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Effects of Communities That Care on Males' and Females' Drug Use and Delinquency 9 Years After Baseline in a Community-Randomized Trial

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Abstract

This study tested sustained effects of the *Communities That Care* (CTC) prevention system on health-risking behaviors 9 years after baseline in a community-randomized trial involving 24 towns in seven states. Earlier analyses found sustained effects on abstinence from drug use and delinquency through Grade 12 in a panel of fifth graders. At age 19, 91 % (n = 3986) of the living panel completed the survey. Data were analyzed using generalized linear mixed models. The prevalence of lifetime and current substance use and delinquency were the primary outcomes. Secondary outcomes included substance use disorders, major depression, suicidality, educational attainment, and sexual risk behaviors. CTC had a significant overall effect across lifetime measures of the primary outcomes for males, but not for females or the full sample, although lifetime abstinence from delinquency in the full sample was significantly higher in CTC communities (ARR = 1.16). Males in CTC communities also continued to show greater lifetime abstinence from cigarette smoking (ARR = 1.22). CTC did not have a sustained effect on current substance use and delinquency nor did it improve the secondary outcomes at age 19 for either gender. Communities using CTC may need to extend their prevention planning to include the high school years to sustain effects on drug use and delinquency beyond high school for both genders.

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Keywords

Prevention; Sustained effects; Delinquency; Drug use; Gender differences

Introduction

Tested and effective programs and policies for preventing adolescent behavioral health problems (including substance use, violence, and delinquency) have been identified, yet widespread dissemination and high-quality implementation of these effective programs and policies in communities has not been achieved (Gottfredson and Gottfredson 2002; Hallfors et al. 2002; Ringwalt et al. 2011; Wandersman and Florin 2003). Science-based prevention planning systems that bring together a diverse coalition of community stakeholders to use local data to guide the selection and implementation of evidence-based preventive interventions have been shown to advance the use of effective policies, programs, and practices and to prevent adolescent behavioral health problems community wide (Holder et al. 2000; Pentz et al. 1989; Perry et al. 2002; Spoth et al. 2013; Wagenaar et al. 1999). However, little is known about the lasting impact of such community prevention efforts on individuals' lives and behaviors (Farrington and Welsh 2013), and it is important to understand whether and how long effects of community interventions persist. If community prevention efforts can move a community's youth onto healthier life trajectories that are maintained, community prevention systems could greatly contribute to long-term improved individual and public health.

Evaluation of long-term effects of community prevention systems can reveal the extent to which initial effects persist, strengthen, weaken, or disappear over time, and can help in determining whether additional intervention may be needed to maintain effects in the long term. For example, an evaluation of *Project Northland* indicated that initial effects on alcohol use were lost when study participants transitioned from middle to high school, but offering booster sessions during high school prompted new positive effects (Perry et al. 2002). Longer follow-up periods can also reveal intervention effects on behaviors that may emerge during later developmental stages, which may or may not have been the original focus of the intervention (Farrington and Welsh 2013; Schweinhart 2013). Several family- and school-based preventive interventions aimed at reducing adolescent substance use, violence, and delinquency have been shown to have long-term effects on the targeted outcomes as well as other behaviors that are developmentally salient at later life stages, such as sexual risk behaviors, mental health, and educational and economic attainment (Hawkins et al. 2008c; Kellam et al. 2008). Although these interventions initially did not target these behaviors, long-term effects were driven by mediators originally targeted in the intervention or through reductions in earlier problems. Because different populations may vary in their exposure or susceptibility to risk factors over time, follow-up analyses also may reveal differential effects for particular subgroups (e.g., sex, race/ethnicity, socioeconomic status, or those who experienced early adversity; Eckenrode et al. 2010). Long-term follow-up evaluations are clearly important but have not yet become standard practice (Flay et al. 2005; O'Connell et al. 2009). A rare example is the evaluation of the PROSPER community–university partnership delivery system, which has been tested in a randomized

trial in 28 communities in Iowa and Pennsylvania (Spoth et al. 2013). Analyses of outcomes 6.5 years post baseline have shown positive longterm effects on reductions in substance use through 12th grade (Spoth et al. 2013).

