Published in final edited form as:

Prev Sci. 2014 February ; 15(0 1): 47–58. doi:10.1007/s11121-012-0321-2.

Universal Family-Focused Intervention with Young Adolescents: Effects on Health-Risking Sexual Behaviors and STDs Among Young Adults

Richard Spoth, Scott Clair, and Linda Trudeau

Partnerships in Prevention Science Institute, Iowa State University, ISU Research Park, Building 2, Suite 2400, 2625 North Loop Drive, Ames, IA 50010, USA, URL: www.ppsi.iastate.edu

Richard Spoth: rlspoth@iastate.edu

Abstract

Considering the prevalence and consequences of health-risking sexual behaviors (HRSBs) and STDs among young adults, their prevention is a public health priority. Emerging etiological and prevention outcome literatures suggested study of the long-term effects of universal family-focused interventions on young adult HRSBs and STDs. Although earlier studies have demonstrated intervention impact on adolescent substance misuse, no study has examined universal family-focused intervention effects on young adult HRSBs and STDs via reductions in adolescent misuse. Sixth grade students and their families enrolled in 33 rural Midwestern schools were randomly assigned to experimental conditions. Self-report questionnaires provided data at pretest ($N_s=238$, 221, and 208 for the Iowa Strengthening Families Program [ISFP], Preparing for the Drug Free Years [PDFY], and control groups, respectively), with seven data points through young adulthood (age 21). In latent growth modeling, three young adult HRSB measures (number of sexual partners, condom use, substance use with sex) and lifetime STDs were specified as distal outcomes mediated by adolescent substance initiation growth factors (average level and rate of change). Results showed that the models fit the data and, except for condom use, there were significant indirect effects, with a higher frequency of significant findings for ISFP. The model additions of *direct* intervention effects on young adult outcomes generally were not supported, consistent with a model positing that long-term intervention effects on young adult HRSBs and STDs outcomes are indirect. As an indication of the practical significance of long-term effects, analyses revealed relative reduction rates ranging from 6 % to 46 % for significant outcomes.

Keywords

Health-risking sexual behaviors; STDs; Family-focused prevention; Young adult outcomes

Responsible sexual behavior is an important public health goal and one of the 10 leading health indicators of the national health objectives for 2010 (Centers for Disease Control [CDC] 2002). According to the Youth Risk Behavior Surveys, the results from 1991 to 2009 showed that there has been progress in addressing key prevention indicators. Findings showed decreases in the percentage of high school students who have had sexual intercourse and who have had multiple sex partners (see <http://www.cdc.gov/healthyyouth/yrbs/pdf/>

[us_summary_all_trend_yrbs.pdf](#)); in addition, the prevalence of condom use has increased (CDC 2008, 2011). Despite these advances, however, sexually transmitted diseases (STDs) are the most common infectious diseases in the United States, with approximately 19 million new infections each year; almost half of new infections occur among adolescents and young adults 15 to 24.

Consideration of a range of social, health and economic factors warrants prioritizing preventive interventions that could reduce health-risking sexual behaviors (HRSBs) and STDs (DiClemente 2001). If STD infections are left untreated, serious complications may result, including cervical cancer, infertility, chronic pain, or death. For example, it is estimated that 15 % of cases of infertility among women can be attributed to chlamydia and gonorrhea infections (Eng and Butler 1997). A full 80 % of cervical cancer cases are caused by four types of human papillomavirus, resulting in 14,000 new cases per year (CDC 1999). There also are significant economic and social consequences associated with STDs, particularly economic costs related to treatment and detection. In 2000, the lifetime medical costs of STDs incurred by people ages 15–24 in the US were estimated at \$6.5 billion (Chesson et al. 2004).

As concerns the link between substance initiation and HRSBs/STDs, substance initiation in adolescence has been shown to predict a range of HRSBs and other problem behaviors that may continue into young adulthood (Guo et al. 2002; Leukefeld and Edwards 1999). This earlier research provides a rationale for further examining (1) the link between universal family-focused preventive interventions and delayed substance initiation and, in turn, (2) the link between delayed substance initiation and subsequent HRSBs/STDs, as well as mechanisms underlying these two links.

Because many risk and protective factors for adolescent substance initiation originate in the family environment (notably, parental monitoring, parent–child affective quality, consistent discipline—Getz and Bray 2005; Wood et al. 2004), family-focused preventive interventions have been developed and tested. In addition to these risk and protective factors, family-focused prevention interventions also target youth competencies and perceptions (e.g., peer refusal, perceptions of mastery-esteem) that are associated with risk for substance initiation (e.g., negative peer influences, reduced exposure to substance use opportunities—Spoth et al. 1996a, b, 2009a, b, 2012). Consistent with these mechanisms of effects of universal family-focused intervention on substance initiation, efficacy testing has shown a number of these types of interventions, including the two in the current study, reduce either or both the level and growth of adolescent substance initiation or misuse (e.g., see National Institute on Drug Abuse 2003; Spoth et al. 2008).

Although the mechanisms underlying the relationship between substance misuse and HRSBs/STDs (e.g., substance-related impairment of judgment and decision-making about sexual risk taking) warrant further elucidation, there is some empirical support for that relationship. This empirical support includes the association between substance misuse and increased numbers of sexual partners or less likely use of condoms. That is, alcohol and marijuana use have both been positively associated with number of sexual partners and negatively associated with condom use (Guo et al. 2002; Lowry et al. 1994; MacDonald et al. 1990; Temple et al. 1993). In addition, alcohol use is especially likely to be associated with HRSBs in the case of first-time sexual events (Halpern-Felsher et al. 1996). While most of these studies cited have been cross sectional, some investigations using growth curve models have found a positive relationship between substance use and HRSBs (Duncan et al. 1999; Guo et al. 2002; Oesterle et al. 2004). Nonetheless, overall, results have been mixed (Fortenberry 1995; Lowry et al. 1994; MacDonald et al. 1990).

Although earlier research provides a rationale for links between (1) universal family-focused prevention and delayed substance initiation or misuse and (2) substance misuse and HRSBs/STDs, no studies could be found that examined young adult HRSB and STD outcomes of universal family-focused interventions targeting adolescent substance misuse. Indeed, only a few studies have examined the effects of any type of universal preventive and positive youth development interventions on HRSBs and STDs among general populations. Typically, outcome studies evaluating HRSBs and STDs involve higher-risk populations; only in a limited number of studies were HRSBs directly targeted for intervention. From these studies, there has been some evidence that preventive interventions do affect HRSBs, albeit primarily indirectly (Olsen and Farkas 1990; Melchior 1998; Satcher 2001). Consistent with the etiological research cited above, one way that family-focused interventions could indirectly reduce HRSBs, and consequent STDs, is via reductions in adolescent substance misuse.

