Pergamon

Addictive Behaviors, Vol. 25, No. 5, pp. 769–774, 2000

0306-4603/00/$–see front matter

PII S0306-4603(99)00050-7

BRIEF REPORT

PREVENTING ILLICIT DRUG USE IN ADOLESCENTS: LONG-TERM FOLLOW-UP DATA FROM A RANDOMIZED CONTROL TRIAL OF A SCHOOL POPULATION

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Abstract — National survey data indicate that illicit drug use has steadily increased among American adolescents since 1992. This upward trend underscores the need for identifying effective prevention approaches capable of reducing the use of both licit and illicit drugs. The present study examined long-term follow-up data from a large-scale randomized prevention trial to determine the extent to which participation in a cognitive-behavioral skills-training prevention program led to less illicit drug use than for untreated controls. Data were collected by mail from 447 individuals who were contacted after the end of the 12th grade, 6.5 years after the initial pretest. Results indicated that students who received the prevention program (*Life Skills Training*) during junior high school reported less use of illicit drugs than controls. These results also support the hypothesis that illicit drug use can be prevented by targeting the use of gateway drugs such as tobacco and alcohol. © 2000 Elsevier Science Ltd.

Key Words. Prevention, Drug abuse, Illicit drugs, Adolescents.

National survey data indicate that drug use among American adolescents has increased markedly over the past several years. For example, the annual prevalence rates for use of any illicit drug among high school seniors increased from 27% in 1992 to over 40% in 1996 (Johnston, O'Malley, & Bachman, 1996). This upward trend in drug use underscores the need for identifying effective prevention approaches capable of producing reductions in the use of both licit and illicit drugs. As recent reviews (e.g., Hansen, 1992) have noted, there has been substantial progress over the past 2 decades toward the development of approaches that successfully prevent early-stage drug use. These reviews indicate that prevention approaches that focus on teaching social resistance skills or a set of general life skills, either alone or in combination, can significantly decrease the initiation of tobacco, alcohol, and marijuana use among secondary school students, and may be capable of producing prevention effects that are reasonably durable (Botvin, Baker, Dusenbury, Botvin, & Diaz, 1995; Pentz et al., 1989).

Adolescents typically begin using drugs in a developmental sequence (Kandel, 1975), with substances occurring at the beginning of this progression (typically alcohol, tobacco, and marijuana) referred to as "gateway" drugs. Individuals who use illicit drugs typically do so after first using one or more gateway substances. An important question that requires further attention concerns the extent to which initial reductions in tobacco, alcohol, and marijuana use eventuate in corresponding reductions in the

This research was supported by grants DA07656 from the National Institute on Drug Abuse and HL33865 from the National Heart, Lung, and Blood Institute, National Institutes of Health.

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use of illicit drugs other than marijuana. While adolescent drug abuse prevention efforts aim to deter the use of one or more gateway drugs, it has long been assumed that prevention programs capable of reducing gateway drug use would eventually have a corresponding impact on illicit drug use if study participants were followed into high school or beyond. However, this has remained as an untested hypothesis.

One of the most extensively evaluated school-based approaches to drug abuse prevention emphasizes cognitive-behavioral skills training methods for enhancing social resistance skills and a broad set of general life skills. This approach has been found to produce both short-term (Botvin & Eng, 1980) and longer-term (Botvin, Baker, Dusenbury, Tortu, & Botvin, 1990; Botvin, Schinke, Epstein, Diaz, & Botvin, 1995; Botvin, Baker, et al., 1995) prevention effects. However, none of these studies has examined the impact of the prevention program on the use of illicit drugs other than marijuana. The current study was designed to provide long-term follow-up data from a large-scale randomized prevention trial concerning the effectiveness of the prevention approach described above by examining data from a sub-sample of students who completed a mailed survey on illicit drug use.

