Reductions in HIV Risk Among Runaway Youth

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Runaway youth are 6–12 times more likely to become infected with HIV than other youth. Using a quasi-experimental design, the efficacy of an HIV prevention program was evaluated over 2 years among 2 groups of runaways: (1) those at 2 shelters who received *Street Smart*, an intensive HIV intervention program, and (2) youth at 2 control shelters. *Street Smart* provided youth with access to health care and condoms and delivered a 10-session skill-focused prevention program based on social learning theory to youth. Prior to analysis of the intervention's outcomes, propensity scores were used to identify comparable subgroups of youth in the intervention ($n = 101$) and control conditions ($n = 86$). Compared to females in the control condition, females in the intervention condition significantly reduced their unprotected sexual acts at 2 years and alcohol use, marijuana use, and the number of drugs used over 12 months. Male adolescents in the intervention condition showed significant reductions in marijuana use over 6 months compared to control youth. Adolescent HIV prevention programs must proactively identify mechanisms for maintaining behavior change over the long-term, and innovative research designs are needed to allow examination of agency-level interventions.

KEY WORDS: HIV; adolescents; minority youth; runaway; homeless.

Prevention of HIV among adolescents is a critical national health priority (National Institute of Health [NIH] Consensus Development Conference Panel, 2000). Runaway youth are a subgroup at particularly high risk of HIV (Rotheram-Borus *et al.*, 1991a). In America's inner cities, homeless youth are estimated to have a median seroprevalence rate of 2.3% (Allen *et al.*, 1994) compared to 0.2–0.4% for adolescents in medical clinics and Job Corps (Quinn *et al.*, 1988; St. Louis *et al.*, 1989; Sweeney *et al.*, 1995). In New York City, a major AIDS epicenter (Centers for Disease Control and Prevention, 2000), HIV seroprevalence rises to 9.8% among 20-year-old homeless young people (Stricof *et al.*, 1991). On the basis of annual national estimates of 733,000 to 1.2 million runaway youth, we estimate that 16,859–27,600 runaway youth in the United States are currently seropositive for HIV. These numbers highlight the importance of implementing effective HIV prevention programs for these youth. The goal of this study is to evaluate the efficacy over 2 years of *Street Smart*, an HIV prevention program delivered in runaway shelters.

Both sexual and substance use behaviors must be targeted in an intervention, because both have been linked to HIV infection (Celentano *et al.*, 1998; NIH Consensus Development Conference Panel, 2000) and are common among homeless youth. A history of sexual abuse, bartering sex for drugs or money, early initiation of sexual intercourse, frequent changes in

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sexual partners, and high rates of unprotected sexual intercourse have been observed among runaway youth (Kipke *et al.*, 1995; Pennbridge *et al.*, 1992; Rotheram-Borus *et al.*, 1992). The observed rates of alcohol, marijuana, and hard drug use in this sample (Koopman *et al.*, 1994) are similar to the drug use reported among other samples of runaways (Kipke *et al.*, 1997; Pennbridge *et al.*, 1990). Noninjection drug use has also been associated with HIV infection (Fullilove *et al.*, 1993; Koniak-Griffin & Brecht, 1995; Ostrow, 1994). Therefore, reductions in alcohol and noninjection drug use were targeted outcomes of the *Street Smart* program, in addition to sexual risk.

Street Smart is an intensive program delivered at the level of a shelter that addresses four components: providing access to health resources, making condoms available, training shelter staff, and providing training sessions for youth. Without access to condoms and ongoing health care, youth would not be able to implement safer sex behaviors, get treatment for sexually transmitted diseases, or have access to medical checkups or HIV testing. In the intervention shelters, condoms were freely available and a weekly trip was made by all youth to an agency that provided ongoing comprehensive social and health care services to youth. In addition, all shelter staff members received training in the *Street Smart* program: the cooks, social workers, security guards, and shelter directors. Staff members were taught information about HIV and a vocabulary and skills for solving problems, negotiating relationships, and being aware of and coping with uncomfortable feelings. The skill-building activities provided to staff were similar to those given to youth. The activities aimed to increase positive beliefs, attitudes, and perceptions toward HIV prevention, elements that have been used in other successful prevention programs for youth (e.g., Botvin *et al.*, 1990). Interacting with staff throughout the day provided youth with spontaneous practice for concepts and skills introduced in the *Street Smart* training, in a manner similar to "dialoguing" in problem-solving training (Shure, 1992).

Social learning theory directed the design of the intervention sessions for youth. The intervention was delivered to small groups of youth in the shelters. Small groups offer the opportunity for (a) practicing how to negotiate safer sex with others by role-playing; (b) mobilizing support for beliefs and attitudes that reinforce safer sex acts and abstinence from substance use; and (c) maintaining positive social support networks for sustained behavior change.

Because the intervention trained all shelter staff, youth could not be randomly assigned within each shelter to an intervention or a control condition. There would have been contamination among youth in different conditions. Therefore, each shelter was assigned to the intervention or control condition using a quasi-experimental design. When this study was mounted, there were only four shelters in the New York City area and there had been no previous HIV prevention programs with high-risk adolescents. It would have not been feasible or cost-effective to mount a randomized trial with the 22 shelters that would have been needed to provide the power to detect significant differences between youth in different conditions.

Because we used a quasi-experimental design, there was little ability to assure that youth in the intervention and the control sample were comparable. At the conclusion of the study, we realized that youth with different risk profiles were triaged to different shelters. To achieve comparability across youth in the two conditions, propensity scores were used to identify subgroups of youth who were similar. In grouping youth, those with the least and those with the most sexual and substance use risk acts were eliminated from the analyses. The application of this procedure also reduced the sample size and the variance in risk behaviors. Typically, an intervention's largest impact occurs among those with the greatest risk behaviors (i.e. the most opportunity for improvement). In this trial, these youth were eliminated to arrive with subgroups at similar levels of risk in each intervention condition.

This paper reports the 2-year outcomes for a program initially reported by Rotheram-Borus *et al.* (1991b) with a smaller sample, evaluated over a 6-month period. Since this earlier publication of the results of *Street Smart* (Rotheram-Borus *et al.*, 1991b), reductions in sexual risk have been demonstrated with a variety of adolescent subgroups: for example, inner-city youth (DiClimente & Wingood, 1995; Jemmott *et al.*, 1992; Rotheram-Borus *et al.*, 1998; Stanton *et al.*, 1996), youth in substance abuse treatment (St. Lawrence *et al.*, 1995), and young gay males (Kegeles *et al.*, 1996; Rotheram-Borus *et al.*, 1995). These programs have typically demonstrated changes over 3 months and have focused only on sexual risk; one recent report demonstrated that behavior changes were sustained for 1 year (see Jemmott & Jemmott, 2000, for a review). This study follows adolescents for 2 years, which is twice as long as that study and includes analysis of both sexual behavior

and substance use.