In consideration of findings that risk and protective factors persisting through the adolescent developmental stage predict to substance misuse outcomes in young adulthood (Guo et al. 2002), an earlier study tested a developmental mediational model in which family-focused preventive intervention effects on adolescent substance initiation growth factors were shown to mediate effects of those interventions on problematic substance use in young adulthood (Spath et al. 2009b). That is, in a latent growth model, intervention condition was specified as a predictor of the intercept and slope of adolescent substance initiation from the sixth to twelfth grades; young adult alcohol, tobacco or illicit substance use was specified as the distal outcome predicted by growth factors of adolescent initiation. The intervention indirect effects on young adult substance use were significant. The addition of direct intervention effects on young adult outcomes was not supported, indicating that effects were primarily indirect. A similar model of mechanisms of effects of family-focused preventive interventions on adolescent initiation and distal young adult HRSBs and STDs was hypothesized in the current study.

The tested developmental model builds on epidemiological research concerning the public health benefits of delayed onset of substance use. The study addresses gaps in the literature concerning an array of outcomes in emerging or early adulthood (Chen, et al. 2004; Offord and Bennett 2002)—the developmental stage characterized by substantial changes in roles and responsibilities across all types of environments (home, work, school). Key health-related behaviors at this stage, affected by adolescent substance use, are sexual ones.

In addition to addressing a gap in the knowledge base on the long-term young adult effects of universal interventions implemented in early adolescence, the tested model addresses other issues specified in the literature. These issues are summarized from an earlier, more detailed description (Spath et al. 2009b). First, it has been difficult to demonstrate indirect or mediating effects of interventions across developmental stages (Ennett et al. 2001; Mason et al. 2008; Shrout and Bolger 2002). In part, this is a result of complex causal pathways—across interrelated physical, emotional, cognitive and social processes leading to specific problem behaviors over time (Masten et al. 2008). The difficulty of tracking intervention effects through complex developmental processes warrants starting with consideration of a parsimonious model, with intervention effects on the growth of substance initiation during adolescence predicting to young adult outcomes. Thus, the tested developmental model posits that the proximal effects of the intervention reduce the level and rate of growth in adolescent substance initiation, and that these effects are the primary means by which long-term intervention effects on young adult HRSB and STD outcomes are produced.

Second, key methodological shortcomings related to the examination of mechanisms of long-term intervention effects also are addressed, including limited application of growth

curve analyses in earlier studies, resulting from too few data time points, and reliance on retrospective reports in many of the prior studies (see Hawkins et al. 2005). Further, recent methodological advances have addressed concerns about missing data in longitudinal studies by utilizing newer methodologies, such as Full Information Maximum Likelihood (FIML) estimation to provide more accuracy in statistical testing (Muthén et al. 1987; Wothke 2000).

Third, a key issue in earlier investigations of long-term preventive intervention effects is limited attention to the practical significance of intervention effects, particularly key when effects are expected to be primarily indirect. One approach to this issue is to estimate effects on “caseness” for each long-term outcome, with caseness defined as levels of HRSBs/STDs that likely are problematic from a public health perspective, as was done for this report.

The particular sexual behaviors examined in this study are consistent with the existing literature in this area, although our measures were limited by the space available in the survey instrument. The specific outcome measures assessed in the current paper include history of STDs, number of past year sexual partners, past year condom use, and substance use in conjunction with sex. In accordance with the tested developmental model, it was hypothesized that universal family-focused intervention effects on young adult HRSB and STD outcomes would occur primarily indirectly, via effects on adolescent substance initiation growth factors. Because there have been only positive or null intervention effects on substance-related outcomes across six waves of data, with no negative effects, study hypotheses were directional. Specific *p* values are reported so both one- and two-tailed test results are clear.

Method

Sample

The study began when participants were sixth graders enrolled in 33 rural Midwestern schools. Schools districts had 15 % of families eligible for free or reduced-cost school lunches; community populations were 8,500. A randomized block design, based on school size and proportion of lower-income households, guided school assignment prior to pretesting. Schools within blocks were randomly assigned to one of three experimental conditions: those receiving the seven-session Iowa Strengthening Families Program (ISFP), the five-session Preparing for the Drug Free Years (PDFY), or a minimal-contact control condition.

All families of sixth graders were recruited for participation ($N=1,309$). Six hundred sixty seven (approximately 51 %) completed pretesting—238 ISFP group families, 221 PDFY group families, and 208 control group families. Recruitment rates compared favorably with, or exceeded, those commonly reported for similar prevention trials at the time (see Spoth and Redmond 1994). Refusal rates were similar across conditions. At the time of pretesting, participating families did not know their assigned experimental condition, although they knew some schools would be offered interventions. Pretested intervention-school families were recruited for the programs after pretesting; those families in the intervention condition schools who did not participate in the pretest assessment were allowed to enroll in the interventions but were not actively recruited and did not provide data for analyses. At pretest, the mean age of the participating students was 11.3 years; 52 % were female; 98 % were White. Also, 86 % of participating families were dual-parent (64 % dual-biological parents). Almost all mothers and fathers had completed high school (97 % and 96 % respectively), and over half reported additional education. Median household income was \$33,900.

Sample participation information (assessments from pre-test through the young adult follow-up, along with prevention program enrollment) is available online at <http://www.ppsi.iastate.edu/publicationsupplements/PF154/154figure.pdf>.

Sample Quality

Detailed descriptions of tests conducted to establish sample representativeness and pretest equivalence, as well as to rule out differential attrition, are provided in earlier reports (Spoth et al. 1998, 1999, 2001). Current and earlier analyses found: (a) the study sample was representative of families in the targeted population; (b) there was pretest equivalence of the intervention and control conditions with respect to family sociodemographic characteristics, substance use and other outcome measures; (c) there was no evidence of differential attrition between intervention and control conditions through the young adult assessment. To elaborate on differential attrition assessments, ANOVA tests of attriters by intervention condition from pretest (Wave 1) to young adult (Wave 7) demonstrated no significant difference across conditions; there were no significant differences on attrition status by condition, on any of the young adult variables examined in this study. In condition x drop out status ANOVA analyses, Wave 1 to Wave 6, the related *p* values ranged between 0.32 and 0.92.

Interventions: Description, Implementation Fidelity, and Participation

PDFY Intervention—PDFY (currently called Guiding Good Choices) is a family competency-training program offered in five weekly 2-h sessions. The primary objectives of PDFY are to enhance protective parent–child interactions and to reduce children’s risk for early substance initiation. The PDFY intervention design was guided by the social development model (Catalano and Hawkins 1996). Additional details on the theoretical underpinnings of PDFY are provided in earlier reports (Spoth et al. 1998, 2001).