METHODS

Sample

The data for the present study were collected as part of a larger long-term follow-up study of a randomized drug abuse prevention trial (Botvin, Baker, et al., 1995). A subsample of students from this larger study completed separate questionnaires related to illicit drug use. Data were collected by mail from 447 individuals who were contacted after the end of the 12th grade. The length of the follow-up period was 6.5 years from the initial baseline data collection. The sample of 447 students in the present study was predominantly White (92.3%) and 40% were male. The mean age was 18.1 years (SD = 0.6). Most participants lived in two-parent families (82.5%) and were from middle-class suburban and rural areas of New York State.

Procedure

Prior to randomization, schools were surveyed and divided into high, medium, or low smoking prevalence, and were randomized into the experimental or control conditions from within these groups. Students in the experimental condition received a drug abuse prevention program consisting of a primary year of intervention in the seventh grade and booster interventions during the eighth and ninth grades. The attrition rate over the 6-year period for the larger study was approximately 40%, due to school absenteeism, transfers, and dropouts. Additional information on the research methods and a description of the preventive intervention used in this study can be found elsewhere (Botvin, Baker, et al., 1995).

Measures

Baseline. The initial survey assessed demographics of participants, school grades, and use of cigarettes, alcohol, and marijuana. For example, cigarette smoking was measured with an item that assessed the number of cigarettes generally smoked, with response options on a 7-point scale from "never" (1) to "more than a pack a day" (7).

Follow-up. Illicit drug use was assessed 6.5 years after the initial pretest by asking participants how often (if ever) they have used any of 13 different illicit drug catego-

Table 1. Lifetime use of illicit drugs by experimental condition

	Experimental group (n = 302)		Control group (n = 145)		
	n	%	n	%	N
Marijuana	133	45.6	78	54.6	435
Cocaine	17	5.8	11	7.7	437
Inhalants	17	5.8	14	9.8	436
Sniff glue or gas from aerosol cans	14	4.8	13	9.1	436
Amyl or butyl nitrates	4	1.4	5	3.5	436
Non-medical pill use	30	10.2	23	16.1	436
Amphetamines	27	9.2	19	13.3	436
Barbiturates	5	1.7	4	2.8	436
Quaaludes	5	1.7	5	3.5	436
Tranquilizers	9	3.1	7	4.9	436
Heroin and other narcotics	10	3.4	11	7.7	436
Heroin	1	0.3	5	3.5	436
Narcotics other than heroin	10	3.4	10	7.0	436
Hallucinogens	38	13.0	30	21.0	436
LSD or other psychedelics	37	12.6	29	20.3	436
PCP	7	2.4	8	5.6	436
MDMA (Ecstasy)	4	1.4	3	2.1	436
Total illicit substance use	148	50.3	79	55.2	435
Total illicits other than marijuana	66	22.5	43	30.1	436

ries. These categories were based on those used in the University of Michigan *Monitoring the Future* study (e.g., Johnston et al., 1996), and included marijuana, cocaine, amphetamines, quaaludes, barbiturates, tranquilizers, heroin, narcotics other than heroin, inhalants, amyl or butyl nitrites, LSD, PCP, and MDMA ("Ecstasy"). Since rates of use for most drugs were low and distributions were highly skewed, scores were logarithmically transformed for all drugs except marijuana. Six illicit drug-use composite scores were created (as shown in Table 2) including a combined "illicit drug use" score that reflected the sum of the individual drug items, and a second summary score that represented the sum of all "illicit drug use other than marijuana."

RESULTS

Base rates of drug use at baseline were low, as expected, with only 5% of the sample having ever used marijuana. A series of t-tests were conducted to determine if the experimental and control groups were equivalent in terms of substance use at baseline.[1] As shown in Table 1, rates of illicit drug use were relatively low at follow-up, with some exceptions. Overall, three substances had been used by 10% or more of the entire sample, and these were marijuana (48.5%), LSD or other psychedelics (15.1%), and amphetamines (10.6%). In terms of rates of illicit drug use by experimental condition, Table 1 shows that the raw proportion of students using each illicit drug was higher in the control group than in the experimental group for all drugs.