The present study examined the long-term impact of *Communities That Care* (CTC), a science-based community prevention capacity building and planning system. CTC aims to improve a community's prevention system by building infrastructure through organizing and training coalitions to adopt a science-based approach to prevention; assess and prioritize young people's risk, protective factors, and behavioral health problems; and match priorities with tested, effective preventive interventions. To achieve this aim, CTC activates a coalition of community stakeholders and guides them to choose, install, and monitor tested and effective preventive interventions to change locally identified elevated risk and suppressed protective factors. These preventive interventions, in turn, are expected to decrease adolescent substance use, delinquency, violence, and related behavioral health problems (Hawkins and Catalano 1992; Hawkins et al. 2008b). CTC resembles the PROSPER community–university partnership system in building the capacity of a local coalition to implement evidence-based interventions. Unlike PROSPER, CTC does not prescribe who leads the prevention efforts, but assesses and prioritizes local epidemiological levels of risk, protection, and behavioral health outcomes, and does not require that specific types of evidence-based programs must be implemented.

Prior results from the CTC trial support the CTC theory of change (Hawkins and Catalano 1992). According to the theory, the CTC system is expected to produce communitywide changes in prevention system functioning, including increased adoption of a science-based approach to prevention and increased use of tested, effective preventive interventions that address risk and protective factors prioritized by the community. These changes in prevention system functioning are expected to produce community-wide changes in youths' exposure to targeted risk and protective factors, which, in turn, result in decreases in adolescent substance use and delinquent behaviors. Results have shown intermediate and sustained increases in the adoption of a science-based approach to prevention (Brown et al. 2011; Rhew et al. 2013) and implementation of a greater number of tested and effective prevention programs targeting students in Grades 5–9 and their families and schools in CTC communities (Fagan et al. 2011). The CTC theory of change suggests that it takes 2–5 years of implementing tested, effective programs for community-level impact on risk and protective factors, and 4–10 years for community-level impact on adolescent substance use, delinquency, and violence to be observed. Analyses of data from a community-randomized trial of CTC found that significant differences between CTC and control communities in targeted risk factors and delinquent behavior were observed as early as 1.67 years after implementing preventive interventions selected through the CTC process, when a panel of youth followed in the trial since Grade 5 was in seventh grade (Hawkins et al. 2008a). An impact on adolescent substance use was first observed after 2.67 years of program implementation, when youth in the panel were in eighth grade (Hawkins et al. 2009). The trial found significant and sustained effects of CTC on the incidence of alcohol and cigarette use and delinquent behavior from Grade 8 to Grade 12 (Hawkins et al. 2009, 2012, 2014).

Reductions in current substance use and delinquent behavior were observed through 10th grade but not in Grade 12.

This study investigated possible sustained effects of CTC on panel youths' behavioral health outcomes 1 year beyond the normal time of high school graduation. This was 4 years after most panel members had last been exposed to tested and effective prevention programs selected through the CTC process and 9 years after initial implementation of CTC in the trial. The primary outcomes expected to be affected by CTC and examined in the present study are substance use and delinquent behavior. Due to their growing salience in late adolescence and young adulthood, we also examined possible secondary outcomes including substance use disorders, educational attainment, depression, suicidality, sexual risk behaviors, sexually transmitted diseases (STDs), and teenage pregnancy. Broader effects on secondary outcomes were hypothesized because the risk and protective factors prioritized and targeted by CTC communities predict these behavioral health outcomes as well (Hawkins and Catalano 1992), which, in turn, are associated with each other over time through developmental cascades (Masten 2014).

