

# Sexual Risk Reduction Interventions Do Not Inadvertently Increase the Overall Frequency of Sexual Behavior: A Meta-analysis of 174 Studies With 116,735 Participants

Natalie D. Smoak, PhD,\* Lori A.J. Scott-Sheldon, MA,\* Blair T. Johnson, PhD,\*  
Michael P. Carey, PhD,† and the SHARP Research Team\*

**Abstract:** A meta-analytic review of the influence of HIV risk reduction interventions on sexual occasions, number of partners, and abstinence was conducted to assess whether condom-related interventions inadvertently undermine sexual risk reduction efforts by increasing the frequency of sexual behavior. Included studies examined sexual risk reduction strategies and used a controlled design. Data from 174 studies (206 interventions,  $N = 116,735$  participants) were included. In general, HIV risk reduction interventions neither increased nor decreased sexual occasions or number of partners reported. Participants in intervention conditions were less likely to be sexually active than those in control conditions. When samples included more black participants, interventions reduced the number of sexual occasions; interventions were more successful at reducing the number of partners in samples that included more men who have sex with men (MSM) or individuals engaged in sex trading. Samples that included more MSM were more likely to adopt abstinence as a risk reduction strategy. Interventions that included more information, motivational enhancement, and skills training also led to greater risk reduction. HIV risk reduction interventions do not increase the overall frequency of sexual activity. To the contrary, for some subgroups, interventions that include components recommended by behavioral science theory reduce the frequency of sexual events and partners.

**Key Words:** sexual frequency, meta-analysis, research synthesis, HIV risk reduction intervention, number of partners, abstinence

(*J Acquir Immune Defic Syndr* 2006;41:374-384)

Over the last 2 decades, numerous studies evaluating the efficacy of HIV risk reduction interventions have focused on condom use or drug-related risk behaviors (eg, needle sharing) as key outcome variables. For example, the

review by Semann et al<sup>1</sup> focused on unprotected sex and use of male condoms and concluded that the proportion of drug users who reduced their risk behavior was 13% greater in intervention groups compared with controls. Although condom use is clearly an important marker of risk reduction, transmission risk can also be measured by outcomes involving sexual frequency indicators, including number of sexual partners, total number of sexual occasions, and sexual activity status (ie, active vs. abstinent). When individuals are part of a risky sexual network, HIV and STI transmission risk increases as sexual frequencies increase.<sup>2-6</sup> In other words, if each act of intercourse is viewed as a potential transmission episode, then fewer acts (with fewer partners) will reduce the likelihood that HIV will be transmitted. Thus, examining frequency-related outcomes is an important yet neglected outcome of risk reduction interventions.

Some authors have called for increasing attention to frequency-related outcomes, noting that focusing solely on condom use as a sexual risk indicator ignores a critical dimension of sexual behavior (eg, reference 7). In addition, experts have mentioned how increased intercourse frequency and numbers of partners lead to increased potential for STI exposure.<sup>8,9</sup> As an illustration, Project RESPECT found more STIs in those with more sexual partners.<sup>10</sup> Similarly, another study estimated preintervention to postintervention changes in participants' STI risk and found that reduced intercourse frequency was a superior marker of decreased risk for less infectious STIs such as HIV, but change in the number of sexual partners was preferable for highly infectious STIs such as gonorrhea.<sup>11</sup> In this analysis, increased condom use was not strongly correlated with changes in STI risk under most conditions.

Although researchers appear to believe that interventions can reduce the frequency of sexual behavior<sup>12</sup> and although their studies routinely assess sexual frequency outcomes, their reports tend to focus their reports on condom use, perhaps because frequency-related effects are often too small to detect in a typical single study. If so, using meta-analytic techniques to synthesize frequency-related outcomes could help determine whether interventions modify frequency-related sexual outcomes and, if so, the size of their impact. To our knowledge, frequency-related outcomes have not been systematically reviewed.

Evaluation of frequency outcomes is especially important because organizations, such as the Family Research Council,<sup>13</sup> Focus on the Family,<sup>14</sup> and the Rutherford

Received for publication August 23, 2005; accepted January 4, 2006.

From the \*Center for Health/HIV Intervention and Prevention, University of Connecticut, Storrs, CT and †Center for Health and Behavior, Syracuse University, Syracuse, NY.

NIH grants R01-MH58563 to Blair T. Johnson and K02-MH01582 to Michael P. Carey.

Other SHARP (Syntheses of HIV/AIDS Research Project) team members who contributed to this article included, in alphabetical order, Pamela Lavallee, Kerry L. Marsh, Allecia E. Reid, and Aaron Smith-McLallen.

Reprints: Natalie D. Smoak, PhD, Center for Health/HIV Intervention and Prevention, Unit 1248, 2006 Hillside Rd, University of Connecticut, Storrs, CT 06269-1248 (e-mail: natalie.smoak@uconn.edu).

Copyright © 2006 by Lippincott Williams & Wilkins

Institute,<sup>15,16</sup> have expressed concern that risk reduction interventions (especially those including condom promotion) will encourage more frequent sexual activity, thereby increasing transmission risk if a person engages in penetrative sex with infected partners. Thus, even if behavioral interventions increase condom use, they may inadvertently enhance risk because of increased sexual occasions or increased numbers of sexual partners or because condoms do not provide perfect protection against all STIs (eg, human papillomavirus). For adolescents, some policy makers worry that learning about or possessing condoms may encourage sexual debut at an earlier age, also potentially increasing transmission risk. The potential unintended effects of condom-based risk reduction interventions have not been systematically examined across samples.

The current meta-analysis addressed these issues and had 3 purposes. First, we examined whether condom-related interventions affected 3 frequency-related outcomes, namely, (1) number of sexual occasions, (2) number of sexual partners, and (3) sexual activity status. We also characterized the associations among these 3 sexual frequency indicators and condom use. The overarching goal was to evaluate the possibility that condom-related interventions may inadvertently undermine sexual health promotion efforts by increasing the frequency of sexual behavior.

Because investigators have used many different intervention strategies and population subgroups, we expected intervention effects to vary across studies. Therefore, we examined participant and intervention characteristics that might influence the magnitude of observed effects. We first evaluated the differential impact of HIV-related interventions as a function of demographic characteristics such as sex, race/ethnicity, and age. In addition, many studies have investigated groups that the HIV epidemic has disproportionately impacted,<sup>17</sup> including injection drug users (IDUs), commercial sex workers (CSWs), alcohol users, and men who have sex with men (MSM), and these were also systematically examined. If these subgroups of individuals are at elevated risk for HIV, one way in which their risk can be lessened is by the reduction of number of sexual occasions and number of sexual partners. Thus, we were particularly interested in how interventions affected frequency outcomes in high-risk groups.

