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Public Health Benefits 16 Years After a Statewide Policy Change: Communities That Care in Pennsylvania

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Abstract

Communities That Care (CTC), an evidence-based prevention system, has been installed outside of a research context in over 500 communities worldwide. Yet, its effectiveness in a non-research context is unknown. Using a repeated cross-sectional design with propensity score weighting at the school district-level, the purpose of this study was to examine the effect of widespread diffusion of CTC across Pennsylvania on adolescent substance use, delinquency, and depression. Anonymous youth survey data were collected from 6th, 8th, 10th, and 12th grade students every other year from 2001 to 2011. Three-hundred eighty-eight school districts participated in one to six waves of data collection during that time, resulting in a total of 470,798 student-reported observations. The intervention school districts received programming provided by CTC coalitions. Outcome measures were lifetime and past 30-day alcohol, tobacco, marijuana, and other drug use. Lifetime and past year participation in delinquency and current depressive symptoms were also analyzed. Analyses revealed that CTC school districts had significantly lower levels of adolescent substance use, delinquency, and depression. This effect was small to moderate, depending on the particular outcome studied. Overall effects became stronger after accounting for use of evidence-based programs; there are likely differences in implementation quality and other factors that contribute to the observed overall small effect size. Future research needs to unpack these factors.

Keywords Communities That Care (CTC) · Effectiveness · Policy change · Evidence-based programs · Dissemination · Outcomes

Over the last 30 years, the number of youth or family-focused programs that have strong evidence of preventing substance use, delinquency, and other poor mental health outcomes has grown considerably; depending on the source, there are now between 50 and 80 universal, selective, or indicated prevention programs (Offord 2000) that have strong preventive effects of substance use, delinquency, depression, anxiety, and other poor outcomes in high-quality experimental trials (Center for the Study and Prevention of Violence 2012; National Research Council and Institute of Medicine 2009). Despite their potential for improving public health, these programs are not commonly used (Hawkins et al. 2015). Only recently has research evidence started to inform program and policy decisions (Greenberg and Abenavoli 2017).

Adopting a prevention system such as Communities That Care (CTC) (Hawkins et al. 2008) or PROSPER (Spoth et al. 2004) can facilitate the use of evidence-based programs (EBPs). In fact, both models have strong evidence of effectiveness in well-funded efficacy trials (Oesterle et al. 2018; Spoth et al. 2017) and have been disseminated beyond the controlled research context. Yet, limited evidence of effectiveness outside of the controlled research context exists (Feinberg et al. 2010). Continuing to measure the fidelity and impact is needed to ensure that the positive outcomes are continually met and public resources are being used effectively. Consequently, the goal of this study is to examine the effectiveness of the natural dissemination of CTC in Pennsylvania.

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Communities That Care

Overview

CTC takes a public health approach to addressing the needs of youth at the community level (Hawkins et al. 2002). Involved stakeholders define the targeted "community" area and receive training in prevention science methods and data-based decision-making (Brown et al. 2011). Following this training, the coalition reviews their youth survey and other needs assessment data to prioritize elevated risk and depressed protective factors, and negative outcomes for intervention. After identifying priorities and programming gaps, the coalition matches existing EBPs to their identified priorities and demographics. Then, the coalition and program providers are trained in intervention and implementation monitoring protocols, while also learning about the importance of fidelity and high implementation quality. Program implementation unfolds with an integrated continuous quality improvement process, tracking outcomes and making adjustments when needed. This process continues in cycles as CTC provides tools to empower coalitions to recognize their achievements and reassess their risk/protective factors, and outcomes over time. In practice, this means that CTC coalitions can prioritize different outcomes and risk/protective factors from each other, and they can select programs that meet youth and families at different points throughout the life course, from pregnancy, preschool, school age, or through adulthood.

This type of approach supports sustainability of efforts by enhancing stakeholder knowledge, skills, buy-in, and commitment (Crowley et al. 2012; Feinberg et al. 2002; Hawkins et al. 2002). Furthermore, empirical research has determined that the CTC process can transform how local prevention systems work, from one in which isolated decisions are made to one in which multiple stakeholders make strategic and coordinated data-based decisions about youth and family programs (Brown et al. 2011). This improvement significantly relates to decreases in adolescent substance use in the CTC randomized controlled trial of 24 communities (Brown et al. 2014).

Results using a longitudinal prospective panel have consistently found positive effects for CTC through and after high school on a range of substance use and delinquent behaviors (Oesterle et al. 2018). CTC has now been disseminated broadly (Haggerty 2018). Are the results from well-resourced research trials generalizable to real-world conditions?

The Pennsylvania Experience

The adoption of CTC in Pennsylvania began in 1992 when federal Title V funds were received by the Pennsylvania Commission on Crime and Delinquency (PCCD) to support local delinquency prevention programming (Feinberg et al. 2010; Pennington and Kolchin 2008). Following this receipt, PCCD changed how they awarded communities funds to combat juvenile delinquency and starting in 1995, public dollars became available to communities through a granting mechanism to implement the CTC process, which includes EBPs. Between 1995 and 2002, 127 sites were given three-year start-up funding to install the CTC process. Ninety percent of the coalitions were still in existence at the end of the initial 3 years, and the majority of coalitions continued their efforts past the initial 3-year start-up funds (Feinberg et al. 2008). Each applicant was free to define their targeted community or communities, and coalitions received training in CTC.

