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Longitudinal Outcomes of an Alcohol Abuse Prevention Program for Urban Adolescents

Steven P. Schinke, Ph.D. *, Traci M. Schwinn, Ph.D., and Lin Fang, Ph.D.

Columbia University School of Social Work, New York, New York

Abstract

Purpose—This randomized clinical trial examined longitudinal outcomes from an alcohol abuse prevention program aimed at urban youths.

Methods—Study participants were an ethnically and racially heterogeneous sample of early adolescents, recruited from community-based agencies in greater New York City and its environs. Once they assented to study participation and gained parental permission, youths were divided into three arms: youth intervention delivered by CD-ROM (CD), the same youth intervention plus parent intervention (CD_p), and control. Once all youths completed baseline measures, those in CD and CD_p arms received a computerized 10-session alcohol abuse prevention program. Parents of youths in the CD_p arm received supplemental materials to support and strengthen their children's learning. All youths completed postintervention and annual follow-up measures, and CD- and CD_p-arm participants received annual booster intervention sessions.

Results—Seven years following postintervention testing and relative to control-arm youths, youths in CD and CD_p arms reported less alcohol use, cigarette use, binge drinking, and peer pressure to drink; fewer drinking friends; greater refusal of alcohol use opportunities; and lower intentions to drink. No differences were observed between CD and CD_p arms.

Conclusions—Study findings lend support to the potential of computerized, skills-based prevention programs to help urban youth reduce their risks for underage drinking.

Keywords

Urban adolescents; Alcohol abuse; Prevention; Computer intervention

American adolescents are heavy consumers of alcohol and other harmful substances. Among U.S. 12th graders, 43% have used alcohol and 28% have been drunk in the past 30 days [1]. Marijuana and tobacco use in the past 30 days are respectively reported by 19.4% and 20.4% of 12th graders [1]. A number of problems are associated with teenage substance use. Alcohol-using young drivers account for 31% of traffic fatalities, the leading cause of death for American teenagers [2]. Adolescent substance use is linked to school failure, poor nutrition, and psychological disorders [3,4]. Impaired adolescents are prone to engage in and fall victim to sexual assault and unprotected sex [5,6].

In response to concerns about underage drinking and other substance use, investigators have developed and tested a variety of prevention programs [7–9]. Understandably, most such programs are directed at places where adolescents congregate—schools and after school programs [10–12]. Some prevention programs engage adolescents and their families [13–

* Address correspondence to: Steven P. Schinke, Ph.D., Columbia University School of Social Work, 1255 Amsterdam Avenue, New York, NY 10027. schinke@columbia.edu.

15]. Other programs have sought to limit adolescents' access to harmful substances, tighten motor vehicles laws, and otherwise impose environmental controls toward either reducing substance use or ameliorating problems caused by it [16,17].

Recent years have seen growing applications of computer technology to deliver prevention programs for adolescent substance use. Across several studies, computer-delivered prevention programming has successfully reduced alcohol and other substance use among adolescents and young adults [18–24]. The appeal of computer approaches for prevention programs is manifold. Young people are comfortable with computer learning. Some data suggest that adolescents prefer to receive health information from a computer rather than from face-to-face interactions [25]. Computer programs allow users to access and navigate content at their own pace. Interactive material can be stimulating and varied and permit skills demonstrations and guided rehearsals. Users of computer-delivered programs can enjoy developmentally and culturally tailored audio, animation, graphics, and video. Branching technology allows users choose content according to their preferences. Protocol fidelity, portability, ease of use, and data storage are added benefits of computer-mediated prevention programs. Once developed and tested, computerized prevention programs can be disseminated without losing their integrity.

The present study tested the long-term efficacy of a computer-delivered alcohol abuse prevention program for early adolescents. Informed by social learning theory, the prevention program engaged youths in a series of interactive exercises, puzzles, and games. Program material helped youths acquire skills for sound decision making and problem solving around alcohol and other substance use pressures, urges, and opportunities. Toward enhancing adolescents' learning, the prevention protocol engaged youths' parents with material that paralleled content received by their children.