A final goal of this review was to evaluate the predictive utility of Fisher and Fisher's<sup>18-21</sup> information-motivation-behavioral (IMB) skills model, a meta-theoretical account of HIV risk behavior. In a direct test of this model, St. Lawrence and colleagues<sup>23</sup> systematically tested and found that the inclusion of all 3 IMB components was more successful at reducing sexual frequency-related behavior than information alone. Because individual studies vary in the extent to which they include or exclude IMB components, we were able to provide a test of this model across the literature of sexual frequency outcomes, something that no prior meta-analysis has done.<sup>22</sup>

## METHOD

### Sample of Studies and Selection Criteria

We searched for studies through the simultaneous use of several strategies. First, we searched electronic reference

databases (Medline, PsycINFO, AIDSearch, CINAHL, Dissertation Abstracts Online, ERIC) using search terms related to HIV and other sexually transmitted diseases (ie, human or acquired and immu\* and syndrome or virus or AIDS or HIV; sexually and transmitted and disease\* or infection or STD or STI), intervention (intervene\* or prevent\*), and sexuality (sex\*, condom\*, or intercourse). Second, we checked HIV-related listservs, the NIH database of grant awardees, and conference proceedings. We also requested papers from individual researchers conducting HIV interventions and searched the reference lists of relevant, obtained papers. Finally, we manually searched journals likely to publish intervention results (eg, *American Journal of Public Health*, *Health Psychology*, *JAMA*). These supplemental strategies ensured the comprehensiveness of the reference database searches. Studies that fulfilled the search criteria and that were available as of May 2003 were included.

Studies were included if they (1) examined a deliberate HIV risk reduction strategy in a nonperinatal context; (2) used a randomized controlled trial or a quasi-experimental design with rigorous controls (eg, participants did not self-select into conditions); (3) measured a frequency-related marker (ie, presence of sexual activity, frequency of intercourse, and number of partners) following the intervention; and (4) provided sufficient information to calculate effect size estimates. For the purposes of this review, a deliberate HIV risk reduction strategy was defined as at least 15 minutes of HIV-relevant instruction. Of the initially relevant articles, 22 had insufficient information for the calculation of effect sizes, and these study authors were contacted. Twelve authors (55%) sent requested information, and their studies were included.

The use of these criteria yielded 174 studies, which investigated 206 separate interventions (see references 23-123 and MJ Rotheram-Borus et al, unpublished data, 1998, for included manuscripts, some of which included more than 1 study). Of the 174 studies, 32 were not published at the time the search was closed (May 2003). In total, the interventions began with a total of 149,660 participants; the average retention rate was 78%, leaving 116,735 participants for analysis. Consistent with meta-analytic convention,<sup>124-126</sup> each intervention was treated as an individual study during analysis.

### Study Information

Two raters independently coded each study for descriptive purposes and to determine whether variation in effect sizes can be attributed to features of the studies. The following dimensions were coded: (1) sample demographics (eg, ethnicity, sex), (2) risk characteristics (eg, sex trade, drug or alcohol use, MSM), (3) HIV serostatus, (4) design and measurement specifics (eg, number of follow-ups), and (5) content of control and intervention condition(s) (eg, total amount of time spent across all sessions). Finally, we also coded studies according to whether they provide IMB skills components, consistent with the IMB model.<sup>18,19</sup>

Across the study- and intervention-level categorical dimensions, coders agreed on the majority of judgments (mean agreement, 83%). Disagreements were resolved

through discussion. Effective reliability for the continuous variables was calculated by the Spearman-Brown result, which takes into account the mean interjudge correlation as well as the number of judges. For these variables, the effective reliability ranged from 0.60 to 1.00 (mean, 0.86).

When studies did not include sufficient data regarding the moderators of interest, values were imputed. When only an age range or category was given (and not the mean age of the sample), we used the midpoint of the age category as the mean age of the sample. In addition, if authors did not report that their sample included MSM, IDUs, sex traders or CSWs, and/or excessive alcohol users, we imputed a zero value for these characteristics, assuming no prevalence.

### Frequency-related Study Outcomes and Effect Size Derivation

We calculated individual effect sizes for all frequency-related measures reported in each of the 206 separate interventions examined across the 174 included studies. Specifically, we analyzed self- or partner-reported sexual frequency measures including (1) number of sexual occasions, defined as the number of episodes of penetrative intercourse (vaginal or anal); (2) number of sexual partners, defined as the number of unique partners an individual had in a given amount of time; and (3) sexual activity status, defined as having or not having some type of intercourse.

The number of sexual occasions and partners were continuous "counts," whereas sexual activity status was dichotomous. Because 2 of the 3 outcomes were continuous rather than dichotomous, the effect size calculated was the standardized mean difference ( $d$ ); odds ratios are meant for cases in which both the independent and the dependent variable are categorical. We represented the third dimension in  $d$  for ease of comparison between the categories. The pooled SD served as the denominator in the effect size calculation, when it was available, or, in a minority of cases, another form of SD (eg, the SD of the paired comparisons) was used because the pooled SD was not available and could not be calculated from the report. Other available statistical information (eg,  $F$  or  $t$  values) was used instead or as a supplement to means and SDs.<sup>128</sup> In calculating the effect sizes, we used statistics that controlled for baseline differences. If a study reported a significant difference on an outcome between the studied groups at baseline and did not control for this difference in analyses of the postintervention outcomes, we omitted the outcome in question. When studies reported odds ratios, we transformed them to  $d$  using the Cox transformation.<sup>128</sup> Within a follow-up measurement assessment, when the questions implied different intervals (eg, previous week vs previous month), we used the data from the interval that best matched the period since the end of the intervention.

The sign of each effect size was set so that it was positive when the outcome favored risk reduction, and effect sizes were corrected for sample size bias.<sup>129</sup> Forty-eight reports provided statistics separately by different groupings (eg, by sex or race); in these instances, effect sizes from each grouping were included in the analysis. As such, some studies

contributed more than one effect size for the same outcome. Effect sizes were calculated on the measures provided at the first available follow-up after the intervention. When available, we also calculated  $d$  for condom use, following the same procedures as above. Analyses followed fixed- and random-effects assumptions<sup>130</sup> to evaluate the mean tendencies for each outcome variable and fixed-effects assumptions to test whether features of the studies could explain variability in the magnitude of effect sizes.<sup>131</sup>

## RESULTS

### Description of Studies

#### Participants

The included studies appeared between 1989 and 2003. On average, samples were 50% men, 54% black (including Africans and Americans), and 24.8 years old. Most studies (84%) were conducted in the United States, with the majority (70%) of these studies conducted in medium to large cities. Across studies, 76% of participants were sexually active.

#### Design

The majority of studies (59%) involved random assignment of individuals, whereas 18% involved random assignment of groups. The remaining studies (23%) matched participants in the intervention and control conditions on at least 1 variable. The majority of studies (98%) used a pretest and posttest design and included an average of 2.1 ( $SD = 1.4$ ) follow-ups after baseline data collection. The present analyses used measures taken at the first follow-up, which occurred at a mean of 15.2 weeks (range, 0–104 weeks) from the intervention (0 weeks implies the first follow-up was <7 days postintervention). Generally, the first follow-up occurred less than 1 week after the intervention in lengthier interventions for which behavior change was occurring during the intervention.

