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Long-term Effects of Drug Prevention on Risky Sexual Behavior among Young Adults

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Abstract

Objective—This study assesses the impact of a school-based drug prevention program, called Project ALERT, on risky sexual behavior among 1901 nonmarried, sexually active young adults who participated in one of two program variations as adolescents. It also tests for differences in program effect depending on program duration (middle school only versus a combined middle school and high school program) and participants' gender.

Methods—Using survey data from a randomized controlled experiment conducted in 45 midwestern communities (55 schools), we assessed program effects on risky sexual behavior at age 21 with three measures—having unprotected sex because of drug use plus engaging in inconsistent condom use and having sex with multiple partners.

Results—Compared to control, Project ALERT reduced the likelihood of all risky sex outcomes except inconsistent condom use among these sexually active young adults, effects that occurred five and seven years after program exposure. Program effects were partially mediated by reductions in alcohol and drug abuse. There were no significant differences in program effects by gender or by program duration compared to control. Implications for future prevention programs and research are discussed.

Keywords

adolescent health; HIV/AIDS; prevention; substance abuse

Introduction

Young adulthood is typically marked by high levels of sexual risk behavior that can lead to HIV, other sexually transmitted diseases, and unplanned pregnancy [1]. Currently, people between the ages of 15 and 29 make up over one quarter of all new HIV infections [2] and are

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at high risk for negative outcomes due to a number of their behaviors—they are more likely to have sex with multiple partners and to use condoms inconsistently or not at all [3–5]. They also engage in comparatively high rates of alcohol and drug misuse, both of which have been linked with risky sexual behavior in cross-sectional and longitudinal studies [6–9]. Problematic substance use during the teenage years predicts substance misuse during young adulthood [10,11] and also creates contexts that facilitate risk in other spheres such as sexual behavior and violence [12–14].

Multiple studies over the past quarter century have shown that drug prevention programs targeted at adolescents can yield short and long-term reductions in substance use [15–17], but less is known about whether those gains extend to other risky behaviors. That such spillover effects might occur is suggested by both theory and empirical data. Problem Behavior Theory and its associated empirical tests indicate that different risky behaviors have common antecedents [15,18], thereby implying that curbing one risky behavior in deviance-prone young people may have effects on others. In addition, multiple studies have documented the relationship between substance use and risky sexual behavior [6–9]. Hence drug prevention programs that reduce substance use may also reduce the likelihood of engaging in risky sex because: 1. the two behaviors are linked via common predisposing factors; or 2) reducing drug use also reduces the likelihood of exposure to additional risk factors such as having sex while judgment is impaired[19], being in settings that encourage risky sexual behavior [19] or being with deviant peers who facilitate such behavior [20]. If such programs do yield spillover effects, the argument for drug prevention during adolescence is strengthened: Effects across multiple domains clearly make such programs more cost-effective and more efficient, while effects that last into young adulthood extend the period during which such benefits occur and thus also increase cost-effectiveness.

Evidence that drug prevention programs can curb HIV-risk comes from a randomized trial of a 30-session program focused on drug knowledge, resistance skills and personal competence. Delivered in grades 7 through 9, it had a protective effect on HIV-risk among young adults aged 24 who had received 60% or more of the intervention [21]. However, the overall measure of HIV-risk included high risk substance use (as well as multiple sex partners and sex when drunk or high), thereby raising questions about whether the program had significant effects on risky sexual behavior alone. Two other programs that have recently documented effects for sexual behavior were designed to affect multiple behaviors, not just drug use. One, a social development program with school/community components that was also tested in a randomized trial, was culturally tailored for inner-city African American youth and delivered in grades 5 though 8. It yielded prevention gains for risky sexual behavior among boys, but not girls [22]; its generalizability may be limited to young inner-city, African American males. The other, a social competence program targeted at 349 children in grades 1 through 6, found effects at age 21 on number of sexual partners and, among single individuals, use of condoms during last intercourse [23]; however, the nonrandomized nature of the latter field trial diminishes the credibility of the findings. Overall, the case for drug prevention as a strategy for also reducing risky sexual behavior is still in question. In particular, additional long-term information on risky sex outcomes distinct from substance use is needed from programs that primarily target drug use, have been tested in rigorous trials that include a variety of communities, and follow young people into adulthood.