After training, 15 two-person teams implemented PDFY with 19 groups of families in the 11 PDFY schools, with an average of 10 families per group. Approximately 56 % of pretested families attended at least one session; 94 % of the attending families were represented by a family member in 3 or more sessions. Notably, 93 % attended 4 or 5 sessions and 61 % attended all five. On average, 16 individuals attended the parent sessions, and an average of 25 individuals attended the one session that included both parents and children. Results from fidelity observations showed that, although there was some variability in group leaders’ delivery, all teams covered the key program concepts. In addition, the teams were found to have covered an average of 69 % of the component tasks in the group leader’s manual. For greater detail regarding the theoretical foundations, content, and implementation of the PDFY intervention, see Kosterman et al. (1997) and Spoth et al. (1998).

ISFP Intervention—The ISFP (now called the Strengthening Families Program: For Parents and Youth 10–14) is based on empirically-supported risk and protective factor models; earlier summaries provide a detailed description of the empirically-based risk and protective factors addressed through the ISFP intervention design (Kumpfer et al. 1996). The program is offered in seven weekly sessions, with the first six lasting 2 h and the last one being held for 1 h. The trained implementers included 21 three-person teams conducting 21 groups in the 11 ISFP schools. Group sizes ranged from 3 to 15 families, with an average of 8 families or 20 individuals attending the weekly sessions. Approximately 50 % of pre-tested families attended at least one session; 94 % of these families were represented by a family member in 5 or more sessions. Also, 88 % attended 6–7 sessions, and 62 % completed all 7. Sessions began with separate, concurrent 1-h skill-building sessions for parents and children, followed by a second 1-h joint session in which parents and children together practiced skills that had been introduced in their separate sessions. Trained

observers monitored the implementation quality of each team two or three times and reported coverage of all key program concepts, averaging 87 %, 83 %, and 89 % of the component tasks in the group leader's manual for the family, parent, and youth sessions, respectively. Further detail on the ISFP, implementation procedures, and quality of implementation can be found in Kumpfer et al. (1996) and Spoth et al. (1998, 2001).

Minimal Contact Control Condition—Families participating in the control group were mailed four leaflets describing aspects of adolescent development (e.g., physical and emotional changes, as well as parent–child relationships). Control group families received this information concurrent with the implementation of the PDFY and ISFP programs in the intervention groups.

Procedure

Families were contacted to schedule the in-home pretest assessment visit; posttesting was approximately 6 months later. All pretested families—including intervention group families who had not enrolled in the interventions—were recruited to complete the posttest and follow-up adolescent assessments. Thus, pretested families were reassessed approximately 6, 18, 30, 48, and 72 months following the pretest (when students were in the sixth, seventh, eighth, tenth, and twelfth grades, respectively).

Subsequent to the above assessments, an additional follow-up interview was conducted when the targeted children had entered young adulthood, at the approximate age of 21. This assessment did not include parents. Trained interviewers conducted Computer Assisted Telephone Interviews (CATIs) with the young adults. Participants were reimbursed for the time required to complete assessments across all waves.

Measures

Young Adult Number of Sexual Partners in Past Year—*NSP* Participants were asked “In the past 12 months, how many people have you had sex with (including vaginal, anal, and oral sex)?” Participants were requested to respond with the actual number of partners in the past year.

Young Adult Condom Use in Past Year—*CU* Participants were asked “In the past 12 months, how much of the time was a latex condom used when you had sexual intercourse?” Response choices included “(1) None of the time (2) Less than half of the time (3) About half of the time (4) Most of the time (5) Always (8) Don't Know (9) Refused;” the latter two responses were treated as missing for the analyses.

Young Adult Substance Use and Sex—*SUS* Participants were asked two questions “When you have sex, how often have you been drinking alcohol?” and “When you have sex, how often have you been using drugs other than alcohol, such as marijuana or cocaine?” Both questions had the following response choices “(1) Never (2) Less than half of the time (3) About half of the time (4) Most of the time (5) Always (8) Don't Know (9) Refused;” the latter two responses were treated as missing for the analyses. Both items were dichotomized into “Never” = 0 and “Less than half of the time” to “Always” = 1 and then summed to create the *SUS* scale, where 0 represented not having used alcohol or other drugs during sex, 1 represented having used alcohol OR other drugs during sex, and 2 represented having used alcohol AND other drugs during sex.

Young Adult Lifetime Sexually Transmitted Diseases—*LSTDs* Participants were asked “Have you ever been diagnosed with a sexually transmitted disease (STD or VD) other than HIV/AIDS, such as gonorrhea, genital warts, chlamydia, trich, herpes, or

syphilis?” Possible responses were yes, no, don’t know and refused; responses of don’t know and refused were treated as missing for the analyses. Responses of “No” were coded as 0, and “Yes” as 1.

Adolescent Alcohol, Tobacco, and Other Drug (ATOD) Initiation Index (AII—Waves 1 to 6)—This measure is the sum of five individual substance initiation measures, each scored so that “Yes” = 1 and “No” = 0. Scores ranged from 0, indicating no initiation, to 5, indicating the initiation of alcohol use (without parental permission), drunkenness, tobacco, marijuana, and other illicit drugs. In this context it is noteworthy that Sneed and colleagues (2004) compared three methods of constructing lifetime substance use indices—a count variable, an index weighted by severity, and a hierarchical index—and concluded that the relationships between the various indices and predictor variables were roughly equivalent for a general population sample with little ethnic diversity.

Internal consistency of the composite measure, as assessed by Cronbach’s alpha, averaged 0.60 across waves. This relatively lower level of internal consistency is not unexpected in light of the fact that the individual items of the composite measure refer to disparate substances and behaviors among which only mid-range correlations would be expected. Measures were corrected for consistency so that if a participant answered “Yes” for initiation of a substance at any wave, responses were scored as “Yes” for each subsequent wave.

Analyses

Latent growth curve models were used to assess intervention effects on adolescent initiation (AII) growth factors and, in turn, AII growth factor effects on young adult HRSB and STD outcomes. As depicted in Fig. 1, the model specifies direct effects on the young adult outcomes from the latent intercept and slope factors describing growth in AII across Waves 2 (posttest in 6th grade) to 6 (12th grade) of the study. The specified latent growth factor loadings on the observed measures of AII set the growth model intercept to the midpoint of the post-intervention period, to most appropriately reflect the average level of initiation across the adolescent developmental stage. Growth across time was modeled as linear (polynomial contrasts reflecting unequally spaced time points were fixed at -2.4 , -1.4 , -0.4 , 1.1 , 3.1). The growth factor indicators were modeled with an autoregressive error structure, and the latent intercept and slope factors were allowed to correlate. The model also controlled for pre-intervention (Wave 1) AII effects on the subsequent adolescent growth factors and young adult outcomes. Other specified control variables measured at Wave 1 were: gender, parent marital status, parent education level, and family income. Finally, the influence of assignment to the intervention condition (versus the control condition; coded 0 = control condition and 1 = intervention condition) was incorporated via direct effects on both the intercept and slope factors of AII, with resulting indirect effects on young adult outcomes through those growth factors. In this manner, the model tested for indirect intervention effects on young adult HRSB and STD outcomes that were accounted for by intervention effects on both the average level (intercept) and rate of change across time (slope) of AII.