Gender Differences in the Impact of CTC

Although CTC is not intended to focus on specific populations or particular individuals or groups of adolescents, it is important to examine whether prevention programs have intended universal effects or if effects vary across subgroups (Flay et al. 2005; O'Connell et al. 2009). The US National Institutes of Health recently called for greater attention to sex and gender in biomedical research to enhance reproducibility of scientific research and prevent and treat diseases effectively in both men and women (Clayton and Collins 2014; Collins and Tabak 2014). Inattention to sex and gender differences in the social sciences hinders advancement of theory development, intervention and treatment design, and reproducibility of results (Klostermann et al. 2014). We focus on potential gender differences in outcomes in this study for several reasons. First, males are more likely than females to engage in some of the primary behavioral outcomes targeted by CTC, particularly delinquency (Moffitt et al. 2001; Puzzanchera and Adams 2011). Although there are only small gender differences in the prevalence of substance use during early and mid-adolescence (Johnston et al. 2013a), the gender gap widens for some substances and frequent use (e.g., daily use) towards the end of adolescence (Wallace et al. 2003), the time period in which effects were analyzed in the current study. Second, there is some evidence that males and females vary in levels of and susceptibility to risk and protective factors related to problem behaviors (Fagan et al. 2007; Kumpfer et al. 2008), which would suggest that interventions designed to alter these factors may have differential effects by gender. Third, the impact of prevention programs has varied by gender in some evaluations, with some programs showing stronger effects for females and others showing stronger effects for males (Fagan and Lindsey 2014). Some programs have also shown harmful effects for one sex or the other, for example, increasing substance use and other behavioral health problems instead of reducing them (Sloboda et al. 2009; Yin and Ware 2000). However, no clear patterns have emerged regarding the types of programs or outcomes most likely to vary by gender (Fagan and Lindsey 2014). Fourth, analyses of data from the trial of CTC have suggested that males were somewhat more likely than females to benefit from CTC in

Grades 8 and 10 (Oesterle et al. 2010, 2014). The current study examined whether gender differences in effects of CTC were also found in late adolescence and across a wider range of outcomes than previously assessed. Determining whether CTC has sustained positive effects for both sexes is important given that CTC is a universal system designed to be implemented community wide.

Methods

Data for this study came from the Community Youth Development Study (CYDS) (Hawkins et al. 2008b), a community-randomized trial of CTC. Twenty-four communities in the states of Colorado, Illinois, Kansas, Maine, Oregon, Utah, and Washington were matched in pairs within state, on population size, racial and ethnic diversity, economic indicators, and crime rates. One community from within each matched pair was assigned randomly by a coin toss to either the intervention (CTC) or control group (Hawkins et al. 2008b). CYDS communities are small- to moderate-sized incorporated towns with their own governmental, educational, and law enforcement structures, ranging from 1500 to 50,000 residents.

Beginning in the summer of 2003, intervention communities received CTC training over 6–12 months by certified trainers. CTC coalition members were trained to use data from cross-sectional CTC youth surveys (Arthur et al. 2002) of public school students in the community to prioritize risk factors to be targeted by tested and effective preventive actions. Control communities received data from CTC youth surveys administered in schools every 2 years, but no resources, training, or technical assistance from the study.

Although CTC is designed for children and youth of all ages, CTC communities in the trial were asked to focus prevention plans on programs for youth ages 10–14 and their families and schools so that possible effects on behavioral health outcomes could be observed within the initial 5-year study period. Starting with the 2004–2005 school year and annually thereafter, community coalitions implemented between 1 and 5 preventive programs to address their prioritized risk factors (Fagan et al. 2009). A total of 18 different universal school-, family-, and community-based programs and selective afterschool programs (e.g., tutoring and mentoring) targeting elevated risk factors were implemented across communities. None of these programs targeted boys or girls specifically. CYDS staff provided technical assistance and communities received financial support for the implementation of preventive interventions throughout the 5-year efficacy trial. Support ended after the 5th year of the study. Although almost all CTC coalitions were still active during the following unsupported period (Gloppen et al. 2012), and some continued to implement programs for middle and junior high school students, very few coalitions provided preventive interventions for high school students in this period. Table A1 in Online Appendix A shows the study's design and timeline.

Sample and Data Collection

Sample

Eight waves of data were collected from a longitudinal panel of public school students in the 24 CYDS communities followed from Grade 5 (2004) through 1 year beyond on-time high

school graduation (2012), when most panel members were 19 years old (average age 19.2, $SD = .4$). Parents of 4420 students consented to their children's participation in the study (76.4 % of the eligible population; 76.1 % in CTC and 76.7 % in control communities). Consented students who completed a wave 1 or wave 2 survey and remained in intervention or control communities for at least 1 semester ($N = 4407$) were tracked and surveyed as part of the longitudinal panel (Fig. 1), even if they left the community, moved schools, or dropped out (Brown et al. 2009). By age 19, 17 panel members were deceased and 2 were permanently excluded from the sample due to refusal or disability that precluded them from filling out the survey. The active still-living sample, therefore, consisted of 4388 adolescents (2174 females and 2214 males). Of the still-living sample members, 90.8 % ($n = 3986$) completed the survey at age 19. Retention did not differ by intervention condition, but was higher for females than males (94 vs. 88 %, respectively). Twenty percent of youth in the panel self-identified as Hispanic/Latino, 64 % were non-Hispanic White, 3 % non-Hispanic African American, 5 % non-Hispanic Native American, 1 % non-Hispanic Asian American, and 6 % reported other race/ethnicities. Thirty percent of youth came from families where the highest educational degree completed by a parent was high school.