This study addresses the need for cumulative evidence about spillover effects associated with drug prevention programs by asking whether Project ALERT, a prevention program targeted at adolescent drug use, has long-term effects on risky sexual behavior among young adults. We chose to focus on the behavior of young adults because they are particularly likely to engage in risky sexual practices. We hypothesized that participants in either form of the ALERT program (14 or 24 lessons) would exhibit significant reductions in risky sexual behavior when

compared with the control group. We also expected the expanded program, which includes an additional ten lessons in high school, to have significantly larger effects than the core middle school curriculum. Because females bear the risk of unplanned pregnancy and are more vulnerable to HIV-risk from heterosexual sex than males [24], we hypothesized that the program would be more effective with females than males. Our mediation hypotheses, that program-induced reductions in both alcohol and drug use would mediate effects on risky sex, were based on the theoretical and empirical links between substance use and risky sex discussed above [6–9,18].

Methods

Participants

To assess Project ALERT's long-term effects on risky sexual behavior, we used data from 1901 twenty-one year olds who were sexually active but not married at the time of data administration and had participated in an experimental trial of the two drug prevention programs that took place in 55 schools from 45 South Dakota communities. We focused on unmarried young adults because lack of condom use among married persons frequently reflects a decision to have children and thus is considerably less likely to constitute a measure of risk for them than for singles. We focused on sexually active young adults because we are interested in the intervention's effect on risky sexual behavior, not whether they engaged in any sex at all.

During program implementation, 631 of the 1901 young adults included in this analysis attended schools that received 14 lessons in middle school (core program); 499 attended schools that received an additional 10 lessons in high school (expanded program); and 771 attended control schools. Overall, 60% were female, 11% were non-White (largely Native American), and 70% lived with both biological parents as adolescents. Prior to the baseline survey in grade seven, 19% of this sample had grades of C or below, 6% had tried marijuana, 34% had tried tobacco, and 63% had tried alcohol.

Study Design and School Sample

The evaluation design randomly assigned 45 school clusters (high schools and their feeder middle-schools) from South Dakota to the two treatment conditions (core and expanded programs) and one control condition. In the middle school core program, students received eleven prevention lessons in grade 7 and three in grade 8. In the expanded program, students received 5 lessons in each of grades 9 and 10 in addition to the middle school lessons. Students in the control condition received other prevention curricula already in place at their schools but were not exposed to the ALERT program in any grade. This design allowed us to assess whether adding high school lessons to the core middle school program yielded additional prevention gains.

To maximize the generalizability of the results, we included communities that varied in size (urban, small town and rural) and geographic region of South Dakota (eastern, western and central). Four school clusters were in cities with more than 50,000 residents; 12 were in towns of 5,000 to 25,000 residents; and the remaining clusters were in rural communities.[1] To enhance pretreatment equivalence across conditions, we used blocking by geographic region and community size and restricted assignment when randomizing school clusters to conditions [16]. Two districts (each with one high school) dropped out of the study after we completed

[1]The full study design randomized 48 clusters. However, assignment of three clusters was restricted to the ALERT or ALERT Plus conditions. Those clusters were not included in this analysis.

randomization and were replaced by schools in a similar region of the state and with a similar ethnic composition.

Curriculum Content

The ALERT middle school curriculum seeks to motivate youth against using drugs and help them build the skills they need to translate that motivation into effective resistance behavior [16]. The lessons focus on three major goals each of which is linked to a specific theory of behavior change: 1. Helping youth understand the benefits of non-use, as well as the seriousness and salience of consequences associated with drug use [25]; 2. Reducing barriers to effective drug resistance by building confidence in one's ability to resist pro-drug pressures [26]; and 3. Building social norms against use and the skills for resisting pro-drug pressures [27]. The additional 9^{th} and 10^{th} grade lessons in the expanded ALERT curriculum have the same overall goals and theoretical underpinnings as the middle school program [28] but also take into account developmental changes during the high school years that affect opportunities and motivations to use drugs (e.g., more diverse friendship networks and dating opportunities, risks associated with drinking and driving, use of drugs to cope with anxiety and other forms of emotional distress). Prior analyses have shown that both versions reduce drug use by altering beliefs about its consequences, changing drug use norms and building drug use resistance self-efficacy [28,29].