#### Interventions

Most interventions (74%) provided HIV counseling and testing, and 97% provided HIV education. Forty-five percent provided condom information, 41% taught condom use skills, and 74% distributed condoms to participants. A majority of the interventions included interpersonal skills training (eg, negotiation skills, 66%) and intrapersonal skills training (eg, self-management to avoid risky sex, 58%). Interventions averaged 8 participants per session, and met for 3 sessions of 75 minutes each, for a total of approximately 4 hours.

#### Frequency Markers and Condom Use

Because previous meta-analyses have found an intervention effect on condom use, we examined the links among the sexual frequency outcomes and condom use. Interventions that improved condom use also reduced the number of partners ( $r = 0.22$ ,  $P = 0.035$ ) and number of sexual occasions ( $r = 0.49$ ,  $P = 0.003$ ). There was no significant link between effect sizes for sexual activity status and condom use ( $r = -0.14$ ,  $P = 0.382$ ).

**TABLE 1.** Overall Efficacy of Interventions to Promote Risk Reduction at Studies' First Follow-up Assessments

Outcome	k	Weighted Mean <i>d</i> <sub>+</sub> (95% Confidence Interval)		Homogeneity of Effect Sizes	
		Fixed Effects	Random Effects	Q	P
Number of sexual occasions	42	-0.004 (-0.033, 0.025)	0.010 (-0.042, 0.061)	92.07	<0.001
Number of sexual partners	107	0.008 (-0.012, 0.028)	0.009 (-0.020, 0.039)	185.79	<0.001
Sexual activity status	49	0.026 (0.002, 0.050)	0.044 (0.003, 0.084)	103.92	<0.001

Each effect size (*d*) was weighted by the inverse of its variance. Confidence intervals not including zero reflect significant intervention effects. *k* indicates the number of studies; *P*, probability (when statistically significant, implies differences within the distribution of effect sizes); *Q*, homogeneity within categories.

### Intervention Impact on Sexual Frequency Outcomes

The first set of analyses examined whether the behavioral interventions impacted the 3 markers of sexual frequency. As Table 1 depicts, these analyses indicated that, overall, intervention programs neither increased nor decreased participants' number of sexual occasions or number of partners relative to the control conditions, but that the interventions did decrease risk for the outcome of sexual activity status (*d*<sub>+</sub> = 0.026 fixed effects; *d*<sub>+</sub> = 0.044 random effects). For all 3 categories of sexual frequency, the hypothesis of effect size homogeneity was rejected, as hypothesized. Therefore, moderator tests were conducted on each effect separately to examine our hypotheses that study features related to this variability.

### Moderators of Intervention Impact on Number of Occasions

We first investigated moderators of the impact of interventions on number of sexual occasions. All demographic characteristics were individually entered into a regression analysis as predictors of number of sexual occasions. The number of sexual occasions increased less when samples included more blacks ( $\beta = 0.434$ ,  $P < 0.0001$ ).

Intervention effectiveness within samples containing various HIV risk groups was also examined. Of particular interest were MSM, IDUs, those known to engage in sex trading or prostitution, and alcohol users. None of these

sample characteristics moderated intervention impact on number of sexual occasions.

We also examined intervention content variables as moderators of intervention impact on number of sexual occasions, including the amount of HIV-related information, condom use, interpersonal and intrapersonal skills, and motivational enhancement. Of these, motivational enhancement and intrapersonal skills moderated the impact of interventions on number of sexual occasions ( $\beta = 0.527$ ,  $P < 0.0001$ , and  $\beta = 0.235$ ,  $P < 0.05$ , respectively).

### Multivariate Model

We then entered each significant univariate moderator mentioned above into a multiple predictor model. In this multiple predictor model, mean effect sizes for each variable were assessed at the mean level of the other predictors. This analysis revealed that proportion of blacks within a sample remained a significant moderator of the impact of interventions on number of sexual occasions. As before, when samples included more blacks, interventions decreased the number of sexual occasions. The amount of motivational enhancement included in an intervention also remained a significant moderator. As the duration of the motivational component increased, interventions became more effective at reducing the number of sexual occasions (Table 2).

### Moderators of Intervention Impact on Number of Sexual Partners

The same analytic strategy was used to examine moderators of intervention impact on number of partners.

**TABLE 2.** Multivariate Model of Intervention Impact on Number of Sexual Occasions (*k* = 42)

Variable	Level*	Adjusted Mean Effect Size (95% Confidence Interval)†	$\beta$	P
Proportion black within sample	0%	-0.025 (-0.072, 0.022)	0.276	0.033
	100%	0.116 (0.012, 0.221)		
Motivational enhancement component	0 hours	-0.005 (-0.042, 0.041)	0.470	<0.001
	1 hour	0.151 (0.073, 0.230)		
	2 hours	0.303 (0.148, 0.458)		
	3 hours	0.454 (0.220, 0.689)		

\*Levels symbolize representative values along the continuous levels observed.

†Each adjusted mean effect size is reported at the mean level of the other study dimension.

Effect sizes (*d* values) are positive for results that favor the intervention group. Analyses are based on fixed-effects assumptions; each effect size (*d*) was weighted by the inverse of its variance. Number of sexual occasions was modeled as the dependent variable in a multiple regression model, with each listed study dimension simultaneously entered as an independent variable.

$\beta$  indicates standardized regression coefficient; *k*, number of studies; *P*, probability.

**TABLE 3.** Multivariate Model of Intervention Impact on Number of Sexual Partners ( $k = 107$ )

Variable	Level*	Adjusted Mean Effect Size (95% Confidence Interval)**	$\beta$	$P$
Proportion MSM	0%	0.001 (-0.023, 0.025)	0.277	<0.001
	100%	0.252 (0.121, 0.383)		
Proportion involved in sex trading	0%	-0.001 (-0.026, 0.025)	0.231	0.002
	100%	0.409 (0.151, 0.667)		
Interpersonal skills component	0 hours	-0.021 (-0.050, 0.009)	0.351	<0.001
	3 hours	0.008 (-0.016, 0.032)		
	6 hours	0.036 (0.012, 0.061)		
	9 hours	0.065 (0.034, 0.095)		
Intrapersonal skills component	0 hours	-0.009 (-0.034, 0.015)	0.272	<0.001
	3 hours	0.050 (0.016, 0.083)		
	6 hours	0.109 (0.048, 0.169)		
	9 hours	0.168 (0.077, 0.259)		

\*Levels symbolize representative values along the continuous levels observed.

\*\*Each adjusted mean effect size is reported at the mean level of each other study dimension.

Effect sizes ( $d$  values) are positive for results that favor the intervention group. Analyses are based on fixed-effects assumptions; each effect size ( $d$ ) was weighted by the inverse of its variance. Number of partners was modeled as the dependent variable in a multiple regression model, with each listed study dimension simultaneously entered as an independent variable.

$\beta$  indicates standardized regression coefficient;  $k$ , number of studies;  $P$ , probability.