Methods

Participants

Study participants were 513 early adolescent girls and boys from greater New York City and its environs, including Trenton, NJ, and Wilmington, DE. The size of the study sample reflected statistical power calculations for finding small effect sizes [26]. Youths were recruited through the auspices of community-based agencies that provided such after-school services as recreation, tutoring, computer labs, and sports. On average, roughly 12 youths from each agency enrolled in the study. At the time of enrollment, the participants had an average age of 10.8 years and 51% were female. Most youths were Black (54%) and Hispanic (30%); 11% were White; and 5% were from other ethnic–racial groups.

Procedure

Prior to their enrollment, youths assented and received parental permission. The research protocol was approved by Columbia University's Morningside Campus Institutional Review Board. By collaborating community-based agency site, enrolled youths were assigned randomly to one of three study arms: youth intervention (CD), youth plus parent intervention (CD_p), and control. Once all youths completed baseline measures, those in the CD and CD_p arms received a 10-session alcohol abuse prevention program delivered by CD-ROM. Parents of youths in the CD_p arm received supplemental materials to support and strengthen their children's alcohol abuse prevention learning.

When youths and parents in the CD and CD_p arms finished their respective initial intervention programs, all youths completed postintervention measurement batteries comprised of scales identical to those given at baseline. Annually, all youths completed follow-up measurement batteries of the same scales administered at baseline and

postintervention. Youths received gift cards for completing outcome measures. After they completed each annual follow-up measurement, CD- and CD_p-arm participants were given booster sessions that reviewed prior content and provided updated prevention material indexed to youths' developmental stages. Parents were not administered any outcome measures.

Intervention

Youths in the CD and CD_p arms accessed the initial CD-ROM prevention program on computers at the collaborating agencies through which they were enrolled. Subsequently, youths completed booster sessions in their homes, gaining access online and through CD-ROM copies of the program.

The initial CD-ROM program took form as 10 interactive sessions, each 45 minutes long. Based on social learning theory, session content helped youths acquire knowledge, attitudes, and skills for promoting their health and for reducing their risks of substance abuse. Thematically, the first session focused on teaching youths a five-step decision-making sequence (described later). This five-step sequence was repeated throughout the remaining nine sessions that emphasized: problem solving, norms, social influences, self-efficacy, coping with pressure, assertiveness, refusal responses, stress reduction, relaxation, and social supports.

Youths acquired session content by watching and interactively directing the actions of animated characters. The characters were six age-mate peers, a shopkeeper, a coach from a community center, and a police officer. Youths were guided through session content by characters representing themselves. Besides watching and directing the outcomes of storylines, youths completed games, puzzles, and quizzes that reinforced prevention program content.

Each session was comprised of two segments—a skills lesson and practice scenarios. Sessions began by establishing goals (e.g., pick up groceries from the local grocer, participate in a community clean-up project before meeting friends, and go to a party). Subsequently, the main character (i.e., youth participant) faced scenarios that required participants to interact with supporting characters that either aided or hindered their accomplishment of session goals. Moving through a gritty, yet friendly urban environment, youths applied their learned skills by directing the decisions and movements of the animated characters. In response to these scenarios, youths drew upon programmatic content, tried out new skills, and received feedback on the success of their practice efforts.

In an illustrative session, focused on decision making, youths viewed animated content on five steps: Stop, Options, Decide, Act, and Self-praise. To learn the first step, youths practiced stopping their behavioral responses so they could better define problems and identify their role in solving them. Applying the second step, Options, youths considered alternative solutions. In the Decide step, youths systematically ranked their options according to the expected benefits and feasibility of each one. On the basis of their rankings, youths chose the best solution. To learn the fourth step, Act, youths vicariously experienced via programmed content the consequences of implementing their decisions. When those consequences were negative because of a poor decision, youths were redirected to begin the process anew. For the Self-praise step, youths rewarded themselves for using decision making steps and for implementing their chosen solutions.

Annual booster sessions for youths in the CD and CD_p arms consisted of additional computerized program material, delivered by CD-ROM or online. Booster session content reviewed earlier material and introduced new, developmentally indexed material. Booster

sessions dealt with dating situations, increased amounts of discretionary time, and alcohol use risks occasioned by college attendance, military service, and independent living.

Parents in the CD_p arm received initial intervention at home by printed materials and videotape. The bulk of parent sessions provided instruction on how youths' parents could enhance youth intervention. Such enhancements involved discussions between parents and youths of skills that youths were learning, helping youths apply programmatic content, and supporting youths when they avoided substance use and engaged in health-promoting activities.