Both the core and expanded versions of ALERT use highly interactive teaching techniques and include content that encourages generalization of the lessons to other risky behavior and explicitly links risky sexual behavior with drug use. Participants watch videos in which adolescents discuss potential problems from drug use, including sexual behavior that has negative consequences (core: 1 lesson; expanded version: 2) and practice resistance skills in non drug-use situations (1 lesson, both versions). Hence there are two plausible routes through which the ALERT programs might curb risky sex: 1. by reducing alcohol and drug use, both of which may be linked with impaired judgment, disinhibition and increased likelihood of being with other peers who engage in risky behavior or in social contexts where sexual intercourse is likely; and 2. by directly altering beliefs about the sexual risks associated with drug use, as well as participants' perceived ability to resist sexual pressure. We were able to test for mediation by alcohol and drug misuse but lacked appropriate data for testing mediation by program-induced changes in beliefs about risky sex or ability to resist sexual pressure.

Data Collection, Weighting and Imputation

We used baseline covariates from the 1997 Wave 1 survey (administered in Grade 7 classrooms just before program delivery), mediating data from the 2004 Wave 6 and 2006 Wave 7 surveys (administered via mail and the web approximately 6 1/2 and 8 1/2 years after baseline, when the average age of the respondents was 19.3 and 21.3 years) and outcome data from the 2006 Wave 7 survey. RAND's institutional review board approved all data collection procedures and instruments. Participants consented to data collection at each survey wave; parents provided consent at the beginning of the study. At Wave 1, we obtained a U.S. Department of Health and Human Services Certificate of Confidentiality that was later updated to include all subsequent waves of data collection.

Of 4,689 respondents (1,879 control, 2,810 ALERT) who completed the Wave 1 survey, 57% each of the ALERT (n=1603) and control (n=1078) groups also completed the Wave 7 survey. Of these, 1901 met the study criteria of being sexually active and not married. Within this group of eligible young adults, there were differences on baseline risk factors between the ALERT and control participants. As shown in Table 1 (columns 1 and 2), eligible ALERT respondents were significantly less likely than control respondents to have received low grades and tried

alcohol as seventh graders, were somewhat more likely to be white and somewhat less likely to have tried marijuana. Estimates of treatment effects were sensitive to these group differences.

To remove differences among groups resulting from randomization or from differential attrition and eligibility, we used propensity-score weights [30] for participant outcomes from both the ALERT and control groups. To estimate the propensity score (the probability that an eligible respondent with a given set of baseline risk factors received the ALERT condition), we used a generalized boosting model, GBM [31], that has proven effective in developing weights that balance the distribution of variables between experimental groups at baseline [31]. We included 51 variables measuring a broad range of risk factors from the grade 7 survey in the propensity score model (e.g. demographics, own and family substance use and beliefs, etc.). After propensity-score weighting, the distributions of each of these 51 variables were nearly identical between the two groups; as shown in Table 1 (columns 3 and 4) there were no significant differences between treatment and control groups on the key baseline characteristics. However, to ensure our estimates were "doubly robust" to errors in our propensity-score weights [32], we also included the key individual-level variables as covariates in our model, along with two school-level variables that were higher in the control group (past week and past month marijuana use; higher by 1 and 2 percentage points respectively).

To impute missing data for Wave 1 covariates (typically under 10%) plus the Wave 6 and 7 mediators (0 to 20%), we used a multivariate Gaussian distribution to approximate the joint distribution for the variables.[2] Imputed values have been found to be robust to model specifications [33]. We synthesized analyses conducted on five imputed data sets, [3] generated by the NORM and SAS Proc MI software [34], by averaging estimated coefficients and pooling within- and between-imputation variability to estimate standard errors [33].