Data Collection

During the school years, panel members completed the Youth Development Survey (YDS; Social Development Research Group 2005–2012), a paper-and-pencil questionnaire designed to be completed in a class period. At age 19, most panel members (88.9 %) took the survey online and the remainder (11.1 %) completed a paper version (10.6 % in the CTC condition, 11.8 % in the control condition). Identification numbers but no names or other identifying information was included on the surveys. Participants received small incentive gifts worth \$5–\$10 during the school years and a \$25 incentive check after completing the survey at age 19. The University of Washington Human Subjects Review Committee approved this protocol.

Measures

Primary Outcomes

Youths reported their lifetime and past-month use of 11 substances (alcohol, tobacco, marijuana, smokeless tobacco, inhalants, nonmedical use of prescription drugs, ecstasy (MDMA), cocaine, LSD, stimulants, and other illicit drugs) at every wave, and past-year substance use starting in Grade 12. Using these prospective data, we examined sustained abstinence through age 19 from each substance as well as any substance use, use of gateway drugs (alcohol, cigarettes, or marijuana), and binge drinking (having five or more drinks in one occasion). Cumulative incidence was examined when at least 50 % of the sample reported never using by age 19. Current use at age 19 was examined in the past month and in the past year.

At each wave, adolescents reported past-year participation in seven delinquent acts (stealing, damaging property, shoplifting, attacking someone with intent to harm, carrying a handgun, being arrested, and beating up someone so badly that they probably needed medical attention). A subset of these items (attacking someone with intent to harm, carrying a

handgun, and beating up someone) was used to measure violent behavior. We used these prospective data to compute sustained abstinence from delinquency and cumulative incidence of violence through age 19 as well as past-year prevalence of both outcomes at age 19. We also examined the number of different delinquent acts (ranging from 0 to 7) and number of different violent behaviors (ranging from 0 to 3) in the past year. At age 19, respondents were also asked whether they had ever and in the past year spent time in a juvenile detention or a juvenile or adult correction center (yes/no) and whether they had been convicted of a crime in the past year (yes/no).

Secondary Outcomes

Secondary outcomes included past-year prevalence of nicotine dependence and diagnosis of disorder with respect to alcohol, marijuana, and illicit drug use; suicidality; major depression diagnosis; high school graduation; college attendance; teen pregnancy; and sexual risk behaviors, including having multiple sexual partners, drinking alcohol or using drugs before the last sexual encounter, not using a condom during the last sexual encounter, having received money or drugs in exchange for sex, diagnosis of HIV/AIDS or other STDs, and their partners having STDs. Measurement details for secondary outcomes are included in Table B1 in Online Appendix B.

Adolescent and Community Characteristics

Individual-level covariates, based on self-reports by students, included age, sex, race (White vs. non-White), Hispanic ethnicity (Hispanic vs. non-Hispanic), parental education (1 = *grade school or less* to 6 = *graduate or professional degree*), attendance at religious services in Grade 5 at baseline (1 = *never*–4 = *about once a week or more*), and rebelliousness at baseline (mean of three items; Cronbach's $\alpha = .69$). Community-level covariates included the total population of students in the community ($M = 2628$; $SD = 1917$) as a measure of population size and the percentage of students eligible for free or reduced-price school lunch ($M = 38.2\%$; $SD = 13.8\%$) as a measure of community poverty, both assessed for the 2003–2004 school year (National Center for Education Statistics 2002–2003).

Analyses

Missing data were imputed using multiple imputations to obtain unbiased estimates of model parameters and their standard errors assuming that data were missing at random (Schafer and Graham 2002). Using NORM version 2.03 (Schafer 2000), 40 datasets including data from all eight waves were imputed separately by intervention group (Graham et al. 2006). Analyses were conducted within each imputed dataset for the still-living sample ($n = 4388$) and then averaged using Rubin's rules as implemented in HLM 7 (Raudenbush et al. 2011; Rubin 1987).