Booster sessions for CD_p-arm parents were largely delivered by CD-ROM and digital audio recordings, the latter sessions via an iPod. Similar to initial intervention content, parent boosters aimed to enhance youths' learning. Parents learned about the importance of monitoring their children's leisure time and friendships, establishing such family rituals as eating meals together and spending time in the evening with one another, and setting and enforcing rules against alcohol and other substance use. Parents were also engaged in a workshop to help them better understand and manage their children. Later boosters for parents included discussions of their children's increased independence, greater access to alcohol, and progression into young adulthood. Throughout, parent boosters emphasized the role of frequent and consistent parent-child communications around temptations and urges that come with adolescent development.

The fidelity of intervention delivery was monitored for youths and parents in CD and CD_p arms. Youths could not advance through sessions in the initial program until they successfully completed quizzes and questionnaires on session content. When they finished booster sessions, youths reported by telephone a code number generated by the program. After parents completed initial and booster sessions, they received a code word that they also reported by telephone.

Roughly 90% of youths assigned to the intervention arm completed the entire initial 10-session prevention program. Nearly 80% completed at least three of the five booster sessions, with 56% completing four or more booster sessions. Adherence rates for initial parent and booster content ranged from 50% (workshop attendance) to 78% (digital audio recording).

Measures

Youths completed baseline measurement batteries by paper and pencil questionnaires administered at the enrollment sites. At postintervention and follow-up measurements, youths completed outcome questionnaires online. Youths who lacked online access completed outcome measures by telephone. Prior to each measurement occasion, these youths received response keys for the questionnaire schedule by mail. The staff called youths, orally administered the measures, and asked youths to say aloud the letter that corresponded to their response. The average length of time between baseline and postintervention survey completions was 7.1 (SD = 3.4) months.

At baseline, postintervention, and annual follow-up measurements, youths self-reported their alcohol and other substance use for the past 30 days on items from the Youth Risk Behavior Survey (YRBS) [27] and Monitoring the Future survey [28]. Answering a series of contingent-response items, youths reported their frequency of alcohol, cigarette, and marijuana use. Test-retest reliabilities for YRBS and Monitoring the Future survey items are .82-.95 and .77-.91, respectively [27,28].

Youths also indicated the extent to which they could refuse offers from a close friend to drink alcohol (α reliability = .84) [29]. Responding to items from the YRBS [27] and from the American Drug and Alcohol Use Survey [30], youths described the extent to which peers attempted to influence their drinking. Kappa coefficients for these YRBS items range from .71 to .86 [31]; American Drug and Alcohol Use Survey items have α reliability = .72–.94 [32].

On items from the Models for Drug Use Scale [33], youths reported how many of their closest friends consumed alcohol and how many close friends had been drunk in the last 30 days (α reliability = .91). Finally, youths predicted the likelihood of their drinking in the future on items from the Commitment to Not Use Drugs Scale [34]. Alpha reliability for the items employed in our study was .84.

Attrition analysis

Baseline measures were completed by 513 youths. Seven years later, 409 youths provided usable follow-up data. Of the 104 youths lost between baseline and 7-year measurements, three died, 19 youths declined further study participation, 33 were unreachable by telephone, mail, and email; 39 chose to not complete the 7-year follow-up measurement; and 10 provided data that proved unusable owing to improbable response patterns. Losses by study arm were 23.9% for CD youths, 21.6% for CD_P youths, and 14.7% for control youths.

To determine whether differential attrition affected intervention effects, we applied χ^2 analysis on attrition status by study arm. The results failed to reach significance ($p = .08$). We then examined arm X attrition interaction effects on outcome variables at baseline and on demographic variables, with two-factor analysis of variance for continuous variables and χ^2 for categorical variables. Except for gender, arm X attrition interaction effects were not found for any of the baseline outcome measures and demographic variables. Relative to girls in CD and CD_P arms, fewer control-arm girls dropped out of the study (11.1%, 11.1%, and 3.1%, respectively; $p < .01$). Consequently, we used the expectation–maximization algorithm to find whether attriters were missing at random [35]. The results of expectation–maximization analysis were not significant ($p = .11$), indicating that differential attrition effects on study outcomes were minimal and ignorable [35,36].