When there were fewer women in the samples, interventions had a more positive impact ( $\beta = -0.155$ ,  $P < 0.04$ ). In addition, interventions were more successful at reducing numbers of partners in samples that included more MSM ( $\beta = 0.158$ ,  $P < 0.04$ ) and more individuals known to engage in sex trading ( $\beta = 0.153$ ,  $P < 0.04$ ). As before, intervention content also impacted intervention effectiveness. When interventions included a higher dosage of interpersonal or intrapersonal skills, participants were more likely to reduce the number of partners ( $\beta = 0.238$ ,  $P < 0.01$ , and  $\beta = 0.270$ ,  $P < 0.001$ , respectively).

### Multivariate Model

We then entered each significant univariate moderator into a multiple regression model. When all variables were considered simultaneously, sex and age were no longer significant moderators of the impact of interventions on number of sexual partners (Table 3); all other moderators remained significant. As before, interventions were more successful at reducing the numbers of partners in samples that included more MSM and more individuals known to engage in sex trading. The amount of skills training included in an intervention also remained a significant moderator. As the duration of either skills component increased, interventions became more effective at reducing the number of partners.

### Moderators of Intervention Impact on Sexual Activity Status

The final set of analyses examined moderators of intervention impact on sexual activity status. When samples included more whites, interventions had a larger, positive impact on sexual activity status ( $\beta = 0.259$ ,  $P < 0.02$ ). Sexual activity status was also more positively impacted when samples included more MSM ( $\beta = 0.217$ ,  $P < 0.03$ ), more IDUs ( $\beta = 0.317$ ,  $P < 0.01$ ), and more alcohol users ( $\beta = 0.372$ ,  $P < 0.001$ ). When interventions included more HIV information and intrapersonal skills training, sexual activity

status was more likely to reflect abstinence ( $\beta = 0.276$ ,  $P < 0.01$ , and  $\beta = 0.392$ ,  $P < 0.001$ , respectively).

### Multivariate Model

Significant univariate predictors were then simultaneously entered into a multiple regression analysis. This analysis revealed that interventions were more successful at impacting sexual activity status when samples included more MSM, and when the total amount of HIV information and intrapersonal skills training was greater (Table 4).

### Intervention Characteristics and Sexual Frequency Outcomes

#### Condom-related Features

We investigated the impact of providing condoms to study participants and allowing participants to directly or indirectly learn condom use skills such as negotiation or proper use on sexual frequency, number of partners, and sexual activity status. None of these intervention features impacted any of the effects of interest, suggesting that teaching individuals about condoms does not result in more acts of intercourse, more sexual partners, or earlier intercourse (all  $P$ 's  $> 0.20$ ).

#### IMB Components

To examine the impact of the IMB components on the 3 frequency-related outcomes, all 3 components were entered simultaneously as predictors of each separate outcome. Consistently, interventions that included more of the IMB components were most successful at reducing number of sexual occasions and number of sexual partners (Fig. 1). The same pattern was not observed for sexual activity status.

### COMMENT

This quantitative synthesis evaluated the extent to which HIV-related interventions influence 3 sexual frequency

**TABLE 4.** Multivariate Model of Intervention Impact on Sexual Activity Status ( $k = 49$ )

Variable	Level*	$d$ (95% Confidence Interval)**	$\beta$	$P$
Proportion MSM	0%	0.056 (0.026, 0.086)	0.222	0.024
	100%	0.235 (0.083, 0.388)		
Information component	0 hours	0.041 (0.008, 0.073)	0.302	0.002
	3 hours	0.047 (0.016, 0.078)		
	6 hours	0.053 (0.023, 0.083)		
	9 hours	0.059 (0.029, 0.088)		
Intrapersonal skills component	0 hours	0.022 (-0.002, 0.046)	0.386	<0.001
	1 hour	0.127 (0.072, 0.181)		
	2 hours	0.232 (0.128, 0.336)		
	3 hours	0.336 (0.181, 0.492)		

\*Levels symbolize representative values along the continuous levels observed.

\*\*Each adjusted mean effect size is reported at the mean level of each other study dimension.

Effect sizes ( $d$  values) are positive for results that favor the intervention group. Analyses are based on fixed-effects assumptions; each effect size ( $d$ ) was weighted by the inverse of its variance. Sexual activity status was modeled as the dependent variable in a multiple regression model, with each listed study dimension simultaneously entered as an independent variable.

$\beta$  indicates standardized regression coefficient;  $k$ , number of studies;  $P$ , probability.

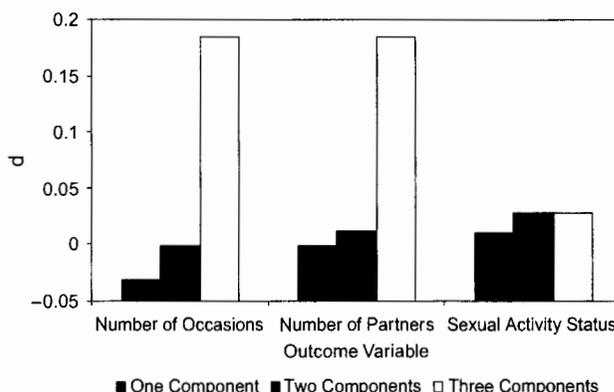
outcomes: number of sexual occasions, number of partners, and sexual activity status. We focused on studies with rigorous controls because such studies provide the strongest and most interpretable evidence regarding the effects of HIV risk reduction programs. In total, 174 studies, including 206 interventions and nearly 120,000 participants qualified for the review. With this large sample, analyses showed that, in general, interventions neither increased nor decreased the number of sexual occasions and the number of partners. These findings provide reassurance that, overall, HIV risk reduction interventions do not inadvertently increase the number of sexual occasions or sexual partners. Moreover, the results indicated that sexual activity was reduced overall (Table 1). It should also be noted that adolescents were no more likely than adults to increase sexual frequency as a result of interventions. As we expected, the overall average magnitude of intervention effects on each of these frequency dimensions was small ( $d_+$  range, -0.004-0.044) and much smaller than that observed in past meta-analyses of condom use and similar risk behaviors (eg,  $d_+$  range, 0.07-1.31).<sup>125,126,132-136</sup> Yet, more important is the fact that the magnitude of studies' effects on frequency-related outcomes varied widely; when interventions included particular features or focused on particular risk groups, sexual risk reduction via number of sexual occasions, number of sexual partners, and sexual activity status was more likely.

### Conditions Related to Reduced Sexual Frequencies

Several sample and intervention features explained variability in sexual frequency outcomes. Our analysis revealed 2 significant moderators of intervention impact on number of sexual occasions: proportion of black participants within the sample and amount of motivational enhancement provided. Interventions were more successful at reducing the number of sexual occasions when samples included more black participants. One might wonder whether the explanation for this finding is that interventions occurring in African nations, where the threat of HIV is higher than in the United

States, have greater success at reducing number of sexual occasions. In our database, only 4 studies that targeted number of sexual occasions occurred in African nations, and, of those, 2 were highly successful at reducing the number of sexual occasions and 2 were not. Most of the studies targeting number of sexual occasions as an outcome occurred within the United States. As such, it does not appear that this is the sole explanation for this finding.