Outcome and Mediating Measures

To capture risky sexual behavior, we used three dichotomous outcome measures—inconsistent condom use, sex with multiple partners, and having unprotected sex because of drug use. Each of these measures provides policy-relevant information for assessing progress in reducing risk for pregnancy, HIV and/or other sexually transmitted diseases. Consistent with CDC practitioner guidelines [35], we defined inconsistent condom use as having reported use of condoms "usually, half of the time, sometimes or never" during sexual intercourse in the last year and sex with multiple partners as having reported intercourse with two or more sexual partners in the last year. Drug-linked unprotected sex was defined as having reported engaging in unprotected sex because of alcohol or drug use one or more times in the last year.

To test our hypotheses about the mediation of treatment effects on risky sexual behavior at age 21, we examined alcohol and drug misuse at age 19 (Wave 6 of data collection, 2 years before the outcomes were measured) and at age 21 (Wave 7, the same period during which we measured sexual behavior). We reasoned that prior alcohol and drug misuse would mediate program effects on risky sex by increasing the likelihood of subsequently having deviant peer associations, being in risky situations, and continuing to misuse alcohol and drugs and that contemporaneous alcohol and drug misuse might *also* mediate program effects by enhancing disinhibition and impairing judgment. We measured alcohol misuse at age 21 with a ten-item alcohol audit score [36] that performs well in predicting DSM-IV alcohol diagnoses [37]; it included items tapping consumption (e.g., frequency, dosage), out-of-control alcohol use (e.g.,

[2]To improve the accuracy of the imputed values, the imputation models for the baseline covariates included all the derived variable scales and demographic variables for Waves 1 and 2. We imputed Wave 6 and 7 mediators with a joint model for the baseline and follow-up variables that used the previously imputed values for the missing baseline data.

[3]The between imputation variance in our estimated treatment effects is very small, so that five imputed data sets is sufficient to provide precise estimates.

unable to stop drinking), and alcohol-related problems (e.g., injuring others, blacking out, alpha=.85, range =0–36). We measured drug misuse at age 21 with a seven-item drug dependence sum based on items chosen to meet DSM-IV criteria [11] that included out-of control drug use (e.g., using more than intended) and problems from using drugs (alpha =.85, range=0–7). At age 19, the available alcohol and drug misuse measures focused on alcohol consequences (9 items) and marijuana consequences (8 items); these tapped past year experience of problems because of use (e.g., missed school or work, trouble at home, traffic accident, criticized by friend, alphas =.83 and .87, range=0–5 and 0–3.5 respectively).

Outcome and Mediation Analyses

To measure effects of exposure to Project ALERT, we compared young adults who participated in either the 14- or 24-lesson version of the program with those who attended control schools. To evaluate the importance of program duration and gender, we subsequently added separate interaction tests for program length and gender to the base model. We estimated a logistic regression model for each outcome that included an indicator (0,1) variable for Project ALERT plus individual and school-level baseline covariates. We present treatment effects in the form of differences in the probability of an outcome, using the logistic regression models to predict the expected rate of risky sex as a result of substance use for the treatment and control conditions as outlined in [38]. To account for the original clustering of participants within schools, we used bias-reduced linearization methods designed to yield standard errors and statistical tests that are unbiased in the presence of intra-cluster correlation [39].

To assess the potential mediation of risky sexual behavior, we selected the outcomes showing treatment effects at age 21 and then identified, among our four pre-selected potential alcohol and drug use mediators, those that qualified for mediation, i.e., both predicted the risky sex outcome and were predicted by ALERT. For qualifying mediators, we estimated the mediation effect by assessing the change in program coefficient (size and p-value) when the mediator was added to the regression model. We also conducted the Sobel [40] test for significance of mediation effects. We fit models that included each qualified mediator separately and models that included all qualified mediators.

Results

Risky sexual behavior was common in our sample of unmarried, sexually active young adults. Seventy-one percent of the control group reported inconsistent condom use; 50% had multiple sex partners in the last year; and 32% said they had engaged in unprotected sex because of using alcohol or other drugs

Table 2 shows program effects on risky sexual behavior for young adults who were exposed to Project ALERT (either the core or the expanded version) compared to the control group. Young adults who participated in ALERT were significantly less likely than their control counterparts to report having sex with multiple partners ($p<.05$, reductions of 12.5%) and engaging in unprotected sex because of drug use ($p<.05$, reduction of 14%). The test for program duration was not significant for either outcome, although the adjusted outcome rates were slightly lower in the core middle school group compared with the expanded program group. There were also no significant differences in results by gender, although the program effects on both significant outcomes were larger for females than for males. Nor did we find a significant result for inconsistent condom use in treatment versus control comparisons. The core program yielded significantly lower adjusted rates for inconsistent use than did the expanded program (69% versus 73%), but neither group was significantly different from the control.

