34] an RCT testing the effectiveness of the CTC model in 24 small to moderate-sized communities (12 matched pairs) located in seven states (Figure 1). One community from each pair was randomized to implement CTC and the other to conduct prevention services as usual.

From spring 2003 through spring 2008 (Years 1–5, the efficacy phase of the trial), each of the 12 intervention communities was provided with training in the CTC model, proactive technical assistance via weekly phone calls and one to three annual site visits by research staff to ensure faithful delivery of the CTC model and selected preventive interventions. They also received funding for a CTC coordinator and up to $75,000 in Years 2–5 to implement programs, policies, and practices showing prior evidence of effectiveness in well-conducted trials, as identified for communities in the CTC *Prevention Strategies Guide* (http://www.communitiesthatcare.net/), and those communities that targeted 5th- to 9th-grade students and their families.

Communities selected interventions that targeted risk factors reported as elevated by local youth on the same surveys used in the current analyses. Priority risk factors and interventions differed between communities. Across communities, 17 different school-, family-, and community-based interventions (examples include Life Skills Training, Guiding Good Choices, and Big Brothers/Big Sisters) were implemented during Years 2–5, with an average of three programs per community.[35–38]

The sustainability phase of the CYDS trial began in 2008; from that point, data were collected to evaluate long-term changes in student outcomes, but training and technical assistance and financial resources were no longer provided. Most intervention communities continued to implement CTC and evidence-based programs.[39]

The present study began by examining profiles of problem behaviors among tenth-graders in spring 2004. Although the randomized trial began in spring 2003, intervention communities spent the first 15–18 months receiving training, forming coalitions, and planning. Intervention programming began in fall 2004.

No intervention effects were expected in spring 2004, and none were found for eighth-graders at that time point.[33] By spring 2010, intervention communities had been implementing CTC with technical and financial support from the study for 5 years and without study support for 2 additional years. Eleven of the original 12 CTC coalitions were still active,[39] and intervention sites were delivering effective prevention programming at higher rates than control communities.[40]

Procedures

Data were obtained from cross-sectional population surveys of students administered in schools during a classroom period by teachers using standardized anonymous administration procedures. Teachers received specific instructions to ensure anonymity of responses and signed an agreement to abide by these instructions.

Screening criteria were used to exclude respondents who lied or responded inconsistently. For instance, if students responded *never* to lifetime use of cigarettes and indicated smoking one or more cigarettes per day during the past 30 days on a separate question, their answers were considered inconsistent. Students with more than two inconsistent responses or who reported that they were not honest in completing the survey were excluded. Because responses were anonymous, passive consent was obtained from parents and informed assent was obtained from students. The University of Washington's Human Subjects Review Committee approved the protocol.

Participants

Cross-sectional data were collected from students in Grades 6, 8, 10, and 12. Intervention effects were examined for 8th and 10th grades only. In Grade 6, reported levels of substance use and delinquency were too low to expect detectable intervention effects, and lower response rates made the 12th grade cross-sectional samples less representative of the population.