Reviews of HIV research led us to anticipate that the intervention's efficacy would vary by the youth's age (Williams *et al.*, 2000) and gender (Exner *et al.*, 1997). Sexual risk acts increase during adolescence (Udry & Billy, 1987) and the types of risky situations youth encounter also shift (Paikoff, 1995). Therefore, age must be controlled in all analyses. Simultaneously, males and females face very different challenges in implementing HIV prevention strategies. Young women are dependent on the compliance of their male partners for condom use (Exner *et al.*, 1997), and young women at highest risk are more likely to use alcohol and drugs at earlier ages than do males (Pedersen *et al.*, 2001). Because women's partners are often older males who hold more power in the relationship (Wells, 1980), it can be more difficult for adolescent women to be assertive with their partners than it is for their male peers. Given the different trajectories of sexual risk by gender, the intervention effects were examined for each gender.

METHOD

Participants

Adolescents aged 11–18 years (49% female) were recruited from four shelters in the New York City area. The agencies were similar in that each had a social worker who provided comprehensive care management and served youth engaging in multiple high-risk behaviors. With approval of the Institutional Review Boards at the New York State Psychiatric Institute and each shelter, voluntary informed consent was obtained from a consecutive series of 311 youth admitted to each shelter (94% consented). A staff member served as "in loco parentis" for each youth. If youth returned home over the course of the study, parental consent was obtained.

Figure 1 outlines the design of the study. The youth were assessed between 24 and 96 hr after entering each shelter and reassessed at 3, 6, 12, 18, and 24 months at their current living locations using standardized procedures (Gwadz & Rotheram-Borus, 1992). Of the 311 youth assessed at baseline, 57% participated at the 3-month follow-up, 58% at the 6-month follow-up, 50% at 12 months, 46% at 18 months, and 70% at 24 months. About half of the youth (43%) completed four or five follow-up assessments, 59% completed at least three assessments, and 74% completed at least two follow-up assessments.
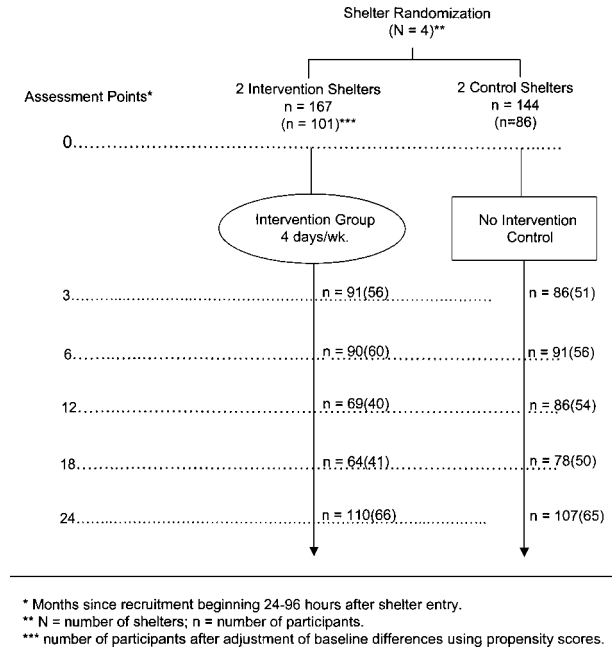

Fig. 1. Outline of the study protocol.

Only 11% were reassessed once over 2 years, and 15% of the sample was never measured after the baseline interview.

Across intervention conditions, the length of stay at the shelters was similar. At one intervention and one control shelter, youth stayed a few days to 4 weeks. At the other intervention shelter and control shelter, youth typically stayed 4–6 weeks. There was little chance of contamination across shelters, as each was in a different NYC borough and one was in New Jersey. However, over the course of the study, youth did rotate to a different shelter in the study while the intervention was being mounted; these youth were eliminated.

Procedures

Trained research assistants of the same gender and (typically) the same ethnicity as the interviewee individually administered the assessments to participants. Each interviewer received extensive training and certification prior to conducting assessments (Gruen *et al.*, 1989); the quality of the interviewing was monitored biweekly through audiotapes and individual and group supervision. Staff members were rotated across intervention and control conditions. The staff interviewer typically did not know the intervention status of the youth at the follow-up interviews.

Assessments

The following domains were assessed using life-time and the previous 3 months as the timeframe

Sexual Risk Acts

Using a structured 45-min interview protocol (Gruen *et al.*, 1989), youth reported the total number of partners and sexual acts, specific sexual acts with each partner, and whether condoms were used during each of these sexual acts. A sexual partner was defined as a male or female with whom the youth engaged in vaginal, anal, or oral sex. A sexual act was defined as a single session of receptive or insertive vaginal, anal, or oral sex. Three risk-behavior indices were calculated: (a) the number of sexual partners, (b) the number of unprotected sexual acts calculated as the sum of the number of vaginal and anal acts unprotected by condoms, and (c) abstinence from vaginal or anal sexual acts. Oral sex was omitted in calculating risk because of its low association with HIV transmission (Carlin *et al.*, 1994).

Substance Use

The prevalence and the frequency of the use of alcohol, marijuana, crack, cocaine, hallucinogens, barbiturates, sedatives, amphetamines, over-the-counter drugs, prescription drugs, and heroin were reported. The use of alcohol, marijuana, and hard drugs (crack, cocaine, or heroin) was measured as dichotomous variables: (0) *did not use*, (1) *used at least once*. The number of different drugs used was also calculated.

Sociodemographic Characteristics

Gender, ethnicity (Hispanic, African American, and others), and age were reported.

Intervention Conditions

Control Conditions

Youth in control shelters received the "current practice in the field." Staff received HIV education training. However, there was no systematic introduction of HIV prevention information or education for youth. HIV prevention activities typically occurred when staff provided individual counseling to youth and reviewed HIV prevention guidelines (e.g., use condoms when you have sex).

Street Smart Intervention

Structure

All staff initially attended 10 days of training over a 6-week period. This reflected high commitment to the project by the agency. As staff were replaced over time, booster training sessions were provided in the shelters and research staff attended staff meetings to provide in-service trainings.

Access to health care and social service resources was provided to youth by a weekly visit to a local community-based agency that provided ongoing comprehensive health and mental health care (The Door). Youth were given a free meal and a tour and participated in a planned group activity at the agency.

For youth, small-group meetings were held 3 days a week, typically in the evening and were co-led by a research and a shelter staff member. Youth were provided food at randomly selected sessions and received $1 for carrying a condom and arriving at the program on time. Tokens of appreciation (1 in. × 1 in. pieces of construction paper) were exchanged among group members as a means of signaling positive affect and desired and appropriate behavior, but these tokens were not exchanged for tangible rewards. Sessions covered three main areas: each session began with exchanging compliments and reports of success in meeting HIV-related goals; the content and new activities planned for that particular session were presented; and new goals and homework were set. Each session ended with expressions of appreciation among group members.