Table 3 presents the results of mediation analyses for sex with multiple partners and unprotected sex because of drug use, the two outcomes for which Project ALERT produced significant effects.[4] Only three of the four pre-selected misuse variables qualified as potential mediators (alcohol misuse at age 21 plus drug misuse at ages 21 and 19). The Sobel tests found that the only significant mediator for multiple partners was alcohol abuse at age 21: adding this variable to the base model reduced the Project ALERT beta by 30% (but its p-value was still significant). For unprotected sex because of drug use, there were two significant mediators—alcohol abuse at age 21, which reduced the ALERT beta by 57%, and drug consequences at age 19, which reduced the ALERT beta by 24%. Both mediators for the unprotected sex outcome also resulted in nonsignificant betas for ALERT. Including all the mediators in the model together yielded similar results.

Discussion

These results show that a drug prevention program for adolescents can have long-term effects on risky sexual behavior, reducing its prevalence among young adults five to seven years after exposure to the curriculum. Compared to their counterparts in the control condition, youth exposed to Project ALERT were significantly less likely as young adults to engage in sex with multiple partners and to have unprotected sex because of using alcohol or other drugs. Although the effects are modest, they indicate that the benefits of such programs are not confined to drug use alone and can continue to be realized many years after program exposure.

Our hypothesis that longer program duration (24 versus 14 lessons) would yield significantly better effects on risky sexual behavior was not supported by the data. The lack of significant results for longer program exposure may reflect the comparatively lower involvement of program participants in the tenth grade lessons as opposed to those for middle school youth. We also note, however, that lack of greater effectiveness for the longer program version does not mean ineffectiveness: in fact, both program variations showed reductions relative to control for sex with multiple partners and unprotected sex because of drug use. From a cost-effective viewpoint, a shorter curriculum that curbs risky sexual behavior multiple years after program exposure is likely to be more attractive to school officials than a longer curriculum that yields similar effects but takes substantially more class time, teacher time and expenditure of effort.

Contrary to our expectations, Project ALERT did not curb inconsistent condom use nor was it more effective with females than with males. The lack of significant effects for inconsistent condom use may reflect the greater difficulty of curbing a behavior that requires negotiation with a partner who may not have been exposed to the ALERT lessons. In addition, our study included very few African Americans, who have been found to be especially responsive to prevention with regard to condom use [23]. Although we did find larger treatment effects on multiple partners and unprotected sex because of drug use for females than for males, the differences were not significant. Additional research is needed to establish whether females are or are not more responsive to this form of prevention than males.

The mediation results suggest that program reductions in alcohol and drug misuse, particularly alcohol misuse, partially explain Project ALERT's effect on risky sexual behavior. This interpretation is supported by previous research documenting strong associations between drinking and risky sexual behavior [6–9]. Nevertheless, none of the mediators completely explained the program results, indicating that additional research is needed to more fully

[4]The table shows the coefficient (log odds-ration or beta) for Project ALERT (column 1) and accompanying p-value (column 2) for the basis logistic regression model that predicted treatment effects without any mediators in the model (Models 1 and 2) and for models in which each of the three qualifying mediators was separately added to the base model. (Model 1a through 1c; 2a through 2c). The final column shows the Sobel test p-value for significance of mediation.

understand how these changes came about. Key candidates for further exploration include the hypothesized changes in resistance self efficacy vis a vis sexual pressure and beliefs about the links between drug use and sexual risk that we were unable to test.