Also during this time, in 1998, the PCCD began investing in EBPs outside of CTC coalitions, and by 2008 funded over 149 programs affecting more than half of the counties in the state. Together, the investment in CTC and in sole-standing EBPs delivered within organizations have created a large influx of EBPs across Pennsylvania (Pennington and Kolchin 2008).

Challenges of Evaluation

Though continuing to evaluate the effectiveness of prevention efforts after the intensive research phase is necessary, evaluations of natural dissemination efforts are extremely complex. Often there are few allotted resources. Evaluation is not always planned in advance and as a result draws from pre-existing data. Not planning in advance limits the design to quasi-experimental, retrospective, or post-test only, rather than the stronger prospective, longitudinal, and experimental designs that better address threats to internal and external validity (Cook and Campbell 1979). Weaker designs tend to be unable to detect a positive significant effect (Rhew et al. 2016) or can overestimate an intervention effect, if matching of the comparison sample is ineffective (Cook and Campbell 1979).

There are also additional challenges specific to evaluating CTC. In a natural dissemination, there could be differences between the communities that apply for the CTC funds and those that do not, and differences between those that are successful with their CTC application and those that are not. Students may leave (or enter) school districts implementing CTC-related programs, thereby limiting intervention exposure on youth identified in an intervention group. Project activities are determined by the skills, interest, commitment, transitions and turnover, and other factors that naturally occur. Consequently, the implementation of EBPs and coalition efforts may start and stop unexpectedly without documentation. CTC coalitions also typically define their targeted geographic area and population (i.e., school district, county, city, etc.), and they may choose to target individuals across ages zero to 18, and into adulthood. Each community, by design, identifies their own priorities and selects their own programs which

may change over time. Funding to communities to sustain this process can vary over time. All of these challenges make it more difficult to capture a positive intervention effect.

Lastly, the CTC process emphasizes using universal interventions, carrying inherent challenges for evaluation (Greenberg and Abenavoli 2017). Universal interventions include youth that are at high risk of experiencing the targeted outcome and youth that are at low risk of experiencing the targeted outcome; it is possible that the intervention does not produce the same effect across all individuals (Greenberg and Abenavoli 2017). Therefore, the true effects of the intervention may be underrepresented as sometimes universal interventions have the strongest effect on the highest risk individuals (Greenberg and Abenavoli 2017). Certainly, however, assessing the effectiveness of multiple programs on different communities can demonstrate how such a delivery system addresses the needs of heterogeneous individuals and communities, thereby increasing the public health significance of any positive findings. Altogether, evaluating the continued effectiveness of community prevention efforts is important, and evidence of continued effectiveness would suggest that investing public resources is worthwhile.

Current Study

The current study lies at the intersection of these issues. This study utilizes data collected from CTC coalitions about programming across an 11-year period, and from the Pennsylvania Youth Survey to assess the effectiveness of CTC on preventing and reducing youth substance use, delinquency, and depression. Using a quasi-experimental design with propensity score weighting at the school district-level, we expect that school districts that received CTC programming will have lower levels of youth substance use, delinquency, and depression. Furthermore, we expect that the association between CTC and youth outcomes will become stronger when CTC coalitions implement EBPs. We use school districts as the unit of analyses because (1) often one coalition serves one or more school districts with programming, (2) need-based programming varied across school districts, (3) an entire school district's needs were typically considered when making programming decisions, and (4) collection of the data available for this evaluation was often organized at the school district level.

Methods

Sample

Pennsylvania Statewide This study takes place in the Commonwealth of Pennsylvania, population over 12 million. With the exception of Pittsburgh and Philadelphia, the state is largely rural. The state has 500 school districts across 67 counties. Overall, 22.0% of its population is under the age of 18. Residents are majority White (82.4%), with Black (11.8%) as the second largest racial/ethnic group; 7.0% of the population reported Hispanic/Latino descent. The medium household income is $53,599, with a poverty rate of 12.9% (United States Census Bureau 2017). Drawing from early administration of the Pennsylvania Youth Survey, rates of alcohol use among youth have been higher in Pennsylvania compared to national norms, and within-state use rates of other substances are typically lower than national norms, but increased throughout the 1990s (Channing Bete Company Inc. 2002). These characteristics made the adoption of CTC a timely policy change aimed at preventing substance abuse and delinquency. This study was approved by the Pennsylvania State University Institutional Review Board.

Youth Sample Across the 11 study years, 418 school districts participated in the survey at least once. Prior to analyses, we deleted students from Pittsburgh and Philadelphia because those cities were not served by CTC, their participation in the youth survey was limited, and their urban setting differs from the rest of the sample which could overly influence our propensity score weighting procedure. Some individual records were missing district and school identifiers, and we were also missing data on some covariates used to create the weights. Consequently, we dropped those school districts from the analyses. This resulted with a total 388 school districts represented over time (1–6 waves of data collected for each district, $M = 2.48$). Overall, 470,795 student-reported observations were recorded across the 6-wave, 11-year data collection period. On average, 496 youth participated in each district, each year (49.5% male).