Across data sets, the sample consisted of between 49% and 53% girls. Between 3% and 6% of students self-identified as African American, and 77% to 80% as Caucasian. In the 2004 sample, 11% of surveyed tenth-graders identified as Hispanic. In 2010, when
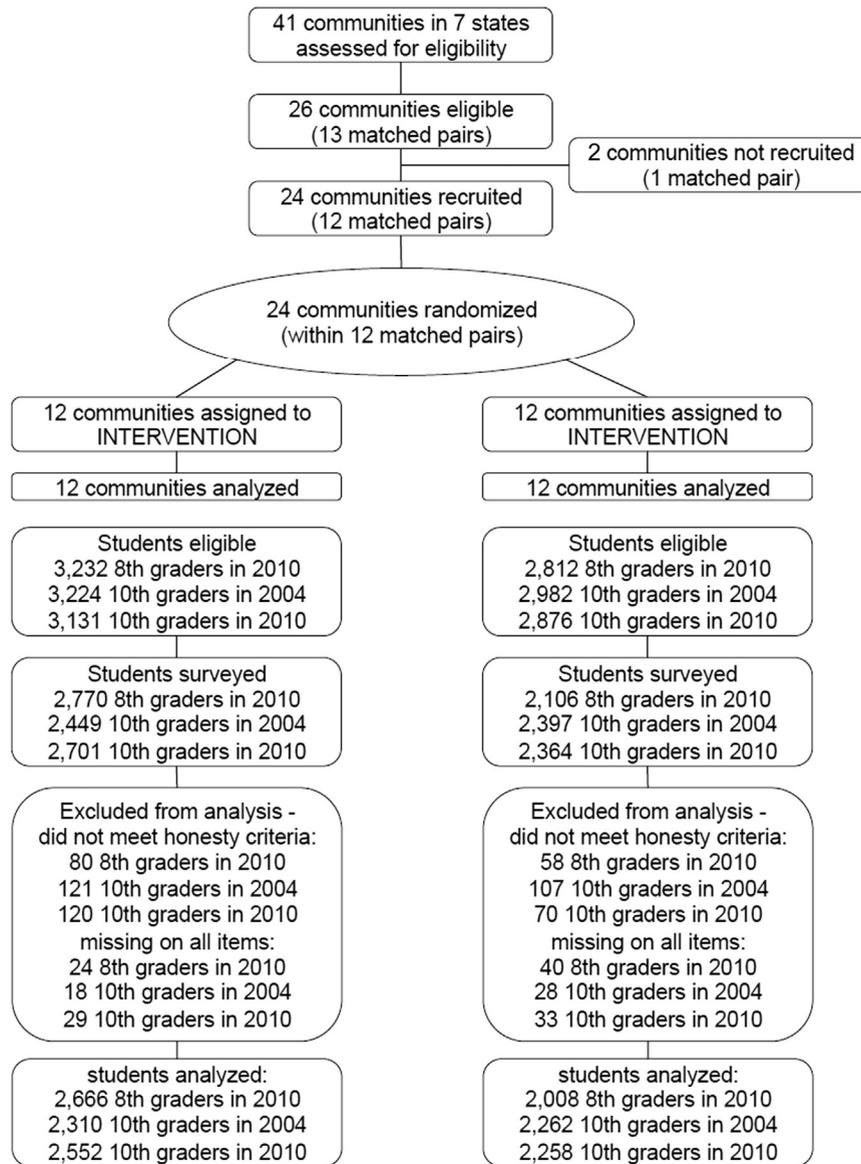
Figure 1. CONSORT diagram for 8th- and 9th-grade CYDS cross-sectional sample used in latent class analysis
CYDS, Community Youth Development Study

new reporting requirements resulted in a change in the wording of race/ethnicity items such that *Hispanic* was designated as a separate category, 23% of eighth-graders and 19% of tenth-graders identified as Hispanic.

Measures

Data were collected using the CTC Youth Survey,[41,42] which is designed to measure risk and protective factors, substance use, and delinquency in middle and high school samples. Analyses used items asking the frequency of alcohol, tobacco, and marijuana use across the lifetime and in the last 30 days, and the number of times in the last 2 weeks they had more than five drinks at one time. Analyses included three levels of substance use: no use, lifetime but not current use, and use within the last 30 days. Students also indicated the frequency with which they engaged in eight

delinquent behaviors over the last year (Table 1); these items and binge drinking were coded yes/no in analyses.

Three community-level variables were included to reduce community-level variability in outcomes. The percentage of students receiving free or reduced-price lunch and the total number of students in the community in thousands were obtained from the National Center for Educational Statistics for the 2003–2004 school year. Additionally, an indicator for Utah was included because these students were uniformly lower in levels of substance use. If community matching is explicitly modeled, the Utah adjustment is not necessary.

Data Analysis

In 2012, multi-level latent class analysis (MLCA) estimated in Mplus[43] was used to examine the effects of CTC on the probability of students' membership in latent classes. The multi-level

Table 1. Predicted responses probabilities from multilevel unconditional latent class analyses