[1]Experimental groups were similar at baseline on most of the drug use variables, including smoking and drinking quantity, and drunkenness and marijuana use frequency. However, there was a statistically significant difference on one of the five substance use scores, with students in the control group reporting higher levels of drinking frequency (M = 2.23, SD = 1.46) when compared to intervention students (M = 1.94, SD = 1.24; $p < .04$). Since there was not baseline equivalence on this one item, it was used as a covariate in subsequent analyses.

Several analyses were conducted to examine the effect of the intervention on illicit drug use at follow-up, using GLM ANCOVAs, comparing the follow-up illicit drug use scores across the two conditions after adjusting for relevant covariates. Separate analyses were conducted for use of marijuana, cocaine, and the six composite illicit drug scores at follow-up. In each analysis, experimental condition was the independent variable, along with several covariates: gender, age, grades, and drinking frequency at baseline. As shown in Table 2, the intervention had a significant effect on several of the illicit drugs at follow-up according to the GLM ANCOVA analyses. For marijuana use, the score for the intervention group was lower than the control group ($F = 4.81, p < .029$). The mean score for inhalants frequency at follow-up was lower in the intervention group than in the control group ($F = 6.37$, $p < .012$), as were the scores for heroin and other narcotics ($F = 4.58, p < .033$) and hallucinogens ($F = 5.95$, $p < .015$). Significant intervention effects were observed for the two summary illicit drug use scores as well. Thus, using the GLM ANCOVA approach, there were several significant program effects for illicit drug use at follow-up, with the intervention group reporting less illicit drug use than the control group.

Because the intervention was randomized and administered at the school level, additional analyses were conducted to control for intracluster correlations (ICCs) among students within schools. In the present context, ICCs quantify the degree of similarity of questionnaire responses within schools and how substance use rates vary at the school level. The generalized estimating equations (GEE) method adjusts the estimated standard error to account for the within-cluster correlation and generally provides for a more conservative test of the hypothesis when a positive ICC is present (Norton, Bieler, Ennett, & Zarkin, 1996). When the ICCs were taken into account using the GEE method, the *p*-value for marijuana became marginally significant and the *p*-value for inhalants became nonsignificant. However, for the remaining behavioral outcome variables (heroin and other narcotics, hallucinogens, and the two summary illicit drug use scores), findings using the GLM and GEE methods were similar, with those who received the intervention reporting lower levels of drug use for these measures than those in the control condition. Taken together, these findings indicate that

Table 2. Adjusted means at 6.5-year follow-up for illicit drug use by experimental condition

	Intervention group		Control group				GLM	GEE
	M	*SE*	*M*	*SE*	*F*	*df*	*p*-value	*p*-value
Marijuana	2.05	0.09	2.40	0.13	4.81	1, 416	.029	.071
Cocaine	0.72	0.01	0.73	0.01	0.34	1, 418	.562	.371
Inhalants	0.71	0.01	0.73	0.01	6.37	1, 417	.012	.664
Nonmedical pill use	0.72	0.01	0.72	0.01	0.57	1, 417	.451	.928
Heroin and other narcotics	0.70	0.004	0.72	0.01	4.58	1, 417	.033	.0001
Hallucinogens	0.73	0.01	0.75	0.01	5.95	1, 417	.015	.002
Total illicit substance use	5.59	0.10	6.05	0.15	6.56	1, 418	.011	.045
Total illicits other than marijuana	3.56	0.02	3.64	0.03	5.74	1, 418	.017	.0001

Note. Inhalants include sniffing glue or gas from aerosol cans, and amyl or butyl nitrates; Nonmedical pill use includes amphetamines, barbituates, quaaludes, and tranquilizers; Hallucinogens include LSD, PCP, and MDMA (Ecstasy). Covariates for all analyses were gender, grades, age, and drinking frequency all measured at baseline. GLM ANCOVA *p*-values represent two-tailed significance levels with the individual as the unit of analyses, and the GEE (generalized estimating equations) *p*-values represent two-tailed significance levels after adjusting for ICCs (intracluster correlations) at the school level.

the prevention program effectively reduced illicit drug use both overall and in terms of the use of specific types of illicit drugs.