All analyses used the intent-to-treat (ITT) design. Because communities rather than adolescents were randomized within matched community pairs, the effect of CTC was estimated as the mean difference in the dependent variables between intervention and control communities. Since community randomization does not guarantee equivalent individual-level samples in both intervention groups, all analyses adjusted for adolescent

and community characteristics and the pre-intervention baseline measure of the outcome to improve the precision of estimated intervention effects (Murray 1998). Where a baseline measure was not available (e.g., substance use disorder, sexual risk behavior), another correlated baseline covariate was used (e.g., baseline alcohol use). All covariates were grand-mean centered. Sustained abstinence and cumulative incidence at age 19 were assessed among those who had not yet engaged in the behavior at baseline. Current prevalence at age 19 was examined in the full sample.

Generalized linear mixed models (GLMM; Breslow and Clayton 1993) with random effects for intercepts were used to model variability in outcomes across adolescents, 24 communities, and 12 community pairs. Poisson regression with a log link, binomial error distribution, and overdispersion was used to estimate adjusted risk ratios (ARRs) and prevalence ratios (APRs) and their confidence intervals (CI). Poisson rather than logistic regression was used because odds ratios from logistic regression do not approximate risk or prevalence ratios when the prevalence of an outcome is high (Cummings 2009). Gender differences were examined, first, in separate analyses for males and females to estimate ARR and APR and their CIs for each gender. Second, a cross-level interaction term was included in the analyses using the full sample to test whether the effect of CTC differed significantly by gender. The statistical significance of intervention effects was tested with 9 degrees of freedom (*df*) and a .05 Type I error rate (two-tailed). The significance of the gender by CTC intervention interactions was tested with 7 *df*. All analyses were conducted using HLM 7 (Raudenbush et al. 2011) and population-average results are reported (Zeger et al. 1988).

Because CTC is designed to address locally specific behavioral health problems that each community prioritizes and targets based on the assessment of its unique risk profile, CTC does not target the same outcomes across all communities. We, therefore, did not necessarily expect to find significant intervention effects on all examined outcomes. For this reason, we used a global test (Feng and Thompson 2002) to evaluate the overall effect of CTC across the primary outcomes of lifetime and current substance use and delinquency and across all secondary outcomes. The global test is based on the average *t*-value from the individual GLMM analyses, taking into account the variation between communities and the community-level correlation among outcomes (Feng and Thompson 2002). The global test also adjusts for the increased risk of a Type I error, which was important in this study where the consideration of primary and secondary outcomes increased the number of dependent variables and statistical tests.

Results

Full Sample

There was no significant overall effect of CTC in the full sample on the cumulative incidence of and abstinence from substance use and delinquency through age 19 (global $t = -.941, p = .367$), past-month substance use (global $t = .491, p = .633$), past-year substance use and delinquency (global $t = .908, p = .384$), or the secondary outcomes (global $t = -1.059, p = .312$). Results from analyses of individual outcomes (Online Appendix C) indicated, however, that CTC significantly increased the prevalence of abstinence from

delinquency by age 19 in the full sample ($ARR = 1.16$; $CI\ 1.00, 1.33$; $p = .049$). CTC had a marginally significant effect on reducing violence initiation ($ARR = .897$, $CI\ .796, 1.011$; $p = .070$). CTC did not impact the variety of past-year delinquent behaviors [adjusted event ratio (AER) = 1.065 , $CI\ .896, 1.267$; $p = .430$] or violent behaviors (AER = 1.050 , $CI\ .840, 1.312$; $p = .635$), nor the prevalence of past-year incarceration and convictions (results available upon request). Results for individual outcomes also revealed a significant effect in the unexpected direction for past-month and past-year ecstasy use (see “Discussion” section).

Analyses by Gender

Global tests indicated that CTC had a significant overall effect on the incidence of and abstinence from substance use and delinquency for males (global $t = -2.314$, $p = .041$) but not females (global $t = .393$, $p = .702$). CTC did not have an overall impact for either gender on past-month substance use (males: global $t = -.796$, $p = .443$; females: global $t = 1.430$, $p = .181$), past-year substance use and delinquency (males: global $t = -.083$, $p = .935$; females: global $t = 1.467$, $p = .170$), or secondary outcomes (males: global $t = -1.175$, $p = .265$; females: global $t = .126$, $p = .902$). Results by gender for each outcome are available in Online Appendix D.