Content

A manual outlining the intervention is available at http://chipts.ucla.edu. The content of the 10 group sessions rotated over 3 weeks. The content of the sessions covered

1. *General and personal knowledge of HIV*. In addition to video and art workshops, in which youth developed soap opera dramatizations, public service announcements, commercials, and raps about HIV prevention, commercial HIV/AIDS prevention videos were reviewed

to increase HIV-related knowledge.

2. *Social skills*. Training in assertiveness and coping skills addressed runaways' unrealistic expectations regarding their emotional and behavioral responses in high-risk situations. The youth were taught to use a "Feeling Thermometer" to identify their emotional states in situations with potential risk for HIV transmission (Trautman & Rotheram-Borus, 1988). Youth labeled their affective responses on a scale from 0 (*comfortable*) to 100 (*uncomfortable*) in response to a large range of situations and by role-playing risky situations with peers. Youth were then taught self-regulation skills to control feelings of anxiety, depression, anger, and desire.

3. *Individual barriers to safer sex* were reviewed in a private counseling session that targeted dysfunctional attitudes and behavior patterns.

Number of Sessions

At one intervention shelter, the number of intervention sessions received per youth (i.e., the dose of the intervention) was highly correlated with the length of stay in the shelter. Youth who stayed at the shelter for a shorter period received fewer sessions. The mean number of sessions was 9.1 ($SD = 6.13$, range 1–28 sessions). The length of stay was longer for all youth at the second shelter (4–6 weeks). All youth at this shelter completed the intervention (i.e., received at least 10 sessions). Attending the program was appealing to the youth: most youth attended the intervention activities if in the shelter (i.e., not working or in school) even though they did not receive monetary incentives for attendance.

Statistical Analysis

The analyses were conducted in two phases. First, the demographic characteristics and lifetime sexual and substance use acts of youth in the intervention and control conditions were compared using t tests for the continuous variables and χ^2 tests for the categorical ones. Randomization occurred by shelter, not by youth. With four shelters, comparability between the two treatment conditions was not achieved for variables at the level of the youth. The intervention and control groups were not similar at baseline in two lifetime substance use measures and on nine sociodemographic characteristics. Direct adjustment of these differences would have added a large number of parameters to the analytic model, which was not feasible given the modest sample sizes. Instead, prior to any examination of the outcome of the intervention, we obtained comparability between youth at the intervention and control shelters by using propensity scores (Rosenbaum & Rubin, 1983, 1984). A propensity score is the probability of assignment to the intervention group, given pretreatment covariates. Participants with similar propensity scores can be considered as having similar pretreatment characteristics; matching on propensity scores has been demonstrated to reduce selection bias. Subclassification methods based on propensity score were chosen to attain comparability between the two treatment groups.

Second, after achieving similarity among youth in the intervention and the control conditions, an intent-to-treat approach was conducted to examine the differences in outcome between the youth in the intervention and the control conditions (Craig, 1996). Mixed-effects models with random coefficients (Bryk & Raudenbush, 1992; Laird & Ware, 1982) were employed to examine the effect of the intervention program on sexual behaviors and drug and alcohol uses. The analysis was conducted separately for males and females, because each gender showed different trajectories over time. Because two sexual behavior outcomes (number of partners and number of unprotected sexual acts) and the number of drugs used were measured as counts, mixed-effects Poisson regression with overdispersion was used for these variables; for other variables measured as dichotomous variables a mixed-effects logistic regression was used. The key independent variables were time (the assessment frame), intervention condition (intervention vs. control), and interaction between time and intervention condition. The time variables were included as quadratic form to capture decreasing and then increasing patterns over time. Age and baseline outcomes were adjusted in the model to control age and baseline differences among participants. Adjustment of the estimated propensity scores was not significant in the model and was not included in the final model.

RESULTS

Establishing Comparability of Youth in the Intervention and Control Conditions

Most youth (59%) were African American, 26% were Hispanic, and 15% were White or of another

ethnic group. At recruitment, the mean age of the youth was 15.6 years ($SD = 1.7$ years). Over their lifetime to recruitment, 49% had been institutionalized, 27% of the youth had sometimes lived on the streets, 29% had been in foster care, 12% had been hospitalized for psychiatric problems, 18% had been in jail, 59% had lived with extended family members, and 59% had lived with friends. There were gender differences in life histories. Males were more likely to have been in institutions (55% vs. 43%, $\chi^2 = 3.97$, $p = .046$), jail (26% vs. 11%, $\chi^2 = 12.09$, $p < 0.001$), and less likely to be with friends (49% vs. 70%, $\chi^2 = 14.68$, $p < 0.001$). In addition, males tended to stay more on the street (31% vs. 23%, $\chi^2 = 2.77$, $p = 0.096$) and tended to be hospitalized less for psychiatric problems (8% vs. 15%, $\chi^2 = 3.67$, $p = 0.055$). At some point over the 2 years following recruitment into the study, 11% were in foster care, 39% in institutional placements, 40% in shelters, 4% in a psychiatric hospital, 10% in jail, and 7% lived on the streets. Males were more likely to be in jail (16% vs. 4%, $\chi^2 = 11.99$, $p < 0.001$) and stayed less often with friends (24% vs. 49%, $\chi^2 = 17.17$, $p < 0.001$). However, for the entire 2-year follow-up period, only

4 youth were in foster care, 7% were in institutional placements, 7% in shelters, 1% in jail, and none stayed in psychiatric hospitals or on the streets for the entire time. There were gender differences in youth.

Table 1 demonstrates that youth at the two shelters ($n = 167$) that received the intervention were different from the youth at the two shelters in the control condition ($n = 144$) on several measures. The youth in the intervention condition were a year younger ($t = 6.01$, $df = 309$, $p < 0.001$) and were less likely to live with foster families, $\chi^2(1) = 7.35$, $p = 0.007$. Youth in the control shelters were also more likely to use alcohol, $\chi^2(1) = 7.94$, $p = .005$, and drugs, $\chi^2(1) = 7.35$, $p = .007$, over their lifetime. To adjust baseline differences, the propensity score technique was applied.