	8th grade 2010				10th grade 2010				
	Abstainer	Experiment	Drug use	Problem	Abstainer	Experiment	Alcohol	Drug use	Problem
Proportion	66%	22%	9%	3%	57%	16%	11%	13%	3%
Cigarettes									
Never	0.98	0.45	0.11	0.17	0.97	0.30	0.52	0.07	0.24
Lifetime	0.02	0.48	0.34	0.23	0.03	0.58	0.34	0.30	0.16
Current	0.00	0.07	0.55	0.60	0.01	0.12	0.14	0.63	0.60
Alcohol									
Never	0.82	0.17	0.03	0.06	0.75	0.11	0.01	0.00	0.08
Lifetime	0.14	0.49	0.13	0.10	0.19	0.78	0.10	0.11	0.06
Current	0.04	0.34	0.83	0.84	0.07	0.11	0.89	0.89	0.85
Marijuana									
Never	1.00	0.72	0.17	0.12	0.99	0.37	0.54	0.03	0.18
Lifetime	0.00	0.21	0.21	0.15	0.01	0.46	0.25	0.21	0.16
Current	0.00	0.07	0.62	0.74	0.01	0.17	0.22	0.76	0.66
Binge drinking									
Yes	0.00	0.15	0.62	0.78	0.00	0.00	0.55	0.66	0.75
Suspended									
Yes	0.05	0.28	0.46	0.89	0.05	0.22	0.12	0.36	0.70
Carried gun									
Yes	0.02	0.12	0.11	0.83	0.03	0.06	0.07	0.09	0.80
Sold drugs									
Yes	0.00	0.01	0.22	0.77	0.00	0.04	0.01	0.40	0.83
Stole vehicle									
Yes	0.00	0.06	0.07	0.59	0.01	0.04	0.01	0.06	0.65
Arrested									
Yes	0.01	0.13	0.24	0.75	0.02	0.12	0.05	0.30	0.76

Table 1. Predicted responses probabilities from multilevel unconditional latent class analyses (*continued*)

	8th grade 2010				10th grade 2010				
	Abstainer	Experiment	Drug use	Problem	Abstainer	Experiment	Alcohol	Drug use	Problem
Attacked someone									
Yes	0.06	0.29	0.50	0.90	0.04	0.18	0.10	0.37	0.90
High at school									
Yes	0.00	0.12	0.66	0.82	0.00	0.21	0.14	0.82	0.94
Gun to school									
Yes	0.00	0.01	0.02	0.54	0.00	0.01	0.01	0.01	0.57

Note: Proportion is the proportion of students estimated to be in each class.

component of the model accounted for the fact that communities rather than individual subjects were randomized.[44,45] The least restrictive, fully random approach[33] was used to account for clustering between communities in the probability that a student would be in each latent class versus the reference class (abstainer was the reference class in this case).

Because communities rather than individuals were randomized to condition, fixed and random effects for the probability of membership in each class were included to maintain the nominal type I error rate. Full information maximum likelihood estimation allowed for the inclusion of subjects with missing data, except those missing data on all variables.

Because the meaning of latent classes may change across time and samples, it is important to also verify that classes are replicated with independent data; results of these analyses are only valid in populations where these latent classes exist. Previous analyses of 8th-grade students found support for both four- and five-class solutions in independent samples collected in communities from the same states.[33] For this study, the five-class solution was also replicated for an independent sample of tenth-graders (Appendix A).

Initial analyses found that the differences between communities in the distribution of students across classes were greater than those shown in previous analyses as indicated by intraclass correlation coefficients (ICCs) for latent class means ranging from of 0.05 to 0.10. This is problematic because higher ICCs for the outcome(s) lower statistical power to find treatment effects.[46,47] Community-level covariates were included in the analyses to account for these differences. The meaning of the latent classes was virtually unchanged, but the ICCs for class means decreased to between 0 and 0.03, due primarily to communities in Utah compared to other states. Rates of substance use and problem behaviors were much lower in Utah communities and thus there were far more abstainers (Table 2).

Results

Initial analyses tested the equivalence of intervention and control conditions for 10th-grade students in 2004, before program implementation. The five-class model including abstainer, experimenter, alcohol user, drug user, and problem behavior classes found previously in 8th-grade and an independent 10th-grade sample (Appendix A) was replicated in 2004. No evidence was found for pre-intervention differences between intervention and control communities in profiles of substance use and delinquency.

The first step in assessing intervention effects on latent classes was the replication of the previously identified latent classes. The four-class solution was replicated for eighth-graders in 2010. However, the five-class solution did not distinguish an alcohol use profile, but instead contained a small group (6%) of students who reported current marijuana use and no binge drinking (Appendix A).