Although the substantive and methodological literature reviewed in the introduction supported the hypothesized developmental model focusing on indirect effects, further SEM model testing was conducted to examine direct intervention effects, in two ways. First, simple direct effects were calculated using the same covariates as the indirect effects model, but eliminating the adolescent growth factors as mediators of intervention effects (eliminating paths a, b, c and d in Fig. 1 and substituting a direct path from intervention condition to the young adult outcome—see Muthén and Muthén 1998–2010). As suggested

by the literature reviewed earlier, such effects were not necessarily expected to be significant or large, due to the length of time between intervention implementation and the young adult outcomes (see Shrout and Bolger 2002). In this context, it is important to note that *Mplus* utilizes the delta method developed by Sobel (1986) to calculate indirect effect significance levels and confidence intervals. Further, recent literature on mediation has suggested that under certain circumstances, including the assessment of distal effects, it is not necessary to have a significant direct effect in order to test for mediation (Shrout and Bolger 2002; MacKinnon et al. 2007).

To conduct an additional test of indirect effects and to confirm that intervention effects on young adult outcomes operated primarily through effects on adolescent developmental growth factors, supplemental model testing was conducted that added a direct path from intervention group participation to the young adult outcomes, while also maintaining the indirect effects pathways through the growth factors. The models examined the significance of the direct and indirect effects, as well as overall model fit. Model fit was compared by using a chi-square difference test with the Yuan-Bentler T^2_* test statistic, an empirically-supported test developed to adjust for clustered sampling and conditions of multivariate non-normality (Fouladi 2000; Muthén and Muthén 1998–2010).

Because adolescents were clustered within schools, school was included as a higher-level cluster variable in the analyses to accurately estimate standard errors and avoid potentially biased significance tests (Kreft and deLeeuw 1998). Robust maximum likelihood estimation was used to address effects of non-normality and non-independence of observations. Analyses were performed with *Mplus* 6.1 (Muthén and Muthén 1998–2010), using Full-Information Maximum Likelihood (FIML) estimates with incomplete data to yield more efficient and less biased parameter estimates than traditional methods for dealing with missing data, and to allow for estimations based on all the available data (Muthén et al. 1987; Wothke 2000). The approximate percentage of those missing all data at young adulthood was 26–27 %. In the case of condom use, as well as substance use and sex, those who had no sex partners in the past year, along with those who were virgins, were excluded so the percentage missing was higher.

In addition to the chi-square value, model fit was evaluated with two indices, as recommended by Coffman (2008): the root mean square error of approximation (RMSEA: Steiger and Lind 1980) and the comparative fit index (CFI: Bentler 1990). Values of the CFI 0.95 and the RMSEA 0.06 are considered to reflect good model fit (Hu and Bentler 1999).

Finally, secondary analyses were conducted to evaluate the practical significance of the intervention effects, as specified in the introduction. For these analyses, cut points were selected for the continuous outcome variables, allowing them to be recoded into dichotomous variables representing positive versus negative “caseness” for that outcome. The dichotomized outcome variables were evaluated for indirect intervention effects using estimates from the same model specification as was applied in the continuous outcomes analyses. The potential impact of each intervention was determined by computing Relative Reduction Rates (RRRs) based on the estimated percentage above the cut points. RRRs indicate the proportion of cases prevented, relative to how many would have occurred in the absence of the intervention.

Cut points for dichotomizing the variables, other than lifetime STDs, were determined by considering variable values indicative of appreciable risk in the studied population. For NSP, since multiple sexual partners create risk for negative outcomes (e.g., increased exposure to STDs, increased possibility of unwanted pregnancies), having one or zero

sexual partners during the past year is likely to be lower risk (Yarber et al. 2008). In the current sample, approximately 72 % of young adults had one or zero partners during the past year; therefore, the remaining 28 % who reported two or more partners were considered higher risk. For CU, approximately 30 % of our sample reported always using condoms; the remaining 70 % were considered to be at higher risk. For SUS, approximately 44 % never combined alcohol or drugs with sex; the other 56 % were considered to be placing themselves at risk based on literature indicating risk of combining the use of substances with sex (Duncan et al 1999; Oesterle et al. 2004).

Results

A table presenting the means and standard deviations of the study variables by intervention group and a table reporting the correlations among the study variables are available online at <http://www.ppsi.iastate.edu/publicationsupplements/PF154/154tables.pdf>. Table 1 presents the model fit indices and standardized parameters for analyses conducted for each intervention and each outcome, as illustrated in Fig. 1. An examination of the fit indices suggests that the models fit the data. Although the chi-square value was significant for most models, the fit indices were within acceptable limits. Further, results were consistent with the hypothesized developmental model; the indirect intervention effects on young adult sexual behavior-related outcomes through the AAI growth factors were significant, with the exception of the models predicting past year CU (note that the CU variable is coded so that higher scores indicate a higher frequency of condom use).

An examination of the hypothesized pathways of effect demonstrates a somewhat different pattern of results for the two interventions. The ISFP intervention significantly predicted both the intercept (the “a” path) and slope (the “b” path) for AAI. PDFY intervention effects on AAI growth factors, although significant, were weaker overall. The results presented in Table 1 also indicate that there was some variation across the outcomes as to whether the intercept or the slope related most strongly to the outcome variable.

As noted in the description of the analytic strategy, simple direct effects were examined as well. Models specifying the control variables and intervention condition directly predicting the young adult outcomes were tested. Findings indicated significant ISFP direct effects on lifetime STDs ($p=0.002$) and SUS ($p=0.004$). A significant direct PDFY effect on lifetime STDs also was found ($p=0.046$).

Additional analyses considered a modification of the model shown in Fig. 1, adding a direct effect path from the intervention to the young adult outcomes. This model modification was supported only for the model testing ISFP effects on lifetime STDs; there was a significant improvement in model fit ($\Delta\chi^2_{(1)} = 4.45, p=0.035$), the direct effect path was significant ($\beta = -0.07, p=0.043$), and the total effect of ISFP on lifetime STDs improved ($\beta = -0.12, p=0.002$). However, there were no analyses for which inclusion of the direct effect altered the direction or significance of the indirect effect. In this context, it is important to note that the direct path that was added reflects any direct or indirect effect of the intervention on the outcomes not accounted for by the interventions’ indirect effect conveyed via the AAI growth factors. Thus, the overall pattern of results detailed above provides consistent support for the model hypothesizing that the interventions’ effects on the distal HRSB and STD outcomes are predominantly conveyed indirectly, through effects on AAI.