Using 45 baseline characteristics, propensity scores were calculated for each youth. Five subclassification groups were constructed on the basis of the estimated propensity scores. Each subclass represented 20% of the youth in the sample. The characteristics of youth in each subclassification group are shown in Table 2. Youth in Subclass 1 were older, included more females, and were more likely to use alcohol and

Table 1. Sample Baseline Characteristics Comparing Youth in the Intervention and the Control Conditions Among the Total 311 Participants and 187 Matched Participants After Controlling Baseline Differences Using Propensity Scores

	Runaways ($n = 311$)		Matched runaways from Subclasses 2,3,4 ($n = 187$)	
	Control ($n = 144$)	Intervention ($n = 167$)	Control ($n = 101$)	Intervention ($n = 86$)
Male	47.9%	53.3%	51.2%	50.5%
Age (*SD*)	16.2 (1.51)	15.1 (1.74)**	16.0 (1.51)	15.6 (1.42)+
Ethnicity				
African American	54.6%	62.4%	51.2%	55.6%
Hispanic	27.7%	25.5%	29.8%	29.3%
White/others	17.7%	12.1%	19.1%	15.2%
Ever in foster care	21.5%	35.5%**	23.3%	31.7%
Conduct problems (*SD*)	1.10 (0.73)	1.02 (0.79)	1.13 (0.78)	1.08 (0.81)
Lifetime sexual activity	83.3%	81.7%	81.4%	88.9%
Recent sexual behavior (last 3 months)				
# of partners (*SD*)	1.96 (3.34)	1.95 (2.96)	1.72 (2.58)	2.04 (2.76)
# of unprotected vaginal and anal sex (*SD*)	7.42 (17.15)	4.90 (12.14)	6.94 (16.50)	5.85 (14.70)
Abstinence from vaginal and anal sex	34.0%	36.0%	38.4%	27.3%
Lifetime alcohol use	78.5%	63.8%**	80.2%	68.7%+
Lifetime drug use	52.1%	36.7%**	24.6%	22.4%
Recent drug and alcohol (last 3 months)				
Alcohol	62.4%	39.4%**	62.4%	41.2%**
Marijuana	31.5%	17.5%**	32.6%	16.5%*
Hard drug	11.1%	6.1%	10.5%	7.1%
# of drugs (*SD*)	0.43 (0.68)	0.26 (0.57)*	0.43 (0.64)	0.26 (0.58)+

Note. A sample after controlling for baseline and eliminating youth on the basis of propensity scores (the third column of the Table).
$^+ p < .10.$ $^* p < .05.$ $^{**} p < .01.$

Table 2. Sample Characteristics Among Youth in Five Subclassifications Based on Groupings of Propensity Scores at the Baseline Assessment

	Group 1	Group 2	Group 3	Group 4	Group 5
Male	40.3%	54.8%	50.8%	46.8%	61.3%
Age (*SD*)	16.7 (1.15)	16.4 (1.26)	15.7 (1.42)	15.4 (1.56)	13.8 (1.55)
Ethnicity					
African American	60.7%	57.4%	55.7%	47.5%	72.6%
Hispanic	24.6%	26.2%	26.2%	36.1%	19.4%
White/others	14.8%	16.4%	18.0%	16.4%	8.1%
Ever in foster care	16.4%	17.7%	20.6%	45.2%	45.2%
Lifetime sexual activity	87.9%	87.0%	85.0%	84.7%	64.9%
Recent sexual behavior (last 3 months)					
# of partners (*SD*)	2.23 (4.10)	2.07(2.71)	2.25 (3.33)	1.35 (1.66)	1.85 (3.37)
# of unprotected vaginal and anal sex (*SD*)	8.20 (17.76)	6.73 (17.14)	7.00 (14.08)	5.34 (13.95)	3.18 (9.29)
Abstinence from vaginal and anal sex	26.2%	35.0%	30.2%	32.3%	51.6%
Lifetime alcohol use	78.7%	75.8%	77.8%	68.3%	52.5%
Lifetime drug use	54.1%	59.0%	39.7%	42.4%	24.6%
Recent drug and Alcohol use (last 3 months)					
Alcohol	63.8%	55.7%	51.6%	45.8%	34.4%
Marijuana	31.7%	31.1%	21.0%	20.0%	16.7%
Hard drug	13.1%	9.7%	1.6%	15.0%	3.3%
# of drugs (*SD*)	0.46 (0.74)	0.40 (0.61)	0.24 (0.53)	0.38 (0.69)	0.21 (0.52)

drugs compared to youth in other subclasses. In subclass 5, youth were younger, included more African American males, and were less likely to use alcohol or drugs. Simultaneously, they were unlikely to have sex compared to other subclasses. Table 3 shows the number of participants in the intervention and control conditions in each subclass.

The first subclass, the 20% of youth with the lowest estimated propensity scores, had significantly more youth from the control condition than the intervention condition (53 youth vs. 9 youth). Similarly, youth in Subclass 5, the 20% with the highest estimated propensity scores (i.e., the lowest risk), had significantly more youth in the intervention shelters compared to the control shelters (57 youth vs. 5 youth). This distribution of subclasses indicated that there were high numbers of youth meeting the "least risky" classification in the intervention condition in Subclass 5 and small numbers in the intervention condition in subclass 1 who had high rates of risk acts. Given the

distribution, a comparison of youth in the control and intervention conditions would not have been possible in those two subclasses. Therefore, we concentrated on the analysis of youth with propensity scores within the middle three subclassification groups. Because of small sample sizes in each subclass, we pooled out all three subclasses and applied the direct adjustment method in the analysis. This procedure resulted in eliminating youth in the top and bottom subclassification groups.

Applying the propensity scores removed or reduced most differences between the intervention and the control groups (see Table 1). Further analysis focused on 187 participants within Subclasses 2, 3, and 4, who had comparable propensity scores across the intervention and control conditions (Table 3). A comparison of these youth in the intervention and the control conditions is presented in Table 1.

Description of the Sample Based on Runaways With Similar Propensity Scores

The numbers in parentheses in Fig. 1 are the number of participants at each follow-up point in Subclasses 2, 3, and 4, after eliminating youth on the basis of propensity scores. The follow-up rates among 187 participants in the analysis were similar to the follow-up rates including all the participants (57% vs. 57%, 62% vs. 58%, 50% vs. 50%, 49% vs. 46%, and 70% vs. 70%, respectively). Similar to the original pool of participants, 44% of the smaller group of 187 youth

Table 3. Frequencies of Youth in Intervention and Control Conditions Based on Their Propensity Scores When Grouped in Five Subclasses

	Control (*n* = 144)	Intervention (*n* = 167)	Total (*n* = 311)
Subclass 1	53	9	62
Subclass 2	42	20	62
Subclass 3	27	36	63
Subclass 4	17	45	62
Subclass 5	5	57	62

completed four or five follow-up assessments, 61% completed at least three assessments, and 77% completed at least two follow-up assessments; only 6% were reassessed once over 2 years and 17% of the sample was never measured after the baseline interview.

Among the 187 youth in the propensity-score-matched sample, the percentages of males and females were very similar (50.8 and 49.2%, respectively). Youth ranged in age from 11 to 18 years ($M = 15.8, SD = 1.47$); females were younger than males by about 0.7 years ($t = 3.40, df = 185, p < 0.001$). About half of the youth (54%) were African American and 30% of youth were Hispanic; 45% had dropped out of school and 24% had full-time jobs at some point in their lifetime. The mean number of months since they last lived with their parents was 3.2, and the average times they ran away from home was 2.6 times.