Rather than use this result that was not replicated in any other sample and therefore potentially unreliable, we proceeded by examining intervention effects for

8th-grade students using four classes, including abstainers, experimenters, drug users, and problem students, which were substantively the same as the four previously identified classes. For 10th-grade students, the five-class solution including the alcohol class was replicated in 2010 and was utilized in subsequent analyses. Response profiles for each grade are shown in Table 1.

Effects of the CTC intervention on class membership in 2010 for both 8th and 10th grades are reported in Table 2. We hypothesized that CTC would reduce the probability of being in the experimenter and alcohol use classes versus the abstainer classes for students in the intervention compared to the control condition. Results showed no intervention effects for the experimenter class for either grade. For 10th-grade students, the intervention reduced the probability of being in the alcohol use versus the abstainer class, as hypothesized. The odds of a 10th-grade student in an intervention community being in the alcohol use class as opposed to the abstainer class was 0.69 (CI=0.48, 1.00) times those of a student in the control condition.

To show the practical implication of these effects, the aforementioned multinomial regression model was used to calculate the predicted probability that a student from a control community not in Utah, at the average level of free and reduced-price lunch (39%), and of the average student population size (3,417 students) would be an alcohol user was 0.26 versus 0.19 if the student lived in a treatment community, the expected reduction in alcohol users due to CTC is from 26% to 19%. Analyses showed no difference in the probability of belonging to either the drug use or problem behavior classes versus the abstainer class in the CTC intervention communities compared to the control communities in 8th- or 10th-grade cross-sectional samples (Table 2).

Discussion

CTC was designed to reduce levels of substance use, delinquency, and other problem behaviors using a community-based prevention system that relies on broad-based coalitions to reduce elevated risk factors and strengthen protective factors with effective preventive interventions. Previous studies have shown significant intervention effects in smoking, drinking, and delinquency in a longitudinal panel of students followed from Grade 5 through 10.[22,23]

Instead of the longitudinal panel, the current study used two cross-sectional samples of 8th- and 10th-grade students collected 6 years apart: in 2004, before prevention programs had been initiated, and in 2010, 2 years after external support for CTC and prevention program implementation had been withdrawn but while intervention sites were continuing to deliver effective prevention programming.[40]

The current study differed from prior outcome analyses in that it tested the specific hypothesis that CTC would reduce the proportion of students in the experimenter and alcohol user classes in repeated cross-sectional surveys. Because some universal interventions have been shown to have the strongest effects among the highest-risk youth,[26–30] the study also assessed the degree to which intervention effects were found among youth engaging in more serious or higher levels of problem behaviors. This possibility was tested by default, given that differences in all profiles were assessed with the LCA approach.

Only one of three hypothesized intervention effects was found: a 7–percentage point reduction in alcohol users in 10th grade. Contrary to our hypothesis, no differences in experimenters were found across intervention conditions for either 8th- or 10th-grade students in the cross-sectional 2010 survey. Analyses showed no evidence of intervention effects on more serious levels of problem behaviors, although these analyses were exploratory and effects were not specifically hypothesized. The inclusion of community-level covariates substantially reduced variability in latent classes between communities because the students in Utah were much more likely to be abstainers than students in any other state. These conclusions assume the stability of the four- and five-class models in the population.

The analyses utilized in this study allowed identification of a group of students for whom the intervention was most effective: tenth-graders who displayed a specific profile of being likely to engage in current drinking and binge drinking, but not other substance use or problem behaviors. Although it is unclear why intervention effects would be largest on alcohol users, that effects on alcohol were found in both cross-sectional and longitudinal data[22,23] is noteworthy. Cross-sectional analyses typically have less power to detect intervention effects than analyses of longitudinal data.[48]

The reduction in rates of alcohol use is also important because alcohol is the most commonly used substance among adolescents.[49] Moreover, use of alcohol during adolescence has been associated with an increased risk of other negative outcomes not measured in this survey, including victimization, risky sexual behavior, and mental health problems,[25,50–52] as well as an increased likelihood of alcohol abuse and dependency during adulthood.[25,53]