Because failure to use condoms and substance use with sex would likely be less risky in the context of a married or cohabitating relationship, post hoc two-group analyses were run to assess whether the influence of the interventions on those two variables differed by relationship status. For PDFY, 36.9 % were married or cohabitating and, for ISFP, it was

33.9 %. Results indicated a stronger ISFP effect on SUS for single individuals (indirect ISFP effect, $\beta = -0.07$, $t = -1.95$) than for married or cohabiting individuals (indirect ISFP effect, $\beta = -0.02$, $t = 0.70$); single individuals in the ISFP group were significantly less likely to combine substance use with sex than control condition single individuals, whereas the difference between ISFP and Control married or cohabiting individuals was non-significant. For PDFY, no differences between groups were found.

Finally, the aforementioned supplemental set of RRR analyses was conducted to provide insight regarding the practical significance of intervention effects on HRSB and STD outcomes. These analyses utilized the dichotomous versions of the young adult outcome variables; intervention effects obtained from these analyses correspond to the estimated probability of an individual achieving caseness. The estimated percentages above the cut points for intervention and control groups were used to calculate the RRR of each intervention for each outcome.¹ An examination of Table 2 indicates that significant indirect effects were found for ISFP on lifetime STDs, NSP, and SUS; significant indirect effects were found for PDFY on lifetime STDs and SUS. There were no significant indirect effects on CU for either intervention. The RRR was calculated for each analysis to estimate the percent of “cases” that were likely prevented as a result of the intervention. These estimated values indicated that RRRs for lifetime STDs were 46 % for ISFP and 18 % for PDFY. The other significant outcomes ranged from 6 % to 22 %. Higher RRRs were obtained for the ISFP intervention, as compared with PDFY, consistent with results for the continuous variable outcomes.

Discussion

The combination of the prevalence rates and consequences of HRSBs and STDs among young adults present a compelling case for examination of prevention intervention outcomes during this developmental stage. From this perspective, there is a striking gap in the knowledge base. That is, no studies could be found that evaluated the potential benefit of universal family-focused preventive interventions previously shown to impact a key predictor of young adult HRSBs and STDs—adolescent substance initiation. Essentially, this type of study requires evaluation of intervention effects on developmental pathways leading to young adult sexual risk-taking. To address these challenges, a parsimonious developmental model was constructed, positing that long-term effects of universal family-focused preventive interventions on a range of sexual behavior-related outcomes would be conveyed primarily indirectly, via direct effects on adolescent substance initiation growth factors.

The key finding of the study is that both of the universal family-based interventions showed indirect long-term effects on HRSB and STD outcomes. The specific pattern of influence—whether indirect effects were primarily through the substance initiation level (intercept) and/or the initiation slope factors—varied across outcome variables and interventions. The general pattern of results was consistent with the hypothesized developmental model; that is, both ISFP and PDFY had significant indirect effects on three of the four outcome measures (number of partners, lifetime sexually transmitted diseases, and substance use and sex) through the adolescent substance initiation growth factors.

¹The estimated sample size of those above the cut points was calculated from the model by multiplying the estimated proportions of those who were above the cut points for each condition by the corresponding condition sample size; the estimated proportion and sample size of those below the cut points were then calculated by subtraction. The predicted percentages above the cut points for intervention and control groups were used to calculate the Relative Reduction Rate (RRR) of each intervention for each outcome. The RRR is calculated by subtracting the estimated percentage of those above the cutoff in the intervention group from the estimated percentage of those above the cutoff in the control group and dividing by the estimated percentage above the cutoff in the control group.

As noted earlier, neither of the interventions was found to have a significant effect on condom use. Reasons for the observed null findings with this particular outcome are unclear. The construction of the survey item on condom use, requiring frequency estimations over a year-long period, may have reduced measure sensitivity or accuracy. Also, the high proportion of the sample in committed relationships may have contributed to this null finding. Although the more limited condom use in this type of relationship probably is less risky, the individuals in such relationships also are less likely to use condoms. In addition, reviews of earlier studies have revealed some mixed findings in the relationship between substance use and condom use and have indicated the factors influencing the relationship are not well understood (e.g., The National Center of Addiction and Substance Abuse 1999).

Although ISFP effects and PDFY effects were not directly compared, the differences in the pattern of findings for ISFP and PDFY are noteworthy. First, with regard to the significant indirect effects noted above, ISFP's level of significance was stronger for each of the outcomes. When direct effects between the interventions and the outcomes were examined, both ISFP and PDFY had a significant direct effect on lifetime STDs, but only ISFP had a significant effect on substance use and sex (the effect of PDFY was marginally significant). In other instances, when ISFP effects have been found to be stronger than PDFY effects, explanations have included the greater length of the ISFP program and the involvement of the target child in the intervention (e.g., see Spoth et al. 2001).

Another point of difference between ISFP and PDFY concerned the subgroup analyses that were based on partner status for substance use with sex. There was a significant intervention effect for ISFP, but not for PDFY, on substance use with sex for single individuals; single individuals who attended ISFP were significantly less likely to combine substances with sex than singles in the control condition, whereas there was not a significant intervention effect for married/cohabitating individuals. Further examinations of ISFP effects found singles overall (ISFP and control condition) were almost twice as likely to combine substance use and sex as were married/cohabitating individuals. Thus, in a manner of speaking, being married or cohabitating confers a protective effect (married/cohabitating status did not differ by intervention condition). Single individuals, absent the protective effect of having a more permanent partner, appeared to be at a higher degree of risk and more likely to demonstrate stronger ISFP effects.

Across the findings on both interventions, there was consistency in the mediating role of the adolescent substance initiation growth factors, particularly when considering results from model fitting that added a direct path from the intervention to the young adult outcomes. In only one case—the ISFP versus control lifetime STD model—did adding a direct path to the model result in a significant improvement in fit. In none of the models, however, did adding a direct path change the significance level of the indirect influences of the interventions through the adolescent substance initiation growth factors. Although results do not suggest a clear explanation for the observed direct ISFP effects on lifetime STDs, and no definitive conclusions can be drawn, it is possible that intervention effects on additional predictors of STDs, such as number of sexual partners or substance use and sex, also are mediators of the direct intervention effects on STDs demonstrated in the model.