Coalition Sample Ninety-five out of the 97 CTC coalitions invited to share information about their programs participated in at least one wave of data collection across study years. On average, 72% of invited coalitions participated at each time points (2001, 2003, 2005, 2007, 2009, and 2011). Program reporting was voluntary; lack of participation could have been because of a pause in coalition activities, a pause in program implementation, or a simple refusal. On average, coalitions reported implementing programs in 2–3 districts each year (range 1–18).

Procedures

The Pennsylvania Youth Survey The PAYS is an anonymous survey assessing risk/protective factors, substance use, and delinquency drawn from the CTC Youth Survey (Feinberg et al. 2007). Beginning in 2001, a stratified and randomly selected state-representative sample was surveyed every

2 years with students in grades 6, 8, 10, and 12 in a repeated cross-sectional design. Other districts were invited to participate. District-level youth participation rates vary across time (range = 30 to 80%).

The CTC Program Survey Coalition lead staff reported programs implemented in targeted districts yearly in two different ways. The 2001–2004 data were collected retrospectively with phone calls by university-based research staff to each lead coalition staff in 2004. Starting in 2005, these data were collected using a web-based survey. Response rates averaged 75%.

Measures

Youth Outcomes All dependent variables came from the CTC Youth Survey (Arthur et al. 2007). Ten dependent variables measured *substance use*. Use in the past 30 days and lifetime use were reported for alcohol, cigarettes, and marijuana (0 = None; 1 = at least once). More severe substance use was captured with four measures scored as dichotomous (0 = zero, or none; 1 = at least once/one): (a) drunk or high at school in the last 12 months; (b) binge drinking in the last 2 weeks; (c) any drug use in the last 30 days (smokeless tobacco, cigarettes, alcohol, marijuana, cocaine, inhalants, hallucinogens); and (d) any drug use in their lifetime (marijuana, cocaine, inhalants, hallucinogens, meth, crack, steroids, heroin, ecstasy). *Delinquency* was measured with five items. Students reported whether or not they were suspended, sold illegal drugs, stole a vehicle, been arrested, or attacked someone to hurt them, at least once in the last 12 months. Students reported whether or not they had ever been in a gang. *Depression* was captured with a 4 item mean ($\alpha = .88$); an example item is, "sometimes I think that life is not worth it."

Youth Covariates Three student covariates were used: (a) student-reported gender (0 = female; 1 = male); (b) student-reported grade (0 = 6th; 1 = 7th; 2 = 8th; 3 = 9th; 4 = 10th; 5 = 11th; 6 = 12th); (c) family risk. Family risk was a 12-item summary that included six family history items and six parental attitudes of substance use and antisocial behavior items (Feinberg et al. 2007).

Defining the Intervention Condition Whether a school district was served by a CTC was deduced from the data collected in the CTC Program survey. The survey recorded which CTC coalitions implemented which programs in which districts, and at which grade(s). Over 300 programs, policies, events, or activities were nominated at least once across the study years.

We created a list of CTC-served districts for each survey year. A school district was included if their catchment area was reported as being served by any CTC program, policy, event, or activity implemented in any setting and targeted to any grade/age group, in the past year (CTC = 1). School districts that were not nominated were assigned the comparison condition (CTC = 0). Due to concerns regarding missing data and spillover effects, school districts that were served by a CTC in 1 year, but later not nominated were dropped for those particular years. We listed district-level CTC frequencies across time in supplementary Table S1 (available online).

Coding Level of Evidence Two researchers rated all submitted programs, policies, events, and activities for level of evidence. This rating was scored as evidence-based = 1; not evidence-based = 0 (see supplementary Tables S2 and S3, and text (available online) for details).

District-Level Covariates District-level scores of US Census and American Community Survey variables were used to create propensity weights (United States Census Bureau 2010). Variables came from the poverty, migration, income, household type, household tenure, household size, educational attainment, and commuting tables (2000, 2010). Only variables that could be theorized to affect the chance each school district would be served by CTC were used.

Analyses

Preliminary Analyses Three sets of preliminary analyses were conducted. First, students that responded affirmatively to using a fictitious drug were dropped. Second, we examined missing data on outcomes and determined it to be low (< 5%); consequently, analyses did not impute any dependent variables. However, 25% of youth were missing the family risk covariate due to their school district choosing to administer the PAYS without the family items; this occurred more often in non-CTC districts. Additionally, youth in CTC school districts had significantly higher levels of family risk. Given that others have controlled for child risk in prior community prevention research projects (Spoth et al. 2017), and given the imbalance of family risk between our intervention and control samples, we used proc. mi in SAS version 9.4 to impute missing values for family risk in five datasets. Third, descriptive statistics were estimated.