At baseline, sexual behaviors were not significantly different over youth's lifetime and the past 3 months (see Table 1): 85% of youth had been sexually active over their lifetime, males with a median of 8 partners ($M = 25.5, SD = 81.1$) and females with a median of 2.5 partners ($M = 6.5, SD = 16.4$). Half of the males and 14% of the females reported 10 or more partners in their lifetime (Rotheram-Borus *et al.*, 1992). The median number of sexual acts for youth with one partner was 15; only 14% reported one sexual partner. Some males (19%) and females (3%) had bartered sex previously. However, about one third of the runaways had been sexually abstinent in the 3 months immediately prior to recruitment.

Alcohol use at baseline tended to be different between matched intervention and control participants (see Table 1): 69% of the intervention group used alcohol in their lifetime compared to 80% of the control group, $\chi^2(1) = 3.19, p = 0.074$. Lifetime substance use was similar between the two conditions. For the 3 months prior to baseline, both alcohol and marijuana use in the intervention condition remained significantly lower than in the control condition, $\chi^2(1) = 8.08, p = 0.005$, and $\chi^2(1) = 6.44, p = 0.011$, respectively. The number of drugs used tended to be lower in the intervention condition ($t = 1.86, df = 183, p = 0.064$).

Intervention Effects

Sexual Behavior

Because male and female youth showed different trajectories over time, separate analyses were conducted for each gender (compare the youth in the control condition in Figs. 2 and 3). Tables 4 and 5 summarize the estimated intervention effects from the mixed-effects model of each primary outcome for males and females, respectively. Figures 2 and 3 present the estimated mean counts or prevalence in each condition across the 2-year follow-up period for females and males. As shown in Table 4, the average number of recent sexual partners tended to be lower in the intervention condition among female adolescents at the 24-month follow-up than in the control condition (OR = 0.68, $p = 0.084$). Among female adolescents in the intervention condition, compared to those in the control group, the average number of unprotected sexual acts tended to be lower at the 3-month follow-up (OR = 0.29, $p = 0.055$) and was significantly lower at the 24-month follow-up (OR = 0.35, $p = 0.018$). There was a tendency towards higher rates of abstinence from vaginal and anal sex acts at the 18-month follow-up among female adolescents in the intervention condition compared to females in the control condition (OR = 2.41, $p = 0.088$).

The reports of sexual risk acts were consistent with anticipated developmental patterns of risk. Higher numbers of sexual partners at baseline were significant predictors of the higher number of sexual partners at follow-ups in females ($t = 3.61, df = 47, p < 0.001$). Higher numbers of unprotected vaginal and anal sex acts at baseline tended to be related to higher numbers of unprotected sex acts at follow-ups among females ($t = 1.75, df = 64, p = 0.085$). Similarly, if female youth were abstinent from vaginal and anal sex at baseline, they were more likely to remain abstinent at follow-ups ($t = 2.94, df = 70, p = 0.004$). The older female participants tended to have more sexual partners at follow-ups ($t = 1.78, df = 88, p = 0.078$), and to be more engaged in unprotected sexual acts ($t = 2.32, df = 89, p = 0.022$) than did younger women.

In contrast to the findings for young women, Table 5 shows that there were no significant differences based on intervention status in the number of sexual partners or in the number of unprotected sexual acts among male adolescents. Similar to young women, having higher numbers of sexual partners at baseline were also significant predictors of higher numbers of sexual partners at follow-ups among males ($t = 4.39, df = 40, p < 0.001$). Higher numbers of unprotected vaginal and anal sex acts at baseline were related to higher numbers of unprotected sex acts at follow-ups among male youth ($t = 2.07, df = 58, p = 0.043$). Similarly, if male youth were abstinent from vaginal and anal sex at baseline, they were more likely to remain abstinent at