The results addressing the practical significance of study findings, indicated by the estimated proportion of participants surpassing the specified “cutoff” values and thereby achieving caseness, suggest that ISFP and PDFY have long-term benefits that extend beyond effects on adolescent substance initiation. Intervention effects on adolescent substance initiation may have set the stage for improved young adult decision-making related to HRSBs by initiating a cascading effect on variables associated with both young adult substance use and HRSBs, such as effective problem-solving and assertiveness. This may have contributed to

the estimated RRR for the ISFP intervention of 22 % on a key young adult outcome—past year number of partners. Also, it may be the case that, in addition to indirect effects on dichotomous young adult outcomes, intervention effects on more than one sexual partner (RRRs were ISFP = 22 % and PDFY = 9 %) and on pairing substance use and sex (RRRs were ISFP = 9 % and PDFY = 6 %) help explain intervention effects on lifetime STDs, by lowering the contributory risks. The reader should remain cognizant of the relatively low STD rates in this sample and how that contributes to the size of the RRR of 46 % for lifetime STDs for ISFP. Nonetheless, the constellation of reported effects on key outcomes could have important public health benefits in reduced social and medical costs for those individuals and communities who participated in these relatively short and cost-effective (Spoth et al. 2002) preventive interventions.

A key limitation of the study concerns generalizability. Although our sample was predominantly white and rural, it seems likely that similar effects would be found in other populations—but that remains to be verified. Other common limitations in community-wide longitudinal effectiveness trials include sample attrition and reliance on self-reported behaviors. Our approach supports confidence in the robustness of the results, though readers should remain cognizant of these threats to validity. Specifically, we addressed sample attrition concerns by ruling out differential attrition and by using full information analytic techniques. As concerns the self-report validity issue, prior research supports the validity of substance use self-reports (Smith et al. 1995; Kraus and Augustin 2001; Williams et al. 1995). In addition, it is noteworthy that differential biases associated with the experimental conditions (e.g. social desirability) would not likely be operating at the young adult data collection point, so many years following the intervention.

Future study will focus on whether positive outcomes are sustained through the young adult years. It also will entail further examination of the mechanisms for the intervention effects. One of these potential mechanisms is the role of the adolescent's social networks. Some research has suggested that a “positive contagion” effect of the interventions via social networks (e.g., participating youth model peer refusal skills for non-participating youth) may be partially responsible for the effects. Other planned research will be an examination of the mediational role of intervention-induced reductions in adolescent exposures to substance use opportunities (called a “protective shield” effect—Spoth et al. 2009a, b, 2012) that, in turn reduces use and serves as a deterrent to various other risky behaviors, including HRSBs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Work on this paper was supported by research grants DA007029 from the National Institute on Drug Abuse and by grant AA014702-13 from the National Institute on Alcohol Abuse and Alcoholism.

References

- Bentler PM. Comparative fit indexes in structural models. *Psychological Bulletin*. 1990; 107:238–246. [PubMed: 2320703]
- Catalano, RF.; Hawkins, JD. The social development model: A theory of antisocial behavior. In: Hawkins, JD., editor. *Delinquency and crime: Current theories*. New York: Cambridge University Press; 1996. p. 149-197.
- Centers for Disease Control and Prevention (CDC), National Center for Chronic Disease Prevention and Health Promotion. *Adolescent and School Health* [Electronic version]. CDC Atlanta: U.S.

- Department of Health and Human Services, Public Health Service; 2002. Available [On-line]: <http://www.cdc.gov/nccdphp/dash/index.htm>
- CDC. Prevention of genital HPV infection and sequelae: Report of an external consultant's meeting. Atlanta: Centers for Disease Control and Prevention; 1999.
- CDC. Trends in HIV- and STD-related risk behaviors among high school students—United States, 1991–2007. *Morbidity & Mortality Weekly Report*. 2008; 57:817–822. [PubMed: 18668019]
- CDC. Sexually transmitted disease surveillance 2010. Atlanta: Department of Health and Human Services; 2011.
- Chen C, Dormitzer CM, Gutierrez U, Vittetoe K, Gonzalez GB, Anthony JC. The adolescent behavioral repertoire as a context for drug exposure: Behavioral autarcesis at play. *Addiction*. 2004; 99:897–906. [PubMed: 15200585]
- Chesson HW, Blandford JM, Gift TL, Tao G, Irwin KL. The estimated direct medical costs of sexually transmitted diseases among American youth, 2000. *Perspectives on Sexual and Reproductive Health*. 2004; 36:11–19. [PubMed: 14982672]
- Coffman DL. Model misspecification in covariance structure models: Some implications for power and Type 1 error. *Methodology*. 2008; 4:159–167. [PubMed: 21331302]
- DiClemente RJ. Development of programmes for enhancing sexual health. *Lancet*. 2001; 358:1828–1829. [PubMed: 11741616]
- Duncan SC, Strycker LA, Duncan TE. Exploring associations in developmental trends of adolescent substance use and risky sexual behavior in a high-risk population. *Journal of Behavioral Medicine*. 1999; 22:21–34. [PubMed: 10196727]
- Eng, TR.; Butler, WT. *The hidden epidemic: Confronting sexually transmitted diseases*. Washington: National Academy Press; 1997.
- Ennett ST, Bauman KE, Pemberton M, Foshee VA, Chuang Y, King TS, Koch GG. Mediation in a family-directed program for prevention of adolescent tobacco and alcohol use. *Preventive Medicine*. 2001; 33:333–346. [PubMed: 11570838]
- Fortenberry JD. Adolescent substance use and sexually transmitted diseases at risk: A review. *Journal of Adolescent Health*. 1995; 16:304–308. [PubMed: 7612636]
- Fouladi RT. Performance of modified test statistics in covariance and correlation structure analysis under conditions of multivariate non-normality. *Structural Equation Modeling*. 2000; 7:356–410.
- Getz JG, Bray JH. Predicting heavy alcohol use among adolescents. *American Journal of Orthopsychiatry*. 2005; 75:102–116. [PubMed: 15709854]
- Guo J, Chung IJ, Hill K, Hawkins J, Catalano R, Abbott R. Developmental relationships between adolescent substance use and risky sexual behavior in young adulthood. *Journal of Adolescent Health*. 2002; 31:354–362. [PubMed: 12359381]
- Halpern-Felsher BL, Millstein SG, Ellen JM. Relationship of alcohol use and risky sexual behavior: A review and analysis of findings. *Journal of Adolescent Health*. 1996; 19:331–6. [PubMed: 8934293]
- Hawkins JD, Kosterman R, Catalano RF, Hill KG, Abbott RD. Promoting positive adult functioning through social development intervention in childhood: Long-term effects from the Seattle Social Development Project. *Archives of Pediatric & Adolescent Medicine*. 2005; 159:25–31.
- Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*. 1999; 6:1–55.
- Kosterman R, Hawkins JD, Spoth R, Haggerty KP, Zhu K. Effects of a preventive parent-training intervention on observed family interactions: Proximal outcomes from Preparing for the Drug Free Years. *Journal of Community Psychology*. 1997; 25:337–352.
- Kraus L, Augustin R. Measuring alcohol consumption and alcohol-related problems: Comparison of responses from self-administered questionnaires and telephone interviews. *Addiction*. 2001; 96:459–471. [PubMed: 11255585]
- Kreft, I.; deLeeuw, J. *Introducing multilevel modeling*. Thousand Oaks: Sage; 1998.
- Kumpfer, KL.; Molgaard, V.; Spoth, R. The Strengthening Families Program for the prevention of delinquency and drug use. In: Peters, RD.; McMahon, RJ., editors. *Preventing childhood disorders, substance abuse, and delinquency*. Thousand Oaks: Sage; 1996. p. 241–267.