Propensity Models All collected data were observational; we did not have a pretest. Consequently, we used inverse probability weighting to construct equivalent intervention and comparison samples at each wave to test the intervention effect. The weights create a balanced distribution of common co-founders in the intervention and comparison condition, thus reducing potential confounding bias. We used proc logistic in SAS version 9.4 rather than multi-level mixed models as the purpose was to generate propensity weights, not to interpret coefficients. We used a stepwise procedure to identify

variables (Steiner et al. 2010) and weighted by the inverse probability, in which the inverse of the probability weighted each observation in the treated group, and the inverse of one minus the probability weighted controls (Hirano and Imbens 2001; Imbens 2000). No individual-level data were used. District-level estimates from the US Census and the American Community Survey in 2000 were used for 2001 through 2007. We used district-level data from 2010 for 2009 and 2011. Twenty-seven variables created the weights; the number of communities in each year ranged from 42 to 131; supplementary Table S1 (available online) lists specific yearly n's by condition. Variables included district-level aggregate indicators of family size, employment, education, racial/ethnic composition, population size, and marital status. Weights were stabilized. The two samples were balanced on each district-level covariate and no overly influential outliers were found (Austin and Stuart 2015). Table S4 (available online) includes the final list of variables.

Hypothesis Testing Two sets of analyses tested hypotheses. First, proc surveyfreq (SAS 9.4) estimated unadjusted odds ratios for the dichotomous variables with the weighted sample. Unadjusted odds ratios estimated how likely the outcome was experienced by individuals exposed to the intervention group. This test supports transparency of all results.

Second, a combination of proc mi, proc glimmix (or hpmixed for the one linear variable), and proc mianalyze tested our hypotheses with the weighted data and imputed (SAS 9.4). Because students could not be identified over time, three level models in which students (level 1) were nested within survey year (i.e., time point, level 2), and year was repeated within district (level 3), were estimated. This strategy was found robust (Feinberg et al. 2010). Intervention status was time-varying at the district-level.

Student-level covariates included gender, grade level, and family risk. We conducted a linear transformation on the self-reported grade from each student by subtracting the district mean grade level from the student-reported grade to create a district-centered grade for each student. This linear transformation controlled for the district-level imbalance of surveyed grade levels. Following prior research, all models also included the mean grade level surveyed in the district as a district-level covariate (Feinberg et al. 2010). Models for dichotomous outcomes used a binomial logit link; only the depression variable was continuous. Final parameter estimates and adjusted odds ratios were computed by SAS.

Two models were run using these specifications. The first model, model 1, compared the full intervention sample (CTC All) to the comparison group. The second model, model 2, divided the full intervention sample into two groups: those districts that received at least one evidence-based program (CTC + EBP), and those districts that were involved with CTC programming but that programming was not an evidence-based program (CTC only). Then, the hypothesis test compared CTC + EBP districts to those districts not at all involved with CTC programming, the comparison group. We limited our tests to the CTC + EBP group versus the comparison to be consistent with prior research and to limit the number of comparisons.

Results

Descriptive Statistics

A total of 388 districts participated in the study across Pennsylvania between 2001 and 2011. Across time, 51.6% of these districts were served by a CTC coalition and 19.6% used EBP (range $min = 3$ in 2001 to $max = 91$ in 2007). Regarding substance use, past 30-day use of alcohol, cigarettes, and marijuana was 24.0%, 11.9%, and 9.3%, respectively. Any lifetime use was 53.4% for alcohol, 26.9% for cigarettes, and 17.7% for marijuana. The majority of students reported no binge drinking episodes in the past 2 weeks and no instances of being drunk or high at school in the past year. Levels of any drug use for the past 30 days and lifetime were moderately low. Rates of other delinquency activities were lower (see Table 1).

Effect of CTC Versus Comparison

Unadjusted Associations Before estimating the complex multi-level models, crude associations between CTC intervention and dichotomous indicators of substance use and delinquency were calculated (Table 2). Table 2 also displays the prevalence rate of each outcome with the weighted data in the comparison sample, the CTC-All sample, and the CTC + EBP sample. The crude findings indicate that individuals in CTC districts were significantly less likely to report 14 out of the 17 outcomes studied. The three non-significant outcomes included being in a gang, attacking someone to hurt them, and stealing a vehicle. The strongest effects were found for drunk or high at school and lifetime marijuana use.

Adjusted Associations Twelve (out of 16, one was not able to be estimated) significant differences remained in the substance use and delinquency models after accounting for multiple covariates (see Model 1, Table 3). Significant substance use variables included 30-day alcohol use, past 30-day and lifetime cigarette use; past 30-day and lifetime marijuana use; any lifetime use of any drug. Drunk or high at school and binge drinking in the