A second possible explanation for this finding involves the increased risk perception that may exist among blacks. It is now widely recognized that, in the United States, blacks have been disproportionately affected by HIV and AIDS; epidemiologic data indicate that approximately 50% of the new HIV infections in 2003 occurred among blacks,<sup>137</sup> although blacks made up only 12% of the United States population in the 2000 census. Moreover, research indicates that concern about HIV tends to be high among blacks,<sup>138</sup> and perceptions of the local prevalence of HIV/AIDS predicts number of sex partners, sexual risk practices, rates of STIs, and HIV testing history.<sup>139</sup> This phenomenon, referred to as "intuitive epidemiology," likely involves an increased vulnerability or risk perception, a construct implicated in



**FIGURE 1.** The impact of IMB components on number of occasions, number of partners, and sexual activity status.

many theoretical models of health behavior change.<sup>140</sup> This increased vulnerability to HIV among blacks may increase the relevance of HIV risk reduction programs for this population subgroup, partially explaining the greater intervention success.

Interventions that included larger motivational components were more successful at reducing the number of sexual occasions. This finding suggests that risk reduction interventions work, at least in part, by engaging intrinsic motivation for self-protection. This interpretation is consistent with a growing body of evidence indicating the motivational approaches to health behavior change can be more effective than traditional health education and psychotherapeutic interventions.<sup>141</sup> Indeed, motivational approaches have shown considerable promise as stand-alone or supplemental interventions for traditionally intractable problems such as smoking,<sup>142</sup> alcohol misuse,<sup>143</sup> and drug use.<sup>144,145</sup> Several studies have demonstrated the value of a motivational intervention in the context of HIV risk reduction as well.<sup>30,146,147</sup> Future research should more fully investigate the types of motivational enhancement that are most successful at reducing the number of sexual occasions and explore the psychological mechanisms by which motivational approaches influence behavior change.

Skills training was an important intervention feature when number of sexual partners was a targeted outcome. Interventions with longer interpersonal and intrapersonal skills training components were more effective at reducing the number of sexual partners. This meta-analytic finding corroborates earlier reviews of evidence obtained from primary level research<sup>132</sup> and demonstrates that negotiating a safe sexual relationship with a partner requires skill.<sup>148,149</sup> Individuals who lack the ability to skillfully decline a partner's advances may be at greater risk for unintended sexual advances, including unprotected sex. When individuals are actively taught how to handle a sexual proposition, they are better able to refuse intercourse with additional partners.<sup>58</sup>

Interventions were also more successful at reducing the number of sexual partners when samples included more MSM or individuals involved in sex trading, 2 groups traditionally viewed as high risk for HIV. One possible mechanism for this finding is the increased awareness of HIV in these subgroups, consistent with the explanation provided earlier for black participants. Overall, these results suggest that interventions are efficacious with those who recognize their vulnerability to HIV.

The amount of HIV information within an intervention also significantly influenced the interventions' impact on sexual activity status. When interventions included more information about HIV and more intrapersonal skills training, the risk reduction impact of interventions on sexual activity status was enhanced, consistent with the IMB model.<sup>18</sup> Self-management skills, a type of intrapersonal skills, play a role in sexual activity status. Managing one's emotions and substance use and avoiding risky situations are important skills for individuals who have engaged in risky sexual encounters in the past, but would now like to avoid these situations.

Evaluation of the influence of condom-related intervention features on the 3 frequency-related outcomes of interest indicated that none of these features moderated the impact of interventions on number of sexual occasions, number of partners, or sexual activity status. This finding should provide reassurance that increased numbers of sexual occasions, larger numbers of partners, and more likely sexual activity are not iatrogenic effects of providing condoms or training in condom use skills and interpersonal negotiation skills.

### Sexual Frequency Reduction as a Prevention Alternative

Overall, interventions that included informational, motivational, and behavioral skills components, consistent with the IMB model,<sup>18,19</sup> were more likely to influence frequency outcomes than were interventions that did not include all 3 IMB components. The number of sexual occasions was significantly reduced after exposure to an hour (or more) of motivational training. Similarly, studies that included 6 hours of interpersonal skills training or 3 hours of intrapersonal skills training were the most successful at reducing the number of sexual partners. Studies were most successful at influencing sexual activity status when they included 6 hours of HIV information and at least 1 hour of intrapersonal skills training. The need for different doses of diverse types of training may be due, in part, to the level of skill participants already have upon entering into the intervention. Research should investigate the dynamic interplay among various types of HIV risk reduction intervention content and participants' initial IMB skills levels, ensuring that no critical component is omitted.<sup>150</sup>

Overall, after more than 20 years of studying HIV and designing related interventions, it is clear that progress toward risk prevention is being made. The results of this synthesis suggest that targeting frequency-related outcomes is another avenue by which HIV transmission risk can be reduced. Although condom use has been touted as the primary and most beneficial sexual risk reduction outcome, interventions that integrate key elements of behavioral theory are also successful at reducing frequency-related outcomes for some population subgroups.

### REFERENCES

1. Semann S, DesJarlais DC, Sogolow E, et al. A meta-analysis of the effect of HIV prevention interventions on the sex behaviors of drug users in the United States. *J Acquir Immune Defic Syndr*. 2002;30:73-93.
2. Reinking D, van Zessen G, Kretzschmar M, Brouwers H, et al. Social transmission routes of HIV. A combined sexual network and life course perspective. *Patient Educ Couns*. 1994;24:289-297.
3. Catania JA. Relationship of sexual mixing across age and ethnic groups to herpes simplex virus-2 among unmarried heterosexual adults with multiple sexual partners. *Health Psychol*. 1996;15:362-370.
4. Parker M, Ward H, Day S. Sexual networks and the transmission of HIV in London. *J Biosoc Sci*. 1998;30:63-83.
5. Friedman SR, Flom PL, Kottiri BJ, Neaigus A, Sandoval M, Curtis R, Des Jarlais DC, Zenilman JM. Consistent condom use in the heterosexual relationships of young adults who live in a high-HIV-risk neighbourhood and do not use "hard drugs". *AIDS Care*. 2001;13:285-296.
6. Morris M, Zavisca J, Dean L. Social and sexual networks: their role in