Statistical analysis

Intervention outcome effects were tested for two comparisons: (1) combined CD and CD_P arms versus control arm and (2) CD versus CD_P arms. Covariates for these analyses were baseline levels on outcome measures, demographic variables, and survey mode (online or telephone). As appropriate, we applied Tukey post hoc tests to explore pairwise differences.

Following recommendations that for randomized controlled trials, ANCOVA is more parsimonious than is repeated measures analyses, we employed the former analytic method [37]. The independence of covariates and intervention arms was tested with ANOVA for continuous variables and χ^2 for categorical variables. Youths' ethnic–racial backgrounds differed by study arms ($p < .0001$), indicating that this demographic background variable and intervention effects were not independent, violating an ANCOVA assumption [38]. Ethnic–racial background was thus excluded from ANCOVA analyses. Tests on the interaction between baseline outcome covariates and intervention arms proved nonsignificant, indicating that the assumption of homogeneity of slope for ANCOVA was met.

Results

At 7-year follow-up, the sample had a mean age of 18.42 years ($SD = 1.11$), was 53.1% female, and was 51.6% Black, 27.4% Hispanic, 9.3% White, and 11.7% other ethnic–racial groups. As they did at baseline measurement, study arms differed in their ethnic–racial composition ($p < .0001$; Table 1). Outcome variable means and standard deviations for youths assigned to CD, CD_p, and control arms at baseline and 7-year follow-up appear in Table 2.

At 7-year follow-up, youths' older age was associated with increased 30-day alcohol ($p < .05$) and cigarette ($p < .01$) use (Table 3). Compared to females, males perceived greater peer pressure to drink ($p < .05$). Youths who completed follow-up measures by telephone were more likely to report 30-day use of alcohol ($p < .01$), marijuana ($p < .05$), and cigarettes ($p < .05$) than youths who completed measures online. Youths' higher scores on measured substance use variables at baseline predicted follow-up reports of greater alcohol use ($p < .05$), more friends who drink alcohol ($p < .05$), and greater intentions to drink in the future ($p < .01$).

Relative to youths assigned to the control arm, those who participated in the prevention program (CD and CD_p arms) reported fewer instances in the past 30-days of alcohol consumption ($p < .05$), binge drinking ($p < .05$), and cigarette smoking ($p < .05$), better alcohol refusal skills ($p < .05$), fewer friends who drink ($p < .05$), reduced levels of peer pressure to drink ($p < .05$), and lower intentions to drink alcohol in the future ($p < .05$). Youths in CD_p and CD arms failed to differ from one another on past month substance use and related measured variables.

Discussion

Seven years after initially receiving a computer-based substance abuse prevention program, a sample of late-adolescent youths continued to realize material benefits. Youths who received intervention, regardless of whether their parents also received intervention, reported less alcohol use, binge drinking, and cigarette smoking, relative to control-arm youths. That youths involved in the prevention program also were better able to refuse drinking opportunities, reported less peer pressure to drink, had fewer friends who drink, and held lower intentions to drink, underscores the prevention program's value.

The concinnity of study findings lends credence to the value of intervening early with adolescents around substance use pressures toward reducing their risks of later problems with alcohol and other drugs. Reductions in binge drinking as well as in cigarette smoking show the long-term potential of early intervention efforts. Theoretically, once adolescents learn new ways of interacting with their peers and their environments, those new patterns will become ingrained as youths successfully try out their learned skills and are rewarded for their successes. The longitudinal nature of study data appears to support the transfer of youths' early learning through middle adolescence and into young adulthood. The relatively small investment needed to build and deliver the computerized prevention program may have borne considerable profit.

Study findings invite speculation about the mechanisms through which intervention-arm youths learned to reduce their substance use behavior. Starting with initial program delivery and continuing with booster sessions, youths acquired knowledge and skills associated with problem solving and the resistance of social influences on substance use behavior. Youths learned a sequenced model to understand and solve problems. And they observed and practiced behavioral skills for refusing peer pressure. Other intervention elements aimed to equip youths with the ability to analyze high-risk situations and to act accordingly toward

lowering their substance use risks. Over time, youths' acquisition and use of new knowledge would have let them interact with their peers and environments in new and salubrious ways. These interactions in turn may have reinforced youths' learning, leading to additional and novel applications of skills acquired during initial and booster session intervention.