Table 1 Descriptive statistics of weighted district-level Pennsylvania Youth Survey sample

	n	Mean	SD	Frequency	Percent
Individual-level covariates					
Gender—male	470,798	–	–	232,792	50.0
Grade	470,798	8.882	2.095	–	–
Grade difference	470,798	−0.000	1.905	–	–
Family risk	335,327	0.471	0.521	–	–
Family risk—imputed	2,353,990	0.476	0.535	–	–
District-level covariate					
Grade mean	962	8.921	1.122	–	–
Outcomes—substance use					
Alcohol use					
30 day	458,638	–	–	109,867	24.0
Lifetime	452,486	–	–	241,444	53.4
Cigarette use					
30 day	460,162	–	–	54,415	11.9
Lifetime	458,872	–	–	123,376	26.9
Marijuana use					
30 day	457,728	–	–	42,336	9.3
Lifetime	451,693	–	–	79,858	17.7
Drunk or high at school	457,808	–	–	38,609	8.4
Binge drinking	455,741	–	–	59,880	13.2
Multi-drug use					
30 day	465,049	–	–	140,553	30.3
Lifetime	421,322	–	–	101,398	24.1
Outcomes—delinquency					
Gang involvement					
Lifetime	456,094	–	–	25,963	5.7
Arrested					
Past 12 months	452,692	–	–	18,357	4.1
Lifetime	452,458	–	–	25,021	5.5
Past 12 months					
Attacked to hurt	452,518	–	–	44,035	9.7
Suspended	453,082	–	–	36,803	8.1
Sold illegal drugs	452,951	–	–	19,655	4.3
Stolen vehicle	454,516	–	–	7749	1.7
Depression symptoms	397,949	0.821	0.810	–	–

past 2 weeks were also lower in CTC districts. Regarding delinquency, youth in intervention districts reported significantly lower likelihood of ever been arrested, been arrested in the last 12 months, suspended in the last 12 months, or sold illegal drugs in the last 12 months. Significant odds ratios ranged from 0.85 to 0.95, indicating that the odds of experiencing the substance use or delinquency outcome ranged from 15% less likely to 5% less likely for students in CTC districts. Students in CTC districts also reported significantly fewer depression symptoms than students in non-CTC districts.

Effect of CTC + EBP Versus Comparison

Unadjusted Associations Crude associations between CTC intervention with evidence-based programming and dichotomous outcomes were calculated before estimating the adjusted models. Analyses revealed stronger effects (Table 2). Unadjusted odds ratios indicate that individuals in CTC districts with evidence-based programming were again significantly less likely to report 14 out of the 17 studied variables. The strongest effects were found for past 30-day and lifetime marijuana use, and lifetime any drug use.

Table 2 Prevalence and unadjusted associations between CTC intervention, and CTC + EBP intervention and dichotomous measures of adolescent substance use and delinquency

	% comparison	% CTC All	Comparison vs. CTC All OR (LCL, UCL)	% CTC + EBP	Comparison vs. CTC + EBP OR (LCL, UCL)
Substance use					
Alcohol					
30 day	*24.60*	*23.60*	*0.95 (0.93, 0.96)*	*21.71*	*0.85 (0.83, 0.87)*
Lifetime	*54.58*	*52.62*	*0.92 (0.91, 0.94)*	*49.89*	*0.83 (0.82, 0.84)*
Cigarettes					
30 day	*12.18*	*11.62*	*0.94 (0.93, 0.96)*	*10.36*	*0.83 (0.81, 0.86)*
Lifetime	*27.67*	*26.39*	*0.94 (0.92, 0.95)*	*24.58*	*0.85 (0.84, 0.87)*
Marijuana					
30 day	*9.71*	*8.96*	*0.92 (0.90, 0.93)*	*7.75*	*0.78 (0.76, 0.80)*
Lifetime	*18.60*	*17.06*	*0.90 (0.89, 0.91)*	*15.07*	*0.78 (0.76, 0.79)*
Severe substance use					
Drunk or high at school	*8.92*	*8.10*	*0.90 (0.88, 0.92)*	*7.43*	*0.82 (0.80, 0.85)*
Binge drinking—2 weeks	*13.39*	*13.00*	*0.97 (0.95, 0.98)*	*11.79*	*0.86 (0.84, 0.89)*
Multi-drug use—30 day	*31.10*	*29.73*	*0.94 (0.93, 0.95)*	*28.04*	*0.86 (0.85, 0.88)*
Multi-drug use (lifetime)	*31.06*	*25.83*	*0.77 (0.75, 0.80)*	*25.03*	*0.74 (0.70, 0.79)*
Outcomes—delinquency					
Ever been in a gang—lifetime	3.95	5.75	1.02 (0.99, 1.04)	5.87	1.04 (1.01, 1.08)
Ever been arrested—lifetime	*5.78*	*5.36*	*0.92 (0.90, 0.95)*	*5.00*	*0.86 (0.83, 0.89)*
Arrested—12 months	*4.20*	*3.96*	*0.94 (0.91, 0.97)*	*3.73*	*0.88 (0.85, 0.92)*
Attacked to hurt—12 months	9.85	9.66	0.98 (0.96, 1.00)	9.80	0.99 (0.97, 1.02)
Suspended—12 months	*8.48*	*7.87*	*0.92 (0.90, 0.94)*	*7.51*	*0.88 (0.85, 0.90)*
Sold illegal drugs—12 months	*4.51*	*4.22*	*0.93 (0.91, 0.96)*	*3.86*	*0.85 (0.81, 0.88)*
Stolen vehicle—12 months	1.70	1.71	1.01 (0.97, 1.06)	1.63	0.96 (0.90, 1.03)