DISCUSSION

The findings of the current study indicate that drug abuse prevention efforts targeting adolescents during junior high school in general, and the prevention approach tested in this study in particular, can produce prevention effects that last beyond the end of high school. These results also suggest that targeting the use of gateway drugs such as tobacco and alcohol can prevent illicit drug use. The data analyzed in this study show that implementing a cognitive-behavioral skills-training prevention program during junior high school produced observable prevention effects after high school with respect to the use of both illicit drugs overall and illicit drugs other than marijuana. Prevention effects were also found for specific illicit drugs including the use of hallucinogens and narcotics. Individuals who received the prevention program had lifetime rates of illicit drug use (other than marijuana) that were 25% lower than for controls (22.5 vs. 30.1), rates of hallucinogen use that were 38% lower (13.0 vs. 21.0), and rates of narcotic use that were 56% lower (3.4 vs. 7.7).

The findings of this study are important because they provide additional evidence concerning the durability of prevention effects. Data from the existing prevention literature typically are derived from short- or intermediate-term studies. Few published studies provide follow-up data of 2 or more years beyond the initial year of intervention. This study shows that significant prevention effects are observable 5.5 years after the primary year of intervention. Previously published data (Botvin, Baker, et al., 1995) show that reductions in tobacco, alcohol, and marijuana produced during junior high school lasted until the end of high school. The data reported in the current paper extend this follow-up beyond high school for the subsample of individuals who completed a mailed survey of illicit drug use.

These data also provide additional support for the long-term effectiveness of a broad-spectrum, cognitive-behavioral, universal prevention approach called *Life Skills Training (LST)*. These data, along with those published previously, suggest that to produce durable effects a prevention approach needs to be comprehensive (i.e., target multiple risk and protective factors), have a strong initial dosage (12 to 15 class periods), and include booster sessions (Botvin, Baker, et al., 1995; Botvin, Schinke, et al., 1995). The effects of more narrowly focused approaches with more limited ongoing intervention decay more quickly, in some cases within as few as 18 months (e.g., Ellickson, Bell, & McGuigan, 1993). In addition, the results of this study suggest that comprehensiveness may be achieved within a single prevention modality, as in this study, using a classroom intervention in the school. This provides a reasonable alternative to more complex community-based prevention approaches that achieve comprehensiveness through the use of multiple prevention modalities (e.g., Pentz et al., 1989).

An issue that has been difficult to address in previous prevention studies concerns the extent to which a universal prevention program can have an impact on more serious forms of drug involvement. Virtually all prevention studies assess efficacy in terms of early-stage use because the prevalence of illicit drug use and other forms of more serious drug involvement are extremely low for the individuals (children or young adolescents) who typically participate in prevention studies. Consequently, it has been unclear whether even the most effective prevention programs can produce reductions in the use of illicit drugs. Thus, the findings presented in this paper are important be-

cause they show that a universal prevention program can reduce the use of illicit drugs. These findings also indicate that prevention effects emerging during junior high school with respect to tobacco, alcohol, and marijuana use can eventually lead to reductions in the use of illicit drugs.

The randomized trial from which these follow-up data were drawn has a number of important strengths including random assignment of schools to condition after blocking for school-wide smoking rates, evidence of pretest equivalence, and use of statistical procedures to control for the intracluster correlations of the outcome variables. However, despite these strengths, caution is warranted in interpreting these findings because of the small sample size, the fact that the sample was predominantly White, and the possibility that many high-risk individuals were not included in the analysis sample. These factors may limit the generalizability of this study's findings.

Additional research is needed to determine the effectiveness of this type of prevention program for reducing illicit drug use among individuals not typically represented in follow-up studies with school populations who may be at higher risk of becoming involved with drugs. Future research should also determine the long-term effectiveness of this type of prevention approach for racial/ethnic minority populations. Finally, it will be important to conduct additional follow-up studies with these populations to determine the durability of prevention effects as they enter young adulthood.

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