- Leukefeld CG, Edwards RW. Recommendations to bridge rural/urban drug-use(r) research and practice. *Substance Use and Misuse*. 1999; 34:785–93. [PubMed: 10210105]
- Lowry R, Holtzman D, Truman BI, Kann L, Collins JL, Kolbe LJ. Substance use and HIV-related sexual behaviors among US high school students: Are they related? *American Journal of Public Health*. 1994; 84:1116–1120. [PubMed: 8017535]
- MacDonald NE, Wells GA, Fisher WA, Warren WK, King MA, Doherty JA, Bowie WR. High-risk STD/HIV behavior among college students. *Journal of the American Medical Association*. 1990; 263:3155–3159. [PubMed: 2348524]
- MacKinnon DP, Fairchild AJ, Fritz MS. Mediation analysis. *Annual Review of Psychology*. 2007; 58:593–614.
- Mason WA, Kosterman R, Haggerty KP, Hawkins JD, Redmond C, Spoth RL, Shin C. Dimensions of adolescent alcohol involvement as predictors of young adult major depression. *Journal of Studies on Alcohol and Drugs*. 2008; 69:275–285. [PubMed: 18299769]
- Masten AS, Faden VB, Zucker RA, Spear LP. Underage drinking: A developmental framework. *Pediatrics*. 2008; 121:S235–S251. [PubMed: 18381492]
- Melchior, A. National evaluation of learn and serve American school and community-based programs. Waltham: Center for Human Resources, Brandeis University; 1998.
- Muthén, LK.; Muthén, BO. Mplus user's guide. 6. Los Angeles, CA: Muthén & Muthén; 1998–2010.
- Muthén B, Kaplan D, Hollis M. On structural equation modeling with data that are not missing completely at random. *Psychometrika*. 1987; 42:431–462.
- National Institute on Drug Abuse. NIH Publication No 04-4212. Rockville: Author; 2003. Preventing drug use among children and adolescents: A researched-based guide.
- Oesterle S, Hill KG, Hawkins JD, Guo J, Catalano RF, Abbott RD. Adolescent heavy episodic drinking trajectories and health in young adulthood. *Journal of Studies on Alcohol*. 2004; 65:204–212. [PubMed: 15151351]
- Offord, DR.; Bennett, KJ. Prevention. In: Rutter, M.; Taylor, E., editors. *Child and adolescent psychiatry*. 4. Oxford: Blackwell Scientific; 2002. p. 881-899.
- Olsen RJ, Farkas G. The effects of economic opportunity and family background on adolescent cohabitation and childbearing among low-income blacks. *Journal of Labor Economics*. 1990; 8:341–362.
- Satcher, D. The Surgeon General's call to action to promote sexual health and responsible sexual behavior. 2001. Available at http://www.surgeongeneral.gov/news/pressreleases/pr_sexualhealth.pdf
- Shrout PE, Bolger N. Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods*. 2002; 7:422–445. [PubMed: 12530702]
- Smith GT, McCarthy DM, Goldman MS. Self-reported drinking and alcohol-related problems among early adolescents: Dimensionality and validity over 24 months. *Journal of Studies on Alcohol*. 1995; 56:383–394. [PubMed: 7674672]
- Sneed CD, Morisky DE, Rotheram-Borus MJ, Lee SJ, Ebin VJ. Indices of lifetime polydrug use among adolescents. *Journal of Adolescence*. 2004; 27:239–249. [PubMed: 15159086]
- Sobel, ME. Some new results on indirect effects and their standard errors in covariance structure models. In: Tuma, NB., editor. *Sociological methodology*. San Francisco: Jossey-Bass; 1986. p. 159-186.
- Spoth R, Redmond C. Effective recruitment of parents into family-focused prevention research: A comparison of two strategies. *Psychology and Health: An International Journal*. 1994; 9:353–370.
- Spoth R, Redmond C, Hockaday C, Yoo S. Protective factors and young adolescent tendency to abstain from alcohol use: A model using two waves of intervention study data. *American Journal of Community Psychology*. 1996a; 24:749–770. [PubMed: 9194328]
- Spoth R, Yoo S, Kahn JH, Redmond C. A model of the effects of protective parent and peer factors on young adolescent alcohol refusal skills. *Journal of Primary Prevention*. 1996b; 16:373–394. [PubMed: 24254853]
- Spoth R, Redmond C, Shin C. Direct and indirect latent-variable parenting outcomes of two universal family-focused preventive interventions: Extending a public health-oriented research base. *Journal of Consulting and Clinical Psychology*. 1998; 66:385–399. [PubMed: 9583342]