LCL lower limit of 95% confidence interval, *UCL* upper limit of 95% confidence interval, *OR* odds ratios describe the odds of experiencing the outcome given the exposure to the intervention (CTC All, or CTC + EBP); odds ratios significantly under 1 indicate that the outcome is less likely to occur given exposure to the intervention; italicized values indicate statistical significance

Adjusted Associations Multi-level models controlling for grade, gender, and family risk were then estimated for no-CTC communities compared to CTC + EBP for indicators of substance use, delinquency, and depression (see Model 2 in Table 3). Twelve out of 15 significant effects remained; two were unable to be estimated. Significant effects were slightly stronger compared to the CTC-All sample. Students in CTC + EBP districts were significantly less likely to have used alcohol in the past 30 days, cigarettes and marijuana for both 30-day and lifetime, and all more severe measures of substance use. The strongest effects were for both measures of marijuana use and any lifetime drug use. The odds of experiencing these outcomes were 22 to 26% less likely for students in CTC + EBP districts for the marijuana and any lifetime drug use outcomes. Students in CTC districts also reported significantly fewer depression symptoms than students in non-CTC districts.

Significant effects also remained for three out of the five estimated delinquency measures. Students in intervention districts were less likely to have been arrested (past 12 months, or in their lifetime), or suspended in the last 12 months than students in comparison districts.

Discussion

The current study evaluated the effect of the Pennsylvania policy investment in CTC with a quasi-experimental, repeated cross-sectional propensity score weighting design. We call this design repeated and cross-sectional because we cannot track individual student participation over time. It is quasi-experimental because of the propensity score weighting procedure used to balance the intervention and comparison samples. Despite the many challenges of this type of evaluation, a small significant preventive effect of CTC on youth outcomes was found school district-wide substance use, delinquency, and depressive symptoms. These results became slightly more consistent and stronger after accounting for EBP use. CTC

Table 3 Adjusted associations of CTC (model 1), and CTC + EBP (model 2) with all outcome measures

	Model 1[a] CTC vs. comparison b (*p* value)	Model 1b CTC vs. comparison AOR (LCL, UCL)	Model 2[a] CTC + EBP vs. comparison b (*p* value)	Model 2b CTC + EBP vs. comparison AOR (LCL, UCL)
Substance use				
Alcohol				
30 day	*− 0.050 (0.0369)*	*0.95 (0.91, 0.99)*	*− 0.086 (0.0023)*	*0.92 (0.87, 0.97)*
Lifetime	− .0.056 (0.0734)	0.95 (0.89, 1.01)	− 0.031 (0.3688)	0.97 (0.91, 1.04)
Cigarettes				
30 day	*− 0.122 (0.0012)*	*0.89 (0.82, 0.95)*	*− 0.198 (0.0000)*	*0.82 (0.75, 0.89)*
Lifetime	*− 0.121 (0.0004)*	*0.89 (0.83, 0.95)*	*− 0.183 (0.0000)*	*0.83 (0.77, 0.90)*
Marijuana				
30 day	*− 0.168 (0.0000)*	*0.85 (0.79, 0.91)*	*− 0.273 (0.0000)*	*0.76 (0.70, 0.83)*
Lifetime	*− 0.163 (0.0000)*	*0.85 (0.80, 0.90)*	*− 0.261 (0.0000)*	*0.77 (0.72, 0.83)*
Drunk or high at school	*− 0.140 (0.0000)*	*0.87 (0.82, 0.92)*	*− 0.198 (0.0000)*	*0.82 (0.77, 0.88)*
Binge drinking	*− 0.065 (0.0158)*	*0.94 (0.89, 0.99)*	*− 0.112 (0.0006)*	*0.89 (0.84, 0.95)*
Any drug use—30 day	− 0.035 (0.1126)	0.97 (0.92, 1.01)	*− 0.057 (0.0285)*	*0.95 (0.90, 0.99)*
Any drug use—lifetime	*− 0.102 (0.0000)*	*0.88 (0.81, 0.95)*	*− 0.107 (0.0000)*	*0.92 (0.82, 0.94)*
Outcomes—delinquency				
Ever been in a gang—lifetime	0.043 (0.1503)	1.04 (0.98, 1.11)	0.083 (0.0209)	1.09 (1.01, 1.17)
Ever been arrested—lifetime	*− 0.088 (0.0063)*	*0.92 (0.86, 0.98)*	*− 0.086 (0.0271)*	*0.92 (0.85, 0.99)*
Arrested—12 months	*− 0.118 (0.0013)*	*0.89 (0.83, 0.96)*	*− 0.105 (0.0178)*	*0.90 (0.83, 0.98)*
Attacked to hurt—12 months	− 0.038 (0.1120)	0.96 (0.92, 1.01)	− 0.031 (0.2785)	0.97 (0.92, 1.03)
Suspended—12 months	*− 0.095 (0.0116)*	*0.91 (0.84, 0.98)*	*− 0.125 (0.0037)*	*0.88 (0.81, 0.96)*
Sold illegal drugs—12 months	*− 0.146 (0.0000)*	*0.87 (0.81, 0.93)*	*nc*	*nc*
Stolen vehicle—12 months	*nc*	*nc*	*nc*	*nc*
Depression symptoms	*− 0.022 (0.046)*	–	*− 0.029 (0.0000)*	–