- the spread of HIV/AIDS among young gay men. *AIDS Educ Prev*. 1995;7:24-35.
7. Cleland J, Boerma JT, Carael M, Weir SS. Monitoring sexual behaviour in general populations: a synthesis of lessons of the past decade. *Sex Transm Infect*. 2004;80(suppl II):ii1-ii7.
  8. Aral SO. Sexual behavior in sexually transmitted disease research: an overview. *Sex Transm Dis*. 1994;21(suppl II):S59-S64.
  9. DiClemente RJ, Crosby RA, Wingood GM, Lang DL, Salazar LF, Broadwell SD. Reducing risk exposures to zero and not having multiple partners: findings that inform evidence-based practices designed to prevent STD acquisition. *Int J STD AIDS*. 2005;16:816-818.
  10. Peterman TA, Lin LS, Newman DR, Kamb ML, Bolan G, Zenilman J, Douglas JM, Rogers J, Malotte CK. Does measured behavior reflect STD risk? An analysis of data from a randomized controlled behavioral intervention study. Project RESPECT Study Group. *Sex Transm Dis*. 2000;27:446-451.
  11. Pinkerton SD, Chesson HW, Layde PM. Utility of behavioral changes as markers of sexually transmitted disease risk reduction in sexually transmitted disease/HIV prevention trials. *J AIDS*. 2002;31:71-79.
  12. Simbayi LC, Chauveau J, Shisana O. Behavioural responses of South African youth to the HIV/AIDS epidemic: a nationwide survey. *AIDS Care*. 2004;16:605-618.
  13. Maher BE. Abstinence until marriage: the best message for teens. Available at: <http://www.frc.org/get.cfm?i=IS03B1>. Accessed December 14, 2005.
  14. Focus on the family. Abstinence policy. Available at: <http://www.family.org/cforum/fosi/abstinence/>. Accessed December 14, 2005.
  15. The Rutherford Institute. Parental rights and opt-out policies: trends in case law. Available at: [http://www.rutherford.org/documents/pdf/brief\\_bank/B09-OP-1.PDF](http://www.rutherford.org/documents/pdf/brief_bank/B09-OP-1.PDF). Accessed December 14, 2005.
  16. The Rutherford Institute. Curriculum excusal for religious students. Available at: [http://www.rutherford.org/documents/pdf/brief\\_bank/B07-CurriculumExcusal.pdf](http://www.rutherford.org/documents/pdf/brief_bank/B07-CurriculumExcusal.pdf). Accessed December 14, 2005.
  17. Center for Disease Control. HIV/AIDS surveillance report: HIV infection and AIDS in the United States, 2003. Available at: <http://www.cdc.gov/hiv/stats.htm#exposure>.
  18. Fisher JD, Fisher WA. Changing AIDS-risk behavior. *Psychol Bull*. 1992;111:455-474.
  19. Fisher JD, Fisher WA. Theoretical approaches to individual-level change in HIV risk behavior. In: DiClemente RJ, Peterson JL, eds. *Handbook of HIV Prevention*. Dordrecht, Netherlands: Kluwer Academic Publishers, 2000:3-55.
  20. Avants SK, Margolin A, Usubiaga MH, Doebbrick C. Targeting HIV-related outcomes with intravenous drug users maintained on methadone: a randomized clinical trial of a harm reduction group therapy. *J Subst Abuse Treat*. 2004;26:67-78.
  21. Margolin A, Avants SK, Warburton LA, Hawkins KA, Shi J. A randomized clinical trial of a manual-guided risk reduction intervention for HIV-positive injection drug users. *Health Psychol*. 2003;22:223-228.
  22. Fisher WA, Fisher JD, Harman J. The information-motivation-behavioral skills model: a general social psychological approach to understanding and promoting health behavior. In: Suls J, Wallston KA, eds. *Social Psychological Foundations of Health and Illness*. Oxford: Blackwell Publishing, 2003:82-106.
  23. St. Lawrence JS, Crosby RA, Brasfield TL, O'Bannon RE 3rd. Reducing STD and HIV risk behavior of substance-dependent adolescents: a randomized controlled trial. *J Consult Clin Psychol*. 2002;70(4):1010-1021.
  24. Baldwin JI, Whiteley S, Baldwin JD. Changing AIDS and fertility related behavior: the effectiveness of sexual education. *J Sex Res*. 1990;27(2):245-262.
  25. Basen-Engquist K, Coyle KK, Parcel GS, et al. School-wide effects of a multicomponent HIV, STD, and pregnancy prevention program for high school students. *Health Educ Behav*. 2001;28(2):166-185.
  26. Boyer CB, Shafer MA, Tschann JM. Evaluation of a knowledge and cognitive behavioral skills building intervention to prevent STDs and HIV infection in high school students. *Adolescence*. 1997;32(125):25-42.
  27. Branson BM, Peterman TA, Cannon RO, Ransom R, Zaidi AA. Group counseling to prevent sexually transmitted disease and HIV: a randomized controlled trial. *Sex Transm Dis*. 1998;25(10):553-560.
  28. Brieger WR, Delano GE, Lane CG, Oladepo O, Oyediran KA. West African Youth Initiative: outcome of a reproductive health education program. *J Adolesc Health*. 2001;29(6):436-446.
  29. Calsyn DA, Saxon AJ, Freeman G Jr, Whittaker S. Ineffectiveness of AIDS education and HIV antibody testing in reducing high-risk behaviors among injection drug users. *Am J Public Health*. 1992;82(4):573-575.
  30. Carey MP, Maisto SA, Kalichman SC, Forsyth AD, Wright EM, Johnson BT. Enhancing motivation to reduce the risk of HIV infection for economically disadvantaged urban women. *J Consult Clin Psychol*. 1997;65(4):531-541.
  31. Chesniak-Phipps L. *Examining the Factors that Influence Sexual Activity and Condom Use Among African American Youth* [dissertation]. Wichita, KS: Wichita State University; 2002.
  32. Chitwood DD, Inciardi JA, McBride DC, McCoy HV, Trapido EA. *Community Approach to AIDS Intervention*. New York: Greenwood Press, 1991.
  33. Choi KH, Lew S, Vittinghoff E, Catnia JA, Barrett DC, Coates TJ. The efficacy of brief group counseling in HIV risk reduction among homosexual Asian and Pacific Islander men. *AIDS*. 1996;10:81-87.
  34. Cohen DA, MacKinnon DP, Dent C, Mason HC, Sullivan E. Group counseling at STD clinics to promote use of condoms. *Public Health Rep*. 1992;107(6):727-731.
  35. Cohen ELS. *High-risk Sexual Behavior in the Context of Alcohol Use: An Intervention for College Students* [dissertation]. Austin, TX: University of Texas at Austin; 2000.
  36. Collins C, Kohler C, DiClemente R, Wang MQ. Evaluation of the exposure effects of a theory-based street outreach HIV intervention on African-American drug users. *Eval Program Plann*. 1999;22(3):279-293.
  37. Cottler LB, Leukefeld C, Hoffman J, et al. Effectiveness of HIV risk reduction initiatives among out of treatment non-injection drug users. *J Psychoactive Drugs*. 1998;30(3):279-290.
  38. Cottler LB, Compton WM, Abdallah AB, et al. Peer-delivered interventions reduce HIV risk behaviors among out-of-treatment drug abusers. *Public Health Rep*. 1998;113(suppl 1):31-41.
  39. Coyle K, Basen-Engquist K, Kirby D, et al. Short-term impact of Safer Choices: a multicomponent, school-based HIV, other STD, and pregnancy prevention program. *J Sch Health*. 1999;69(5):181-188.
  40. Dancy BL, Marcantonio R, Norr K. The long-term effectiveness of an HIV prevention intervention for low-income African American women. *AIDS Educ Prev*. 2000;12(2):113-125.
  41. Danielson R, Marcy S, Plunkett A, Wiest W, Greenlick MR. Reproductive health counseling for young men: what does it do? *Fam Plann Perspect*. 1990;22(3):115-121.
  42. Ehrhardt AA, Exner TM, Hoffman S, et al. A gender-specific HIV/STD risk reduction intervention for women in a health care setting: short- and long-term results of a randomized clinical trial. *AIDS Care*. 2002;14(2):147-161.
  43. El-Bassel N, Schilling RF. 15-Month follow-up of women methadone patients taught skills to reduce heterosexual HIV transmission. *Public Health Rep*. 1992;107(5):500-504.
  44. Fawole IO, Asuzu MC, Oduntan SO, Brieger WR. A school-based AIDS education programme for secondary school students in Nigeria: a review of effectiveness. *Health Educ Res*. 1999;14(5):675-683.
  45. Fraser CM. *The Impact of an Undergraduate HIV/AIDS Education Course on Students' AIDS Knowledge, Attitudes, and Sexual Risk Behaviour* [dissertation]. Burnaby, British Columbia, Canada: Simon Fraser University; 1996.
  46. Gibson DR, Lovelle-Drache J, Young M, Hudes ES, Sorenson JL. Effectiveness of brief counseling in reducing HIV risk behavior in injecting drug users: final results of randomized trials of counseling with and without HIV testing. *AIDS Behav*. 1999;3(1):3-12.
  47. Gilliam A, Seltzer R. The efficacy of educational movies on AIDS knowledge and attitudes among college students. *J Am Coll Health*. 1989;37:261-265.
  48. Goertzel T, Bluebond-Langner M. What is the impact of a campus AIDS education course? *J Am Coll Health*. 1991;40(1):87-92.
  49. Gold RS, Rosenthal DA. Examining self-justifications for unsafe sex as a technique of AIDS education: the importance of personal relevance. *Int J STD AIDS*. 1998;9:208-213.
  50. The Voluntary HIV-1 Counseling and Testing Efficacy Study Group.