Number of Partners

Unprotected Vaginal and Anal Sex

Abstinence from Unprotected Vaginal and Anal Sex

Use of Alcohol

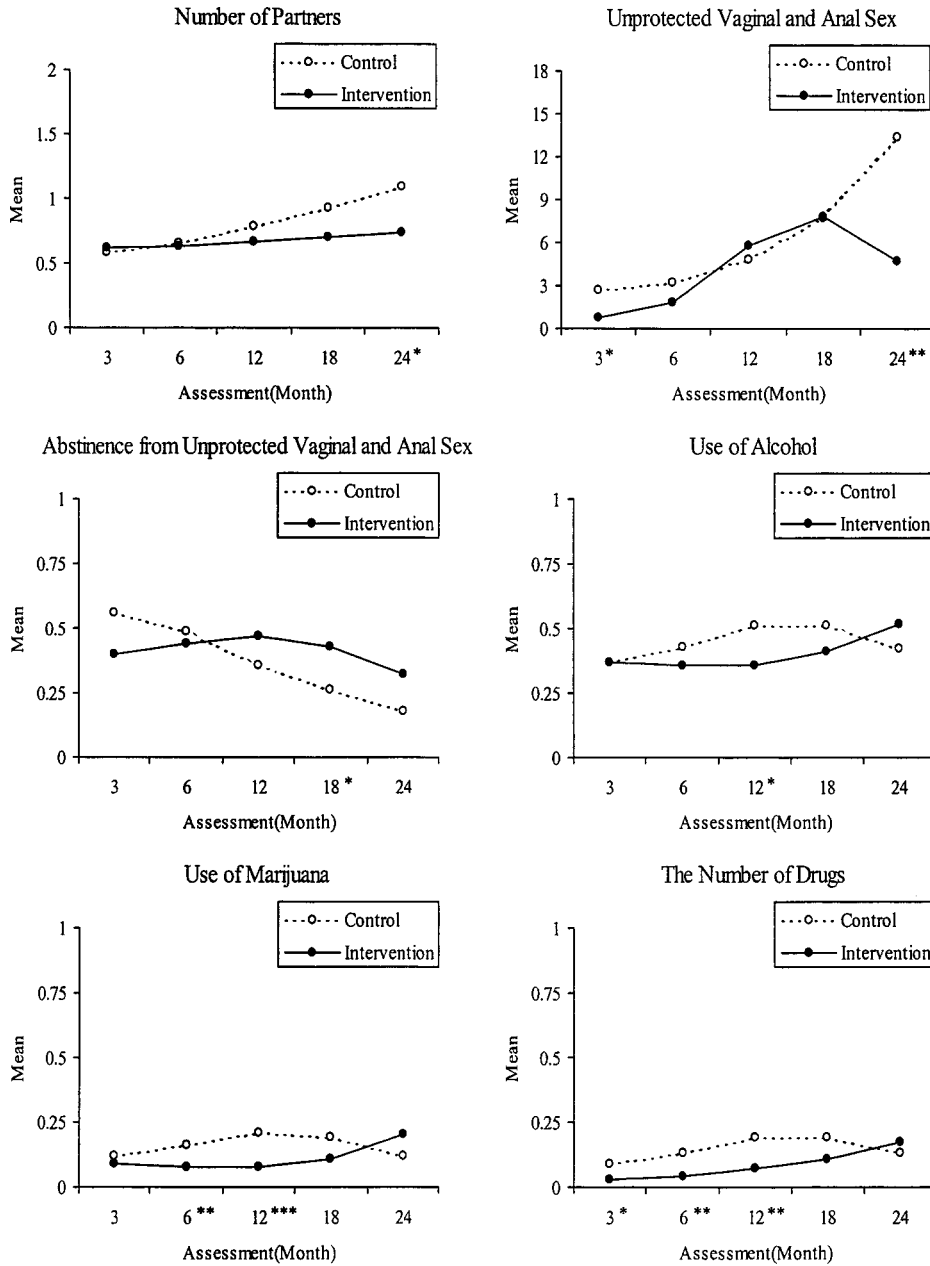### Use of Marijuana

The Number of Drugs

Fig. 2. Presentation of the estimated means of sexual risk indices and substance use measures in the intervention condition and the control condition by over 24 months (females).

follow-ups ($t = 3.31, df = 51, p = 0.002$). There were no age effects among male participants.

Substance Use

As shown in Table 4, alcohol use tended to be lower in the intervention condition than in the control condition among female adolescents at the 12-month follow-up ($OR = 0.43, p = 0.053$). Marijuana use

was significantly lower in the intervention condition among female adolescents at the 6-month follow-up ($OR = 0.31, p = 0.033$) and the 12-month follow-up ($OR = 0.19, p = 0.005$). The number of drugs used was lower in the intervention condition among female youth at the 6-month follow-up (OR = 0.33, $p = 0.027$) and the 12-month follow-ups (OR = 0.36, $p = 0.019$) and tended to be lower at the 3-month follow-up (OR = 0.36, $p = 0.082$).
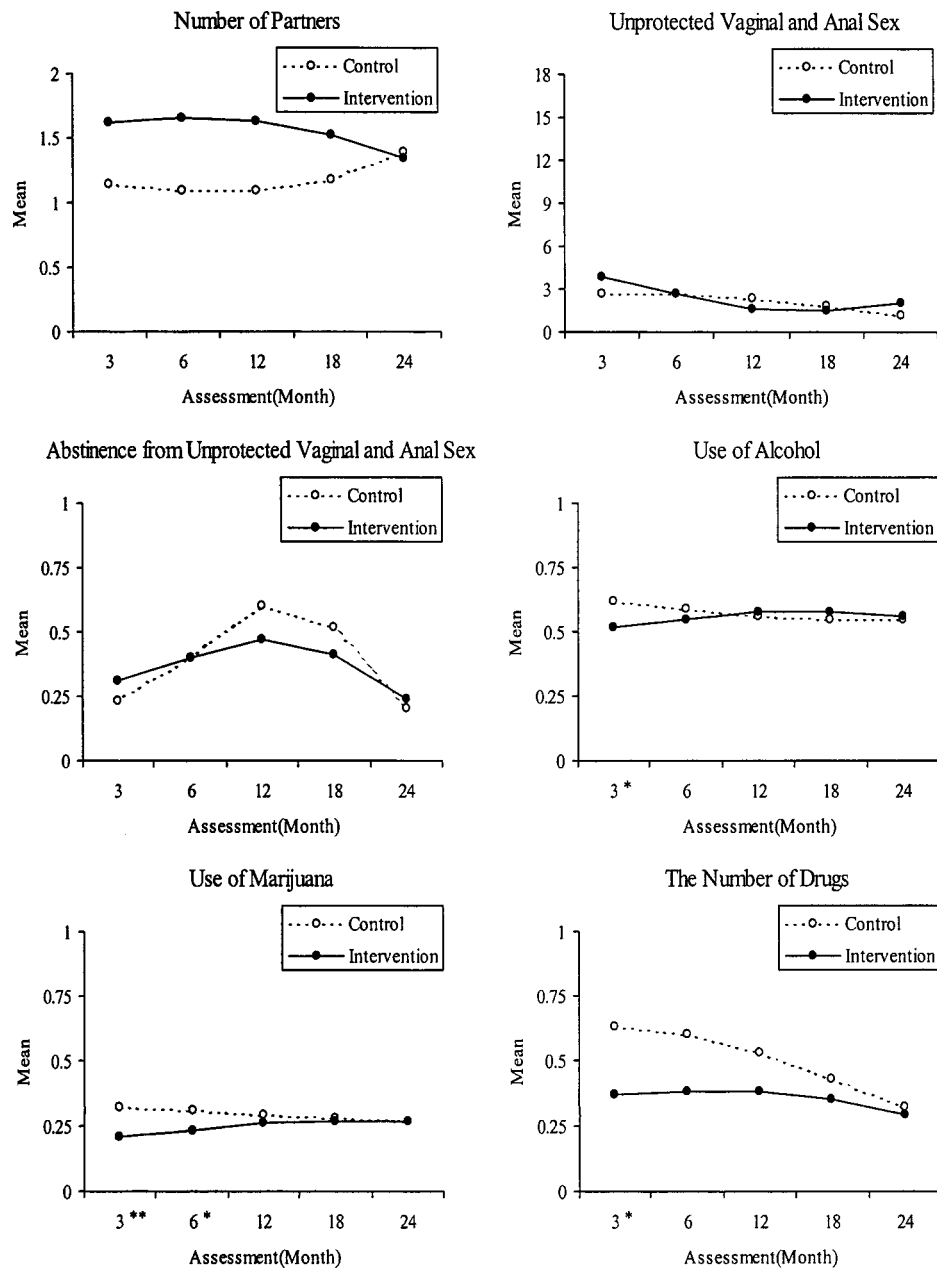
Fig. 3. Presentation of the estimated means of sexual risk indices and substance use measures in the
intervention condition and the control condition by over 24 months (males).

Alcohol use tended to be lower among male adolescents at the 3-month follow-up ($OR = 0.25$, $p = 0.100$; see Table 5). Among male youth, marijuana use was lower at the 3-month follow-up ($OR = 0.19, p = 0.050$) and tended to be lower at the 6-month follow-up ($OR = 0.31$, $p = 0.082$). Among males, the number of drugs used tended to be lower at the 3-month follow-up (OR = 0.59, $p = 0.085$).