We also examined effects on specific outcomes to identify which behaviors were most strongly improved for males and females. Figures 2 and 3 show the model-predicted prevalence and ARR with their confidence intervals by gender for each abstinence (Fig. 2) and incidence (Fig. 3) measure. Results from subgroup analyses by gender indicated that males in CTC communities compared to males in control communities were significantly more likely to have abstained from any delinquent behavior ($ARR = 1.33$; $p = .021$) and from ever using cigarettes ($ARR = 1.22$; $p = .013$). There were no statistically significant sustained effects of CTC on abstinence and incidence of substance use and delinquency among females at age 19.

CTC did not have a statistically significant effect in the desired direction on other specific primary or secondary outcomes for males or females. Subgroup analyses by gender revealed, however, three significant effects of CTC that favored the control communities. The prevalence of current ecstasy use (in the past month and the past year) was higher among females in CTC compared to females in control communities. More males in CTC compared to males in control communities reported having received money or drugs in exchange for sex in the past year. However, the validity of these results is doubtful given the number of specific outcomes examined in this study. Some significant findings in the undesirable direction are expected by chance; hence, we have focused on interpreting global tests. The reliability of the results also is questionable given the sparseness of data for these outcomes. Only two or three youth per community, on average, reported these behaviors, in four communities, no youth reported using ecstasy in the past month, and in seven communities no one reported having received money or drugs in exchange for sex.

Discussion

The current study assessed long-term effects of a preventive community system on adolescent behavioral health problems in a community-randomized trial. It is one of a few studies to investigate if earlier community-wide impacts on substance use, delinquency, and violence were maintained, diminished, strengthened, or expanded to other behaviors and problems that have their onset in late adolescence. Similar to the PROSPER community-university partnership system, CTC was found previously to have long-term effects on primary outcomes, including incidence of substance use, delinquency, and violence through 12th grade, 8 years post baseline and 3 years after study support for the interventions ended (Hawkins et al. 2014). Effect sizes in both trials ranged similarly from about 12 to 32 % in relative prevalence or risk reduction (Spoth et al. 2013). The present study extended the analysis by another year to beyond high school and 9 years post baseline and found sustained long-term effects of CTC on continued abstinence from delinquency through age 19, particularly among males. As indicated by the global test, young men in CTC communities continued to show greater abstinence overall from all substances and delinquency through age 19 as well as greater abstinence from cigarette smoking, specifically. Sustained long-term effects were not found for females, for past-month or past-year substance use or delinquency, or for secondary outcomes at age 19. Reductions in current substance use and delinquent behavior were observed through Grade 10, but not in Grade 12 or at age 19.

The sustained impact of CTC on abstinence from delinquency and smoking initiation is important given that delinquent behaviors tend to peak in adolescence when outcomes were assessed (Elliott 1994), the strong addictive nature of tobacco (Kendler et al. 2013), and also the significant costs to society of both criminal behaviors and smoking (McCollister et al. 2010; Parrott and Godfrey 2004). Benefit-cost analyses of CTC effects on behavioral outcomes measured in Grades 8 and 12 showed economic benefits of CTC were largely due to preventing the initiation of delinquent behavior, with some additional benefit from sustained abstinence from cigarette smoking and alcohol use initiation (Kuklinski et al. 2012, 2015).

The fact that intervention effects were found for males but not females is inconsistent with the universal intent of CTC. Intervention communities in the trial did not target specific gender groups with preventive interventions, and none of the 18 interventions implemented across CTC communities showed strong or consistent gender differences when evaluated in high-quality studies. However, several factors may have contributed to the observed results. The adopted programs may have targeted risk factors that are more prevalent or more strongly linked to behaviors for males compared to females, such as poor parental monitoring and exposure to delinquent peers (Fagan et al. 2007; Moffitt et al. 2001). Males may also be more responsive than females to changes in community-level practices and norms, such as those targeted by CTC. Other community-based interventions have shown stronger effects for males and/or iatrogenic effects for females but not males (Flay et al. 2004; Perry et al. 2003; Yin and Ware 2000). These hypotheses are speculative, however, and should be tested using mediational analyses (Gabrhelik et al. 2012) to examine if changes in particular risk factors are associated with differential effects across gender.