The absence of differences between youths who received the CD-ROM intervention only and those whose parents also received intervention materials deserves scrutiny. One explanation is that parental influences on children wane during adolescence. Parents in our study, moreover, received less intervention than their children received. Consequently, the CD and CD_p arms shared more similarities than differences. Owing to the length of the randomized clinical trial, features of the prevention program that had salience for youths during the early adolescent years may have been less potent as youths matured. Quite possibly, parent involvement procedures were among these elements. Parental involvement procedures may have had less value as the developmental process progressed. Thus, the decision to include parents in prevention programs may rest largely on the age of youth participants. Parental involvement may prove useful when children are young. Once children leave home; however, inclusion of parents in prevention programming may not be cost-beneficial.

Another finding that invites speculation are differences in reported substance use between youths who completed follow-up measurement online and those who gave their reports by telephone. Notwithstanding that both methods of data collection assured youths of confidentiality, telephone responders reported higher rates of substance use than did online responders. Most youths (82%) reported online. Those who used the telephone, therefore, may have been in the minority of late adolescent youths who lack personal computers or Internet access. If true, these youths might have already been falling behind their peers in staying apace with technological advances and may otherwise not have enjoyed access to computers connected to the Internet. Whether youths who prefer the telephone response mode are at higher risk for substance use is a question for further research.

The rationale for recruiting study participants from community-based agencies warrants discussion. Whereas school-based research may capture the interest of motivated youths and parents, those who do not regard school as a rewarding experience may participate at lower rates or suffer frequent absences. Further, participation in a school-based intervention could be interpreted by youths as involving additional schoolwork and time at school—again perhaps not attractive possibilities to high-risk youths. Consequently, the study sample was potentially biased toward youth who are at higher risk for substance use and other problem behavior.

Baseline differences in the ethnic–racial composition of the sample are in part explained by the assignment of intact collaborating agency units to study arms. Because each collaborating community agency had a different demographic profile of youths served by the agency, ethnic–racial differences among arm assignments are unsurprising. Randomness can result in patterns.

Limitations to our study include reliance on a relatively small sample, the self-report nature of outcome data, which could have resulted in lower reports of substance use for program-arm youth than for control-arm youth due to the formers' receipt of prevention program materials, and participant loss to attrition. Moreover, only youths who assented to study participation and who had parental permission to participate were enrolled, introducing motivational bias into the sample. Computer-delivered programs are suitable only for youths and families with access to the necessary technology. The study, originally conceived simply to learn whether computer-delivered prevention programming was feasible,

employed a perhaps overly simplistic design by not including an active control arm. The absence of outcome data on parental behavior is another study limitation.

Mindful of these limitations, we regard our results as adding longitudinal support to the impact of computer-delivered substance abuse prevention programming for urban youths. The future for computer-accessed interventions aimed at adolescents is bright. Because youths increasingly rely on new technologies for school and extracurricular purposes, giving them access to computerized prevention programming is logical, and as our data suggest, may prove efficacious. Original research needs to further explore such features as the fidelity of computerized program delivery, the verisimilitude of telephone and online self-reports, and the ability to track youths longitudinally through the Internet. The rapidity of technological advancements also begs for work on other new media venues for prevention program delivery and research, including social networking sites, text messaging, and similar brief, yet potentially influential means for reaching youths and changing their behavior. Modest findings reported here are certain to be followed by more sophisticated work on the use of computers to study and improve adolescent health.