Alcohol use at baseline was a significant predictor of the alcohol use at follow-ups for both males and females ($t = 8.37, df = 88, p < 0.001$ for males; $t = 5.82, df = 71, p < 0.001$ for females). Similarly, marijuana use at baseline was a significant predictor of marijuana use at follow-ups for both males and females ($t = 9.37, df = 85, p < 0.001$ for males; $t = 5.44, df = 58, p < 0.001$ for females). The higher

Table 4. Estimated Intervention Effect and 90% Confidence Interval (in parentheses) at 3-, 6-, 12-, 18-, and 24-month Follow-up Based on Mixed Effects Models for Female Runaways

	3-month follow-up		6-month follow-up		12-month follow-up		18-month follow-up		24-month follow-up	
# of sexual partners[a]	1.06	(0.64–1.74)	0.98	(0.68–1.41)	0.85	(0.60–1.19)	0.75	(0.55–1.02)	0.68+	(0.47–0.98)
Frequency of unprotected sexual acts[a]	0.29+	(0.10–0.83)	0.58	(0.26–1.31)	1.21	(0.64–2.28)	1.02	(0.56–1.86)	0.35*	(0.17–0.71)
Abstinence from unprotected sexual acts[b]	0.48	(0.17–1.41)	0.80	(0.36–1.78)	1.67	(0.73–3.80)	2.41+	(1.04–5.58)	2.41	(0.77–7.62)
Alcohol use[b]	1.03	(0.44–2.46)	0.64	(0.33–1.26)	0.43+	(0.21–0.88)	0.60	(0.27–1.33)	1.72	(0.54–5.49)
Marijuana Use[b]	0.61	(0.20–1.85)	0.31*	(0.13–0.75)	0.19**	(0.07–0.49)	0.38	(0.13–1.11)	2.51	(0.61–10.38)
Number of drug used[a]	0.36+	(0.14–0.93)	0.33*	(0.15–0.73)	0.36*	(0.18–0.73)	0.58	(0.29–1.15)	1.34	(0.59–3.05)

[a]The intervention effects were measured as multiplicative effects on the outcomes. For example, the geometric mean number of sexual partners in the intervention group was 1.06 times greater than for the control groups at 3-month follow-up.
[b]The intervention effects were measured by odds ratio. For example, the odds of being abstinent from unprotected sexual acts among youths in the intervention group was 52% less than for youths in the control group at 3-month follow-up.
$^{+}p < .10$. $^{*}p < .05$. $^{**}p < .01$.

numbers of youth reporting drug use at the baseline assessment were also related to higher numbers of drug use at follow-ups among both male and female youth ($t = 10.14$, $df = 50$, $p < 0.001$ for male; $t = 2.99$, $df = 58$, $p = 0.004$ for females). There was no relation between age and substance use over 2 years for both males and females.

Hard drug use was rare in this study. Only 13.9% of youth were engaged in hard drug use over 2 years. Females in the intervention condition used hard drugs (12%) at about the same rate as females in the control condition (17%). The pattern was similar among males: substance use was 11% in the intervention condition and 16% in the control condition. After con-

trolling for hard drug use at baseline, the percentage of hard drug use over 2 years in the intervention condition was not significantly different to the one in the control condition for male or female youth.

DISCUSSION

There are several limitations to this study. First, the follow-up rate for the runaways at specific assessment points is a limiting factor. Fortunately, a 70% follow-up rate was obtained for the final assessment at 2 years, even though the follow-up rate was significantly lower at the interim assessments. However, even when the follow-up rates were around the 50%

Table 5. Estimated Intervention Effect and 90% Confidence Interval (in parentheses) at 3-, 6-, 12-, 18-, and 24-month Follow-up Based on Mixed Effects Models for Male Runaways

	3-month follow-up		6-month follow-up		12-month follow-up		18-month follow-up		24-month follow-up	
# of sexual partners[a]	1.42	(0.81–2.46)	1.49	(0.96–2.31)	1.49	(0.92–2.42)	1.29	(0.81–2.04)	0.96	(0.56–1.66)
Frequency of unprotected sexual acts[a]	1.43	(0.62–3.33)	0.99	(0.48–2.06)	0.70	(0.32–1.52)	0.82	(0.35–1.94)	1.62	(0.53–4.96)
Abstinence from unprotected sexual acts[b]	1.67	(0.44–6.44)	0.99	(0.35–2.76)	0.56	(0.19–1.61)	0.61	(0.19–1.95)	1.28	(0.24–6.99)
Alcohol use[b]	0.25+	(0.06–0.99)	0.51	(0.16–1.62)	1.30	(0.44–3.90)	1.72	(0.53–5.57)	1.16	(0.24–5.55)
Marijuana Use[b]	0.19*	(0.05–0.76)	0.31+	(0.10–0.93)	0.62	(0.21–1.82)	0.95	(0.26–3.47)	1.08	(0.17–6.93)
Number of drug used[a]	0.59+	(0.36–0.97)	0.63	(0.39–1.02)	0.72	(0.41–1.27)	0.81	(0.41–1.61)	0.90	(0.38–2.12)

[a]The intervention effects were measured as multiplicative effects on the outcomes. For example, the geometric mean number of sexual partners in the intervention group was 1.42 times greater than for the control groups at 3-month follow-up.
[b]The intervention effects were measured by odds ratio. For example, the odds of being abstinent from unprotected sexual acts among youths in the intervention group was 67% less than for youths in the control group at 3-month follow-up.
$^{+}p < .10$. $^{*}p < .05$. $^{**}p < .01$.

level, different youth were assessed at the follow-up points so that 74% have at least three data points (baseline and at least 2 follow-up points) over 2 years. When a greater proportion of the sample is assessed at 2 years, the benefits of the intervention are more apparent in measures of sexual risk. Moreover, a mixed-effects model can handle unbalanced longitudinal data with measurements taken at an arbitrary set of follow-up time points, and it provides consistent estimates when the mechanism generating missing data can be explained with observed values in the data (Littell *et al.*, 1996; Little & Rubin, 1987).

Second, because the intervention involved the entire staff at the shelter and included changes in the routine of the environment, it was not possible to randomly assign youth within shelters to intervention and control conditions. The intervention was delivered to all youth within a setting. The randomization of shelters to condition led to another study limitation: the lack of comparability of youth at the intervention sites at the time of recruitment. Propensity scores allowed us to select comparable subgroups of youth and examine the intervention effects among subgroups of youth comparable at the baseline assessment. However, the subclassification based on propensity score resulted in a smaller sample size than originally recruited, because there were subgroups of youth for which there were not enough comparable youth in the intervention or control shelters (Song *et al.*, in press). The small sample size led to a number of results being of marginal significance, even when the effect size was moderate to large.

The use of propensity scores is a methodological strategy that may be useful to other intervention researchers attempting to compare the results from naturally occurring variations in interventions delivered in community settings. The use of this analytic strategy led to a conservative estimate of the effect sizes of the intervention. The youth whose behaviors were the least and the most risky at recruitment were eliminated from the analysis. Most intervention effects are achieved by reducing risk among those demonstrating the greatest number of risk behaviors. In this study, those youth were eliminated from the analysis and the ability to demonstrate intervention effects was similarly reduced. Future evaluations using *Street Smart* must examine the intervention's impact among those at highest risk for HIV and ensure that comparable samples are available at recruitment.