An unexpected finding was that the intervention did not affect the proportion of students who were experimenters in either grade and that the alcohol use class was not replicated in the 8th grade. One explanation for these null findings is the systematic decrease in substance use seen both in these data (the percentage of 8th-grade abstainers increased from 58% in 2004 to 66% in 2010) and in recent years in national surveys.[49]

These trends could have impacted profiles of substance use such that the alcohol use class was no longer evident for eighth-graders. Decreasing percentages of experimenters in 8th and 10th grade also reduces power to find intervention effects for these students. Future cross-sectional surveys of students in the CTC study communities could help inform some of these issues. Although this study did not look at

intervention effects in other years, it would be especially informative to examine these effects in 2008 and, given that interventions are sustained, in 2012 data.

This study did not find a reduction in rates of serious drug use or problem behaviors for students in intervention versus control communities. These analyses also had low power to detect effects given the low rates of involvement in

Table 2. Effects of the Communities That Care intervention on latent classes

	8th Grade			10th grade		
	Estimate	SE	OR	Estimate	SE	OR
Experimenter versus abstainer class						
Intercept	**−2.09**	0.17		**−1.49**	0.29	
CTC treatment	0.06	0.08	1.06	−0.21	0.16	0.81
Free/reduced-price lunch	**2.57**	0.41	13.07	0.64	0.60	1.90
Number of students	0.03	0.03	1.03	**0.12**	0.05	1.13
Community in Utah	**−0.71**	0.12	0.49	**−1.03**	0.26	0.36
Random intercept	0.00	0.00				
Alcohol use versus abstainer class						
Intercept		NA		**−1.32**	0.27	
CTC treatment		NA		**−0.37**	0.18	0.69
Free/reduced-price lunch		NA		0.20	0.53	1.22
Number of students		NA		0.05	0.07	1.05
Community in Utah		NA		**−1.44**	0.48	0.24
Random intercept		NA		0.07	0.04	1.07
Drug use versus abstainer class						
Intercept	**−2.99**	0.30		**−1.36**	0.30	
CTC treatment	0.10	0.08	1.11	−0.11	0.15	0.90
Free/reduced-price lunch	**2.29**	0.56	9.87	−0.37	0.59	0.69
Number of students	0.04	0.08	1.04	**0.15**	0.03	1.16
Community in Utah	−0.80	0.46	0.45	**−1.62**	0.19	0.20
Random intercept	**0.10**	0.04		0.04	0.04	
Problem behavior versus abstainer class						
Intercept	**−3.94**	0.58		**−3.62**	0.37	
CTC treatment	0.40	0.25	1.49	0.16	0.15	1.17
Free/reduced-price lunch	0.40	1.16	1.49	**1.63**	0.75	5.10
Number of students	**0.26**	0.09	1.30	0.08	0.05	1.08
Community in Utah	**−1.80**	0.45	0.17	**−1.22**	0.29	0.30
Random intercept	0.12	0.12		0.00	0.00	

Note: Analyses use data from 2010 included 4,671 eighth-graders and 4,810 tenth-graders who were in the cross-sectional Communities That Care sample. The alcohol use class was not included in the 8th-grade analyses. Number of students was divided by 1,000 in analyses.
Boldface indicates statistical significance ($p < 0.05$).
CTC, Communities That Care; NA, not applicable.

these behaviors. Additionally, given that communities largely implemented universal prevention strategies targeting youth who had not yet initiated involvement in problem behaviors, we did not have strong expectations for finding intervention effects in these groups.

Although this paper did not demonstrate the hypothesized intervention effects, the more nuanced evaluation provided by these analyses did allow identification of a specific subgroup of students for whom the intervention was effective. The strength of this LCA approach is that it recognizes that not all substance or alcohol use is the same, and it allows for the creation of particular profiles of problem behaviors based on all measured outcomes. In this case, the analyses were able to distinguish between alcohol users, those who experimented with substance use, and those who used alcohol as part of a pattern of more serious problem behaviors. It is possible that students who engage only in alcohol use view this behavior as normative, whereas they consider other illegal drugs or delinquent behaviors as more deviant. The current study suggests that CTC may be effective at altering the attitudes and behaviors of alcohol users more than those of others.

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Appendix

Supplementary data

Supplementary data associated with this article can be found at http://dx.doi.org/10.1016/j.amepre.2014.04.004.