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Table 1

Youth demographics at baseline and 7-year follow-up, by study arm

	Baseline		7-yr follow-up					
	CD (n = 188)	CD _P (n = 162)	Control (n = 163)	p	CD (n = 143)	CD _P (n = 127)	Control (n = 139)	p
Age, yr, mean (SD)	10.79 (1.0)	10.87 (1.0)	10.88 (1.0)	ns	18.41 (1.2)	18.50 (1.1)	18.36 (1.1)	ns
Female, number (%)	86 (46)	91 (56)	84 (52)	ns	65 (45)	74 (58)	80 (58)	ns
Ethnicity-race								
Black, number (%)	122 (65)	82 (51)	61 (37)	.0001	94 (66)	66 (52)	51 (37)	.0001
White, number (%)	14 (7)	13 (8)	23 (14)		7 (5)	10 (8)	21 (15)	
Hispanic, number (%)	30 (16)	50 (31)	60 (37)		24 (17)	38 (30)	50 (36)	
Other, number (%)	23 (12)	17 (11)	19 (12)		18 (13)	13 (10)	17 (12)	

Table 2

Youths' scores on baseline and 7-year follow-up outcome variables, by study arm

Outcome	Baseline		7-yr follow-up			
	CD (n = 188)		CD _p (n = 162)		CD (n = 143)	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SE)	Mean (SE)	Mean (SE)
Alcohol refusal ^a	5.83 (.5)	5.86 (.5)	5.80 (.6)	4.25 (.1)	4.06 (.1)	3.77 (.1)
Drinking friends, number ^b	1.16 (.6)	1.10 (.5)	1.23 (.7)	2.26 (.1)	2.43 (.1)	2.53 (.1)
Peer pressure ^c	1.08 (.4)	1.08 (.4)	1.05 (.3)	1.47 (.1)	1.55 (.1)	1.71 (.1)
Intentions ^d	1.29 (1.6)	1.74 (1.3)	1.24 (1.1)	4.69 (.3)	4.74 (.3)	5.57 (.3)
30-d use ^e						
Alcohol	.05 (.5)	.07 (.5)	.05 (.3)	2.77 (.6)	2.51 (.6)	4.25 (.6)
≥ 5 drinks in row	.09 (1.1)	.00 (.0)	.03 (.2)	1.05 (.5)	.76 (.5)	2.15 (.5)
Marijuana	.00 (.0)	.04 (.5)	.04 (.5)	3.35 (1.0)	4.68 (1.1)	3.59 (1.0)
Cigarettes	.08 (1.1)	.16 (2.0)	.05 (.5)	7.40 (4.2)	7.82 (4.4)	20.79 (4.2)

Baseline variance shown as standard deviations; follow-up variance shown as standard errors due to adjusted marginal means.

^aSix-point scale where higher scores are better.

^bLower scores (i.e., fewer drinking friends) are better.

^cFour-point scale where lower scores are better.

^dTen-point scale where lower scores are better.

^eReported occasions or instances of use for each respective substance.

Table 3

ANCOVA results for orthogonal comparisons of outcome variables, by study arms at 7-year follow-up

	30-day substance use							
	Alcohol	≥5 drinks	Marijuana	Cigarettes	Alcohol refusal	Drinking friends	Peer pressure	Intentions to drink
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
CD and CDp vs. Control ^a	-.48* (.23)	-.40* (.20)	.21 (.42)	-4.20* (1.72)	.13* (.06)	-.06* (.03)	-.06* (.03)	-.28* (.13)
CDp vs. CD ^b	-.11 (.40)	-.13 (.36)	.72 (.73)	.48 (3.03)	-.08 (.10)	.08 (.05)	.04 (.06)	.02 (.22)
Age	.67* (.33)	.57 (.29)	.53 (.59)	7.24** (2.46)	-.16 (.08)	.07 (.04)	-.06 (.05)	.22 (.18)
Gender ^c	.75 (.66)	.54 (.58)	1.12 (1.19)	.53 (4.92)	.10 (.16)	-.14 (.08)	.20* (.09)	-.51 (.36)
Survey mode ^d	2.36** (.85)	.74 (.75)	3.68* (1.53)	12.50* (6.35)	.37 (.21)	-.16 (.11)	.17 (.12)	.07 (.47)
Baseline	1.78* (.71)	2.38 (1.95)	.85 (1.40)	-.68 (1.91)	.24 (.15)	.20** (.08)	-.08 (.13)	.44** (.14)

Coefficients are unstandardized.

*
 $p < .05$;**
 $p < .01$.^aContrast code = 1, 1, -2, respectively for CD, CDp, and control arms.^bContrast code = 1, -1, 0, respectively for CD, CDp, and control arms.^cDummy code = 0, 1, respectively for female and male.^dDummy code = 0, 1, respectively for online or telephone.