- Spath R, Goldberg C, Redmond C. Engaging families in longitudinal preventive intervention research: Discrete-time survival analysis of socioeconomic and social-emotional risk factors. *Journal of Consulting and Clinical Psychology*. 1999; 67:157–163. [PubMed: 10028221]
- Spath R, Redmond C, Shin C. Randomized trial of brief family interventions for general populations: Adolescent substance use outcomes four years following baseline. *Journal of Consulting and Clinical Psychology*. 2001; 69:627–642. [PubMed: 11550729]
- Spath R, Guyll M, Day SX. Universal family-focused interventions in alcohol-use disorder prevention: Cost-effectiveness and cost-benefit analyses of two interventions. *Journal of Studies on Alcohol*. 2002; 63:219–228. [PubMed: 12033699]
- Spath R, Greenberg M, Turrisi R. Preventive interventions addressing underage drinking: State of the evidence and steps toward public health impact. *Pediatrics*. 2008; 21:311–336.
- Spath R, Guyll M, Shin C. Universal intervention as a protective shield against exposure to substance use: Long-term outcomes and public health significance. *American Journal of Public Health*. 2009a; 99:2026–2033. [PubMed: 19762678]
- Spath R, Trudeau L, Guyll M, Shin C, Redmond C. Universal intervention effects on substance use among young adults mediated by delayed adolescent substance initiation. *Journal of Consulting & Clinical Psychology*. 2009b; 77:620–632. [PubMed: 19634956]
- Spath R, Trudeau L, Guyll M, Shin C. Benefits of universal intervention effects on a youth protective shield 10 years after baseline. *Journal of Adolescent Health*. 2012; 50:414–417. [PubMed: 22443848]
- Steiger, JH.; Lind, J. Statistically based tests for the number of common factors. Paper presented at the Annual Meeting of the Psychometric Society; Iowa City, Iowa. 1980.
- Temple MT, Leigh BC, Schafer J. Unsafe sexual behavior and alcohol use at the event level: Results of a national survey. *Journal of Acquired Immune Deficiency Syndrome*. 1993; 6:393–401.
- The National Center on Addiction and Substance Abuse at Columbia University. *Dangerous liaisons: Substance abuse and sex*. NY: The National Center on Addiction and Substance Abuse (CASA) at Columbia University; 1999.
- Williams CL, Perry CL, Dudovitz B, Veblen-Mortenson S, Anstine PS, Komro KA, Toomey TL. A home-based prevention program for sixth-grade alcohol use: Results from Project Northland. *Journal of Primary Prevention*. 1995; 16:125–147. [PubMed: 24254750]
- Wood MD, Read JP, Mitchell RE, Brand NH. Do parents still matter? Parent and peer influences on alcohol involvement among recent high school graduates. *Psychology of Addictive Behavior*. 2004; 18:19–30.
- Wothke, W. Longitudinal and multigroup modeling with missing data. In: Little, TD.; Schnabel, KU.; Baumert, J., editors. *Modeling longitudinal and multilevel data: Practical issues, applied approaches, and specific examples*. Mahwah: Erlbaum; 2000. p. 219-240.
- Yarber WL, Milhausen RR, Huang B, Crosby RA. Do rural and non-rural single, young adults differ in their risk and protective HIV/STD behaviors: Results from a national survey. *The Health Education Monograph Series*. 2008; 25:7–12.

Fig. 1. Model of universal intervention effects via adolescent growth in substance initiation. *Note.* Controlling for gender, T1AAI, T1 Parents' Marital Status, T1 Family Income and T1 Parent Education; Intercept was specified at the midpoint of the adolescent time frame

Table 1

Intervention effects on young adult outcomes

Variable									
N	X ²	DF	p value	CFI	RMSEA	a	b	c	d
ISFP versus control									
Lifetime sexually-transmitted diseases									
446	64.05	33	0.001	0.974	0.046	-0.16 (-3.75)***	-0.28 (-3.93)***	0.04 (0.42)	0.19 (2.21)**
Past year number of partners									
446	62.63	33	0.001	0.974	0.045	-0.15 (-3.62)***	-0.25 (-4.08)***	0.08 (1.12)	0.21 (2.50)**
Past year condom use									
446	72.48	33	<0.001	0.961	0.052	-0.16 (-2.99)***	-0.26 (-3.96)***	-0.26 (-2.42)**	0.05 (0.44)
Substance use during sex									
446	56.55	33	0.007	0.979	0.040	-0.16 (-3.76)***	-0.27 (-4.11)***	0.29 (1.64)**	0.07 (0.53)
PDFY versus control									
Lifetime sexually-transmitted diseases									
428	50.45	33	0.026	0.988	0.035	-0.09 (-1.93)**	-0.11 (-1.95)**	0.63 (2.58)***	-0.28 (-1.57)*
Past year number of partners									
428	51.55	33	0.021	0.987	0.036	-0.09 (-1.84)**	-0.11 (-1.84)**	0.05 (0.43)	0.20 (2.04)**
Past year condom use									
428	53.11	33	0.015	0.987	0.038	-0.09 (-1.93)**	-0.11 (-1.95)**	-0.16 (-1.52)**	0.12 (1.17)
Substance use during sex									
428	46.88	33	0.055	0.990	0.031	-0.09 (-1.91)**	-0.11 (-1.90)**	0.29 (1.40)*	0.14 (0.82)

* $p < 0.10$;

** $p < 0.05$;

*** $p < 0.01$;

one-tailed tests. t -values for a, b, c, d parameters are in parentheses. Concerning the Ns presented in the first column, one individual assigned to the PDFY condition was not included in the analyses because that individual transferred to a school in a different condition. One tailed tests are used because (1) prior intervention effects observed, across many, varied proximal and distal measures across seven waves of data, have been in the same direction, and (2) other intervention studies have supported the expectation of program effectiveness

Table 2

Model-based intervention effects on dichotomous young adult outcomes

Variable	Estimated N above cut-off	Estimated N below cut-off	Total N	RRR
ISFP versus control				
Lifetime sexually-transmitted diseases				
ISFP	7 (2.9 %) **	231 (97.1 %)	238	46
Control	11 (5.4 %)	197 (94.6 %)	208	
Past year number of partners >1				
ISFP	61 (25.8 %) **	177 (74.2 %)	238	22
Control	69 (33.1 %)	139 (66.9 %)	208	
Past year condom use < always				
ISFP	165 (69.2 %)	73 (30.8 %)	238	3
Control	149 (71.4 %)	59 (28.6 %)	208	
Substance use and sex > never				
ISFP	128 (53.9 %) **	110 (46.1 %)	238	9
Control	107 (59.5 %)	101 (40.5 %)	208	
PDFY versus control				
Lifetime sexually-transmitted diseases				
PDFY	12 (5.6 %) *	208 (94.4 %)	220	18
Control	14 (6.8 %)	194 (93.2 %)	208	
Past year number of partners >1				
PDFY	63 (26.6 %)	157 (73.4 %)	220	9
Control	61 (29.3 %)	147 (70.7 %)	208	
Past year condom use < always				
PDFY	155 (70.5 %)	65 (29.5 %)	220	2
Control	150 (71.9 %)	58 (28.1 %)	208	
Substance use and sex > never				
PDFY	121 (54.8 %) *	99 (45.2 %)	220	6
Control	121 (58.4 %)	87 (41.6 %)	208	

RRR relative reduction rate; ratio of intervention-control difference on the percentage of those above cut-off to the control percentage above cut-off

* $p < 0.05$;

** $p < 0.01$; One-tailed tests of model-based indirect intervention effects (ISFP and PDFY versus Control).

Because separate analyses compare (1) ISFP vs Control and (2) PDFY vs Control, model-based estimates of the percentages above the cut-off for the Control group differ between the two analyses. Those estimates are the basis for the estimated Ns