Italicized values are statistically significant; b = unstandardized regression coefficient, with the intervention condition scored a "1" and the comparison condition scored a "0"; a negative coefficient consequently indicates that the intervention condition is less likely to have experienced the outcome; *LCL* lower limit of 95% confidence interval; *UCL* upper limit of 95% confidence interval; *AOR* adjusted odds ratio; adjusted odds ratios are scored such that a number below 1 indicates that the intervention group was less likely to experience the outcome; [a] 3-level multi-level models were run for each outcome separately. Models controlled for grade, gender, and family risk at the individual-level. District-level controls included district average grade; all data were weighted at the district-level; *nc* = did not converge, results are not reported

coalitions that implemented EBPs in their targeted districts had better outcomes for youth.

The investment in EBPs within Pennsylvania has been expansive. The "comparison" group in the current study is likely not equivalent to a no-treatment comparison. Given Pennsylvania's additional investment in replicating EBPs outside of CTC (Pennington and Kolchin 2008), many youth in the comparison condition are likely to have been served by EBPs. In fact, usage rates of alcohol, tobacco, and marijuana estimated in the PAYS have dropped consistently and considerably (range 15 to 40%) in this sample since 2001. That the natural dissemination of CTC significantly improved outcomes in school districts above and beyond the positive change that was already occurring in Pennsylvania is remarkable. It also suggests that the needs assessment, priority selection, program selection processes, and fidelity monitoring support provided by the CTC coalitions to the organizations that implement programs improves program effectiveness.

Due to the 11-year study span, we included all programs implemented at any point across the study period and at all developmental periods (age 0—adulthood). This decision differs from prior research that only focused on programs targeting the middle school grade levels (Feinberg et al. 2010), and from the experimental research that directed coalitions to first implement programs targeting middle school (Hawkins et al. 2008). We counted programs such as Nurse Family Partnership in our CTC and CTC + EBP groups even though program effects would not be measured until the babies served by this program were in sixth grade (average 12 years old). In addition, this selective program targeted first time, low-income moms (Center for the Study and Prevention of Violence 2012; Offord 2000). Nurse Family Partnership and other similar programs are frequently selected by and connected to CTC coalitions, but reach a relatively small sample. CTC coalitions were also encouraged to select

universal programs, which typically include a much larger sample but are likely to impact youth at different risk-levels, differently (Greenberg and Abenavoli 2017). This study did not have those directives, making it more difficult to measure a significant preventive effect district-wide, compared to an individual-level effect. Yet, we found significant preventive effects of CTC and CTC + EBP across outcomes.

This evaluation was not longitudinal, and consequently pulled from pre-existing historical data about programming and youth outcomes. Recorded program data was often incomplete or recorded differently between sites. For example, a family-based program for youth ages 10–14 and their parents could have been recorded as a parent program in one school district and as a youth program by another. At times, the targeted grade level was not volunteered. At other times, a special age/grade or range of ages/grades were targeted for programming, which differed between communities. Consequently, we took a broad definition when creating our intervention groups. Any district that was reported to benefit from any CTC-related programs was marked as a "CTC" community, regardless of what program and grade level were targeted. The data became more unreliable at each lower level. Consequently, we are most confident about which districts in which years were exposed to CTC and CTC + EBP programming. This choice weakens the chance of finding a significant preventive effect, as grade levels that were not targets for programming are considered in this analysis. The program survey also had a 72% response rate; some coalitions did not respond due to a pause in functioning, and other coalitions did not respond due to personal choice. We took precautions to limit the possible effect of missing program data, yet we lost a significant amount of precision with these decisions, as well.

Due to the timing of the statewide investment, and the timing of the youth survey surveillance system, we were unable to determine a "pretest" measure for each school district. Consequently, we defined our intervention and control samples each year, and estimated the propensity weights each year. We can only interpret that the significant difference between the two samples is likely due to the intervention, as our propensity weighting procedure works to equalize the two conditions for each year. This decision, though best representing the timing of the intervention, also makes it more challenging to find a significant preventive effect of the intervention. It is possible that the overall observed effect, especially for the more severe outcomes, may be driven by larger significant differences in the upper grade levels, as rates of harder drug use and selling illegal drugs, stealing a car, etc. tend to be quite low throughout all of high school, but are highest in the upper grades (10th and 12th grade).