- Efficacy of voluntary HIV-1 counseling and testing in individuals and couples in Kenya, Tanzania, and Trinidad: a randomized trial. *Lancet*. 2000;356:103-112.
51. Hadden BR. *An HIV/AIDS Prevention Intervention with Female and Male STD Patients in a Peri-urban Settlement in KwaZulu Natal, South Africa*. KwaZulu Natal, South Africa: University of Natal, September 1997.
  52. Harvey B, Stuart J, Swan T. Evaluation of a drama-in-education programme to increase AIDS awareness in South African high schools: a randomized community intervention trial. *Int J STD AIDS*. 2000; 11(2):105-111.
  53. Hernandez JT, Smith FJ. Abstinence, protection, and decision-making: experimental trials on prototypic AIDS programs. *Health Educ Res*. 1990;5(3):309-320.
  54. Hobfoll SE, Jackson AP, Lavin J, Johnson RJ, Schroder KE. Effects and generalizability of communally oriented HIV-AIDS prevention versus general health promotion groups for single, inner-city women in urban clinics. *J Consult Clin Psychol*. 2002;70(4):950-960.
  55. Hubbard BM, Giese ML, Rainey J. A replication study of Reducing the Risk, a theory-based sexuality curriculum for adolescents. *J Sch Health*. 1998;68(6):243-247.
  56. Kamali A, Quigley M, Nakiyingi J, et al. Syndromic management of sexually-transmitted infections and behaviour change interventions on transmission of HIV-1 in rural Uganda: a community randomized trial. *Lancet*. 2003;361(9358):645-652.
  57. Kamb ML, Fishbein M, Douglas JM, et al. Efficacy of risk-reduction counseling to prevent human immunodeficiency virus and sexually transmitted diseases. *J Am Med Assoc*. 1998;280(13):161-1167.
  58. Kelly J, St. Lawrence J, Hood H, Brasfield T. Behavioral intervention to reduce AIDS risk activities. *J Consult Clin Psychol*. 1989;57(1):60-67.
  59. Kelly J, Lawrence J, Diaz Y, et al. HIV risk behavior reduction following intervention with key opinion leaders of population: an experimental analysis. *Am J Public Health*. 1991;81(2):168-171.
  60. Kelly J, Murphy DA, Washington CD, et al. The effects of HIV/AIDS intervention groups for high-risk women in urban clinics. *Am J Public Health*. 1994;84(12):1918-1922.
  61. Kelly J, McAuliffe T, Sikkema K, et al. Reduction in risk behavior among adults with severe mental illness who learned to advocate for HIV prevention. *Psychiatr Serv*. 1997;48(10):1283-1288.
  62. Kelly J, Murphy D, Sikkema K, et al. Randomised, controlled, community-level HIV-prevention intervention for sexual-risk behaviour among homosexual men in U.S. cities. *Lancet*. 1997;350: 1500-1505.
  63. Kindberg T, Christensson B. Changing Swedish students' attitudes in relation to the AIDS epidemic. *Health Educ Res*. 1994;9(2):171-181.
  64. Kipke M, Boyer C, Hein K. An evaluation of an AIDS risk reduction education and skills training (ARREST) program. *J Adolesc Health*. 1993;14(7):533-539.
  65. Kirby D, Korpi M, Adivi C, Weissman J. An impact evaluation of Project SNAPP: an AIDS and pregnancy prevention middle school program. *AIDS Educ Prev*. 1997;9(suppl A):44-61.
  66. Kwiatkowski CF, Stober DR, Booth DR, Zhang Y. Predictors of increased condom use following HIV intervention with heterosexually active drug users. *Drug Alcohol Depend*. 1998;1-6.
  67. MacNeil JM, Mberesero F, Kilonzo G. Is care and support associated with preventive behaviour among people with HIV? *AIDS Care*. 1999; 11:537-546.
  68. Magnani RJ, Gaffikin L, de-Aquino EM, Seiber EE, Almeida MC, Lipovsek V. Impact of an integrated adolescent reproductive health program in Brazil. *Stud Fam Plann*. 2001;32(3):230-243.
  69. Main DS, Iverson DC, McGloin J, et al. Preventing HIV infection among adolescents: evaluation of a school-based education program. *Prev Med*. 1994;23:409-417.
  70. Mansfield C, Conroy M, Emans S, Woods E. A pilot study of AIDS education and counseling of high-risk adolescents in an office setting. *J Adolesc Health*. 1993;14(1):115-119.
  71. McCusker J, Stoddard AM, Hindin RN, Garfield FB, Frost R. Changes in HIV risk behavior following alternative residential programs of drug abuse treatment and AIDS education. *Ann Epidemiol*. 1996;6(2): 119-125.
  72. McMahon RC, Malow RM, Jennings TE, Gomez CJ. Effects of a cognitive-behavioral HIV prevention intervention among HIV negative male substance abusers in VA residential treatment. *AIDS Educ Prev*. 2001;13(1):91-107.
  73. Metzler CW, Biglan A, Noell J, Ary DV, Ochs L. A randomized controlled trial of a behavioral intervention to reduce high-risk sexual behavior among adolescents in STD clinics. *Behav Ther*. 2000;31(1): 27-54.
  74. Nyamathi AM, Flaskerud J, Bennett C, Leake B, Lewis C. Evaluation of two AIDS education programs for impoverished Latina women. *AIDS Educ Prev*. 1994;6:296-309.
  75. Nyamathi A, Leake B, Flaskerud J, Lewis C, Bennett C. Outcomes of specialized and traditional AIDS counseling programs for impoverished women of color. *Res Nurs Health*. 1993;16:11-21.
  76. Nyamathi A, Stein J. Assessing the impact of HIV reduction counseling in impoverished African American women: a structural equations approach. *AIDS Educ Prev*. 1997;9(3):253-273.
  77. Nyamathi A, Flaskerud J, Keenan C, Leake B. Effectiveness of a specialized vs traditional AIDS education program attended by homeless and drug-addicted women alone or with supportive persons. *AIDS Educ Prev*. 1998;10(5):433-466.
  78. Nyamathi A, Flaskerud JH, Leake B, Dixon EL, Lu A. Evaluating the impact of peer, nurse case-managed, and standard HIV risk-reduction programs on psychosocial and health-promoting behavioral outcomes among homeless women. *Res Nurs Health*. 2001;24(5):410-422.
  79. O'Leary A, Ambrose TK, Raffaelli M, et al. Effects of an HIV risk reduction project on sexual risk behavior of low-income STD patients. *AIDS Educ Prev*. 1998;10(6):483-492.
  80. Otto Salaj LL, Kelly JA, Stevenson LY, Hoffmann R, Kalichman SC. Outcomes of a randomized small-group HIV prevention intervention trial for people with serious mental illness. *Community Ment Health J*. 2001;37(2):123-144.
  81. Pauw J, Ferrie J, Villegas RR, Martinez JM, Gorter A, Egger M. A controlled HIV/AIDS-related health education programme in Managua, Nicaragua. *AIDS*. 1996;10:537-544.
  82. Pearlman DN, Camberg L, Wallace LJ, Symons P, Finison L. Tapping youth as agents for change: evaluation of a peer leadership HIV/AIDS intervention. *J Adolesc Health*. 2002;31(1):31-39.
  83. Peeler CM. *An Analysis of the Effects of a Course Designed to Reduce the Frequency of High-risk Sexual Behavior and Heavy Drinking* [dissertation]. Pullman, WA: Washington State University; 2000.
  84. Pereira LM. *Risk and Relationship: Examining the Outcomes of Couples-based HIV Prevention Among Low-income Men of Color in Heterosexual Relationships* [dissertation]. New York: Columbia University; 2001.
  85. Picciano JF, Roffman RA, Kalichman SC, Rutledge SE, Berghuis JP. A telephone based brief intervention using motivational enhancement to facilitate HIV risk reduction among MSM: a pilot study. *AIDS Behav*. 2001;5(3):251-262.
  86. Reikowski DJ. *A Behavior and Cognitive Intervention for AIDS Prevention* [dissertation]. Stanford, CA: School of Education, Stanford University; 1994.
  87. Roffman R, Picciano J, Ryan R, et al. HIV-prevention group counseling delivered by telephone: an efficacy trial with gay and bisexual men. *AIDS Behav*. 1997;1(2):137-154.
  88. Roffman RA, Stephens RS, Curtin L, et al. Relapse prevention as an intervention model for HIV risk reduction in gay and bisexual men. *AIDS Educ Prev*. 1998;10(1):1-18.
  89. Rosengard C. *Safer-sex Behavior Change in College Students: A Theory-driven Strategy for Designing AIDS-risk Reduction Interventions*. Storrs, CT: University of Connecticut, 1994.
  90. Rosser BRS, Bockting WO, Rugg DL, et al. A randomized controlled intervention trial of a sexual health approach to long-term HIV risk reduction for men who have sex with men: effects of the intervention on unsafe sexual behavior. *AIDS Educ Prev*. 1999;14(3 suppl A): 59-71.
  91. Rosser BRS, Bockting WO, Rugg DL, et al. A randomized controlled intervention trial of a sexual health approach to long-term HIV risk reduction for men who have sex with men: effects of the intervention on unsafe sexual behavior. *AIDS Educ Prev*. 2002;14(3 suppl A):59-71.
  92. Rotheram-Borus MJ, Koopman C, Haignere C, Davies M. Reducing HIV sexual risk behaviors among runaway adolescents. *J Am Med Assoc*. 1991;266(9):1237-1241.
  93. Rotheram-Borus MJ, Murphy DA, Fernandez I, Srinivasan S. A brief