Potential limitations of this study include its reliance on self-report data, possible bias from sample attrition, and insufficient data for controlling for partner relationships other than marriage and for testing additional potential mediators. Although validation of drug use through physiological and internal reliability tests supports the accuracy of drug use self-reports [16], we have no way of validating the sexual behavior measures. In addition, we failed to obtain surveys from 43% of the original baseline sample. However, attrition did not differ across experimental conditions and we made extensive efforts to equate the analysis sample on baseline risk factors; hence threats to internal validity were greatly reduced. Our respondent sample might differ from the nonrespondents, warranting caution in generalizing our results to the entire population of sexually active, single, young adults. By restricting the sample to single adults, we avoided the potential confounding effects of marriage on the interpretation of outcomes, but our inability to account for duration of sexual relationships, which may influence condom use, might have contributed to our lack of findings for inconsistent use. Finally, lack of data precluded testing whether program-induced changes in beliefs about the association between drug and sexual risks or perceived ability to resist sexual pressure also mediated program effects.

This study shows that drug prevention during adolescence can have long-term effects on risky sexual behavior among young adults and that reductions in recent alcohol and drug misuse, as well as prior drug misuse, contributed in part to this effect. These results are all the more important because of the high proportion of young adults who engage in sexual behavior that puts them at risk for HIV, other STD's and, among women, unplanned pregnancy. They are particularly relevant for schools faced with pressure to de-emphasize drug prevention and other health-related efforts. Results showing that evidence-based drug prevention can yield an additional benefit that lasts years after program exposure enhances both the rationale for providing it and the cost-effectiveness of doing so.

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Table 1

Weighted and Unweighted Characteristics of Analytic Sample by Experimental Condition

	Eligible Analytic Sample (W7)			
	Unweighted		Propensity Score Weighted	
Baseline (W1) Characteristics	**Control N=771**	**Treatment N=1130**	**Control N=771**	**Treatment N=1130**
	%	%	%	%
Female	60.3	59.7	60.4	59.6
White Ethnicity	85.6	90.9	88.2	89.9
Nuclear Family	71.1	70.0	72.3	69.7
Grades (C or below)	21.6	16.8*	19.3	17.5
Tried Marijuana	7.9	5.0	5.8	5.4
Tried Cigarettes	32.9	34.1	29.9	34.9
Tried Alcohol	66.4	61.2*	65.0	61.8

* Note: p<.05 compared to control. Treatment includes both the 14-lesson (core) version and the 24 lesson (expanded) version of Project ALERT.

Table 2

Project ALERT Effects on Risky Sexual Behavior Among Sexually Active Unmarried Young Adults[a]

Outcome Variable	Project ALERT %	Control %
Unprotected sex because of drug use	27.2*	31.6
Sex with multiple partners	43.5*	49.7
Inconsistent condom use	71.2	71.1

*p<.05, compared to control group.

[a]The table presents model-adjusted prevalence rates by group (treatment vs. control). Participants in schools that delivered 14 lessons are combined with those in schools that delivered 24 lessons. Logistic regression models estimated the treatment effects correcting for covariates and then estimated prevalence rates using these models, first assuming all participants received Project ALERT and then assuming all participants received the control condition.

Table 3

Alcohol and Drug Use Mediation of Project ALERT Effects on Risky Sex

	Unmarried Sexually Active Young Adults (N=1901)		
Outcome Variable	**Project ALERT Beta**	**p-value for Beta**	**Sobel p-value**
Model 1: Sex with Multiple Partners			
• Effect of ALERT	−.26	.003	NA
ALERT Effect after Mediators added to Model 1:			
• Model 1a: After adding alcohol abuse score, age 21	−.18	.04	.000
• Model 1b: After adding drug dependence sum, age 21	−.23	.009	.056
• Model 1c: After adding drug consequences, age 19	−.23	.008	.056
Model 2: Unprotected Sex Because of AOD Use			
• Effect of ALERT	−21.	.049	NA
ALERT Effect after Mediators added to Model 2:			
• Model 2a: After adding alcohol abuse score, age 21	−.09	.47	.000
• Model 2b: After adding drug dependence sum, age 21	−.19	.10	.08
• Model 2c: After adding drug consequences, age 19	−.16	.16	.003

Columns 1 and 2 give the coefficient (log odds-ratio or beta) for Project ALERT (column 1) and accompanying p-value (column 2) from the basic logistic regression model that predicted treatment effects without any mediators in the model (Models 1 and 2) and for models in which each of the three qualifying mediators was separately added to the base model (Models 1a through 1c; 2a through 2c). Column 3 gives the Sobel test p-value for significance of mediation.