Finally, some behaviors may be more prevalent among males and, thus, have more room to decline in response to an intervention. This is plausible for delinquency where the prevalence was at least 10 percentage points higher among males than females in this sample, but is less plausible for smoking. Consistent with national data (Johnston et al. 2013b), the prevalence of tobacco and other substance use did not differ much by gender in this study.

This study had some limitations. First, the communities in the trial were all small free-standing incorporated towns in western, mid-western, and northeastern states. The findings may not generalize to suburban and urban cities and locations in other parts of the United States, such as the south. Second, the study was designed to examine main effects across 12 community pairs. Power to detect meaningful gender interactions may have been limited. Third, behavioral outcomes were measured by youth self-reports, which may be biased by social desirability or dishonesty. We would expect this type of measurement error to be non-differential according to study condition, which would lead to conservative estimate of effects. Nevertheless, to increase validity of the data we excluded some respondents from the analysis based on several validity screens, including implausible patterns of drug use, self-reported dishonesty, and reported use of a fictitious drug.

This study also had several important strengths. First, retention rates were excellent through age 19 (91 %) and did not differ by condition, maintaining high validity of data analyses. Second, the study examined long-term effects of CTC not only on primary but also on secondary outcomes becoming salient during late adolescence, the developmental period considered in this study, including substance use disorder, educational outcomes, mental health, and sexual risk behaviors. Effects on secondary outcomes were hypothesized because the risk and protective factors targeted by CTC communities predict these behaviors. In fact, mean levels of community-targeted risk factors were found to grow less rapidly from Grade 5 to Grade 10 and were significantly lower in 10th grade in CTC compared to control communities (Hawkins et al. 2012). However, effects on secondary outcomes were not found at age 19. Consideration of primary and secondary outcomes in this study increased the number of dependent variables and statistical tests. We have taken several approaches to control the risk of a Type I error when making statistical inferences: (a) we identified primary and secondary outcomes at the outset of the study (D'Agostino 2000); (b) we calculated global tests across multiple outcomes to identify overall intervention effects on primary and secondary outcomes; and (c) we examined the effect of CTC on composite measures of any substance use and gateway drugs as well as on individual substances to be able to detect general effects of CTC as well as effects on specific substances.

This study found important sustained long-term effects of CTC 9 years beyond baseline on continued abstinence from delinquency overall and on delinquency and smoking through age 19 for males specifically. However, the study did not find sustained effects on current drug use or delinquency or on the examined secondary outcomes. Late adolescence is a time when youth begin to move away from the parental home and gain greater independence, but also face new risks as they move into young adulthood. The present ITT analyses did not take into account whether youth were still living with their parents or had moved away from the original study community. Supplementary analyses beyond the scope of this report will

need to examine if sustained effects of CTC were stronger or broader for those youths who were still living in CYDS communities at age 19. The limited sustained effects overall also suggest that CTC communities may need to include in their prevention planning continued programming during the high school years and maybe even focused on late adolescence and early young adulthood to sustain earlier observed reductions beyond high school. Booster sessions during high school helped, for example, to extend positive effects in the Project Northland study (Perry et al. 2002) and may also strengthen long-term effects of CTC, including on secondary outcomes (Farrington and Welsh 2013).

Finally, the fact that CTC effects were stronger among males than females suggests that communities using the CTC framework might consider taking gender into account when planning and implementing prevention programs. For example, they may examine student survey results separately by gender to determine if males and females report different levels of risk and protective factor exposure and ensure that prevention programs address the needs of both sexes. Analyses of gender differences in the impact of community-based interventions and greater theoretical attention to differences in exposure to and salience of community influences for males and females are important as to date little such work exists (Fagan and Lindsey 2014; Zahn and Browne 2009).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Fig. 1.
Flow of communities and participants in the randomized trial

Fig. 2.

Adjusted risk ratios (CTC vs. control) and 95 % CIs for abstinence from substance use and delinquency by age 19 among baseline non-initiators

Fig. 3.

Adjusted risk ratios (CTC vs. control) and 95 % CIs for cumulative incidence of substance use and violence by age 19 among baseline non-initiators