Third, more than 50% of the study participants in this study were African American. The small number of youth in other ethnic groups made it difficult to estimate stable ethnic differences. In the analysis, the program's benefits did not vary by ethnicity. However, a larger sample size with larger samples of Latino and Caucasian youth may generate ethnic differences in the program's impact.

A comprehensive review of the efficacy of HIV prevention programs has highlighted the importance of simultaneously addressing both sexual and substance use risk acts (NIH Consensus Development Conference, 2000). Similar to the findings of other studies (Fishbein & Coutinho, 1997; Kamb *et al.*, 1998; Rotheram-Borus *et al.*, 1998), reductions in the reports of sexual and substance use risk behaviors were evident in both the intervention and the control conditions among female participants at follow-up assessments. Reductions in risk acts among participants in the control condition appear to be a common finding. For example, the National Institute of Mental Health Multisite HIV Prevention Trial found a 33% increase in consistent condom use among high-risk adults in a control condition who were assessed repeatedly (NIMH Multisite HIV Prevention Trial Group, 1998). The process of reviewing one's behavior in detail with another person may have an impact on that behavior (NIMH Multisite HIV Prevention Trial Collaborators, 1997). The validity of self-report measures of sexual behavior and substance use among youth has been established previously (Brener *et al.*, 1995; Orr *et al.*, 1997; Shew *et al.*, 1997). It would have been desirable to have biological indices of reductions in sexually transmitted diseases (STDs); future studies will have such markers. However, self-reported symptoms of STDs were so low, we would not have been able to detect differences between the intervention and the control conditions.

Although there are substantial limitations, the developmental behavior patterns that are observed add credibility to the findings. Youth who reported high rates of sexual risk and substance use at the time of recruitment were more likely to report higher rates of risk acts over time. This pattern was observed for the numbers of partners, unprotected risk acts, and alcohol and marijuana use. Older adolescent females were more likely to have unprotected sex, again a common developmental pattern (Udry & Billy, 1987).

Despite these limitations, the benefits of the HIV prevention program are observed both in indices of female sexual risk acts and substance use. The results vary by gender and at different follow-up points. For females, the number of sexual partners was lower at 24 months and the number of unprotected sexual acts was lower at both 3 and 24 months. At 24 months, the ratio was substantial (e.g., 0.35 for unprotected

acts). For males, there were no significant reductions in the intervention compared to the control condition for sexual risk at 24 months. This was unexpected because young women generally have less control over condom use and are often introduced to drug use by boyfriends. Yet, females did reduce sexual risk acts and sustained these effects over time.

There were significant reductions in substance use among both females and males. However, relapse occurred by 12 months. The number of drugs, alcohol, and marijuana used by females was lower for about 12 months; yet, for males, the number of drugs and marijuana used were significantly lower for only 3–6 months. Because drug use has not typically been assessed in adolescent HIV prevention programs, most interventions have only observed outcomes for up to 12 months. Therefore, it may be that the type of relapse observed in this study is common to HIV prevention programs (Rotheram-Borus *et al.*, manuscript submitted for publication).

Alternatively, it is likely that the trajectories into and out of homelessness vary over time by gender; we hypothesize that these trajectories may be associated with the gender differences in the impact of the intervention program. Young women are likely to be able to leave the streets when becoming involved in romantic relationships; their survival needs are often met as their partners provide food and shelter. Negotiation of condoms and sexual relationships may be much easier when not homeless. In an ongoing study of homeless youth, we have found that compared to young women, young men are more likely to be homeless for a longer period of time and to go to the streets, rather than to a shelter, when they first become homeless (Witkin *et al.*, 2001). The intervention's loss of impact over time may reflect the ongoing challenges faced by young people, especially males, after leaving the shelter. For example, males were more likely to be in jail over the next 2 years, compared to females. However, we do not have information to assess this hypothesis.

Cumulatively, successes and failures of HIV intervention programs for adolescents suggest three challenges for prevention researchers. First, almost all US-based programs have been time-limited and have tried to improve skills during the program to prevent relapse; most of the evaluations have been 3–12 months. In the only study that has demonstrated an ability to increase abstinence (Jemmott *et al.*, 1998), relapse was observed at 3 months. As we monitor effects over longer periods, as was done in this study, substantial relapse occurs, beginning within 1 year. In a study of adolescents whose parents are living with HIV, we found significant and substantial reductions in risk acts over 2 years (Rotheram-Borus *et al.*, 2001). Yet relapse then begins and continues for at least 4 years (Rotheram-Borus *et al.*, manuscript submitted for publication). Existing programs address relapse, typically in the final intervention sessions, and provide skills to understand relapse on the basis of Marlatt's strategies (Marlatt & Gordon, 1985). Yet, future adolescent HIV prevention programs must build in mechanisms for ongoing support and training to maintain positive behavior changes, as youth face new developmental challenges. In this study we attempted to provide ongoing support by linking youth to health care and social service agencies. However, this was not sufficient. To maintain these intervention effects over time, the sites for intervention delivery will have to move to settings of routine interactions for youth at high risk: malls, worksites, health care settings, or churches. Alternatively, structural interventions may provide mechanisms for ongoing support. For example, in Australia, homeless youth are provided monthly stipends to ensure stable housing and have guaranteed access to health care. Such policies may be warranted in the United States as well.

Second, there is an increasing recognition of the need for normative research designs that allow agency-level and community-based interventions. Interventions that focus on the structure and context of persons at high risk (in this case, shelters) are going to require quasi-experimental designs in their initial implementation. Propensity scores and random-effect models will be increasingly needed. Our ability to randomly assign settings to intervention and control conditions within randomized controlled designs is also very limited. Without substantial evidence that the program is efficacious, it is premature to use a randomized controlled trial. Yet, without using a randomized trial, the results will be suspect.

Third, given that the existing research literature has demonstrated the proof-of-concept of prevention programs, researcher's goals must now shift to disseminating and implementing the programs on a broad scale in a high quality and cost-effective manner (NIH Consensus Development Conference Panel, 2000). More than 1 million runaway youth are served nationally each year by 2,700 community-based agencies (National Network of Runaway and Youth Services, 1991). These providers can reach youth at high risk for HIV infection; the challenge is to create the dissemination, training, and funding mechanisms to facilitate and maintain implementation of HIV programs over time. When attempting to disseminate effective interventions, researchers have often focused

on intervention fidelity to ensure effective results in the next generation of programs. The balance between fidelity and adaptation has not been well-articulated by those committed to intervention diffusion. A research agenda for taking interventions to scale must be pursued.

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