Pennsylvania adopted the CTC system a decade before it was validated. At the beginning, CTC endorsed a broad list of potential programs, policies, and practices (Hawkins et al. 2002), at least some of which are no longer suggested today (Center for the Study and Prevention of Violence 2012). The definition of what CTC considered an EBP has changed; the evidence base of programs has increased. Currently, there are 83 programs on the Blueprints for Healthy Youth Development program list (Center for the Study and Prevention of Violence 2012). CTC coalitions in Pennsylvania listed implementing over 300 different programs, policies, and practices across the study period, many of which did not meet our evidence-based criteria. Those coalitions not implementing EBPs would not be implementing CTC with fidelity given present day program guidelines. The training and technical assistance model currently offered to CTC communities is more thorough and proactive than it was when many Pennsylvania communities started, and it explicitly emphasizes the need to select programs from the Blueprints EBP list (Center for the Study and Prevention of Violence 2012). The differences between CTC and comparison communities were stronger when CTC coalitions utilized EBPs. It is likely that these results would be stronger if more CTC coalitions implemented EBPs. These results replicate prior research: EBPs significantly improve outcomes (Feinberg et al. 2010; Rhew et al. 2016).

This was a secondary data analysis of a natural dissemination; many other events may have impacted our results. For instance, whereas Pennsylvania started a large investment in CTC in the late 1990s, its investment began to wane in the later 2000s with the thinking that coalitions would continue programming without state resources. In reality, however, this is difficult and perhaps not prudent, as a continued statewide investment in EBPs would be expected to gain momentum and continually improve outcomes for youth and families, thereby continually saving tax dollars as new cohorts of youth experience programs at targeted ages. In addition, it is possible that additional covariates would predict whether or not a CTC actually implemented EBPs; not considering this may have weakened our results. This was an intent to treat analysis, including students that moved in and out of the intervention (and comparison) groups or switched conditions over time; there was no way to track individual-level exposure to the intervention. It is also possible that some programs had delayed effects that were not accurately captured with this analysis strategy. Future research can explore these limitations.

Implications for Future Work

Plan for Evaluation in Advance The state and federal policy landscape is changing with respect to substance use and science. For example, medical and recreational marijuana is becoming legalized. Some states are investing in EBPs,

prevention systems such as CTC, and the development of implementation support centers (Mettrick et al. 2015; Wandersman et al. 2008). Additionally, many states are actively considering comprehensive plans to address the opioid epidemic. Given this context, these results suggest that it is extremely important for statewide and community-wide prevention efforts to plan in advance for a high-quality evaluation (Patton 1997). It may be good enough to invest in systematic documentation of intervention-related processes such as the statewide and community-level events and outcomes. For example, state efforts could integrate regular statewide data collection strategies at the beginning of the effort (Mrazek et al. 2006). Planning focused on the different levels of analysis, levels of intervention assignment and implementation, and how to connect different types of data sources from different reporters is needed and would be aided by partnerships between prevention researchers and policymakers. A pretest with clearly defined cohorts, documenting the selection strategy, rationale, or rubric would increase the power of an evaluation (Cook and Campbell 1979). A longitudinal design to complement an anonymous statewide youth risk/protective factor and behavior surveillance system is also important to consider. Though typically more costly, a prospective randomized or quasi-experimental longitudinal design may be well worth the cost to document the success (or failure) of major youth and family-focused policy changes. Evaluation procedures that are flexible enough to support ongoing routine reporting, or annual summary reporting may also support buy-in and participation. Lastly, the CTC process is an evaluative process, and sharing implementation and outcome data with funders or evaluators aligns with the values of the effort. Given the central role of evaluation in this process, developing a feedback loop in which implementation sites benefit from and can use the evaluation data that they (and other sites) reported could help immensely with participation, thereby improving reliability and validity.

Change Policy to Promote the Use of EBPs Connected to Evidence-Based Prevention Systems These improvements were due to a change in policies and procedures within the state-level juvenile justice system. As a result, we suggest that other state juvenile justice systems can have a significant impact on youth outcomes by making similar policy and procedural changes to how funding for youth/family programs are awarded to communities. As part of this policy change, state (or other philanthropic) funders can require CTC coalitions to implement at least one EBP among their selected programs and strategies. The current CTC implementation materials and coaching that guides sites emphasizes the importance of EBPs. The receipt of future funding can be tied to the selection and implementation of EBPs.

Further Unpack Effect Size As described, there are many reasons why we found a small effect size in this study. In addition to the challenges already listed, implementation-related challenges such as fidelity to the CTC process and implementation quality of the selected programs are likely also important factors to consider (Brown et al. 2014; Brown et al. 2013). Decisions by the state fiscal sponsor that changed the total amount of funding available for CTC in different years, and that changed the size and duration of grants may also play a role. Future research is needed to understand the salient factors in a non-research implementation context, and how those factors impact outcomes. Without this, it will be difficult to actualize sustained public health benefit of this work.

Conclusion

The current study used pre-existing data to evaluate the effectiveness of a policy change in improving outcomes for youth. Small, consistent, significant preventive effects were found; these results wereslightly stronger and more consistent after considering program type. The measured effect was small, but likely underestimated due to several factors. The current study provides support that community prevention systems utilizing a range of programs can be combined for analyses. This study also provides support for the risk and protective factor approach. The range of outcomes affected in this study is remarkable. The continued emphasis on coalitions using EBPs, planning for evaluation in advance of major policy efforts, and further unpacking the reasons for the small overall effect size are crucial to continuing to support public health now and into the future.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the

institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent For this type of study, formal consent is not required.

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