- HIV intervention for adolescents and young adults. *Am J Orthopsychiatry*. 1998;68(4):553-564.
94. Rotheram-Borus MJ, Van Rossem V, Lee M, Gwadz M, Koopman C. Reductions in HIV risk among runaway youth. Unpublished. 1998.
  95. Sangiwa G, Balmer D, Furlong C, et al. Voluntary HIV counseling and testing (VCT) reduced risk behavior in developing countries: results from the voluntary counseling and testing study. Presented at the XII International AIDS Conference; June-July 1998; Geneva.
  96. Saxon AJ, Calsyn DA. Alcohol use and high-risk behavior by intravenous drug users in an AIDS education paradigm. *J Stud Alcohol*. 1991;53:611-618.
  97. Sherry J. *AIDS Education and Adolescent Sexual Self-efficacy and Behavior* [dissertation]. New York: Fordham University; 1997.
  98. Simpson DD, Camacho LM, Vogtsberger KN, et al. Reducing AIDS risks through community outreach interventions for drug injections. *Psychol Addict Behav*. 1994;8(2):86-101.
  99. Slonim Nevo V. The effect of HIV/AIDS prevention intervention for Israeli adolescents in residential centers: results at 12-month follow-up. *Soc Work Res*. 2001;25(2):71-88.
  100. Smith MU, Dane FC, Archer ME, Devereaux RS, Katner HP. Students together against negative decisions (STAND): evaluation of a school-based sexual risk reduction intervention in the rural south. *AIDS Educ Prev*. 2000;12(1):49-70.
  101. Sorenson JL, London J, Hetziman C, et al. Psychoeducational group approach: HIV risk reduction in drug users. *AIDS Educ Prev*. 1994;6(2):95-112.
  102. Speizer IS, Tambashe BO, Tegang SP. An evaluation of the "Entre Nous Jeunes" peer-educator program for adolescents in Cameroon. *Stud Fam Plann*. 2001;32(4):339-351.
  103. St. Lawrence J, Brasfield T, Jefferson K, Alleyne E, O'Bannon R. Cognitive-behavioral intervention to reduce African American adolescents' risk for HIV education. *J Consult Clin Psychol*. 1995;63(2):221-237.
  104. Stanton BF, Li X, Galbraith J, Feigelman S, Kaljee L. Sexually transmitted diseases, human immunodeficiency virus, and pregnancy prevention. *Arch Pediatr Adolesc Med*. 1996;150:17-24.
  105. Sterk CE, Theall KP, Elifson KW, Kidder D. HIV risk reduction among African-American women who inject drugs: A randomized controlled trial. *AIDS Behav*. 2003;7(1):73-86.
  106. Sterk CE, Theall KP, Elifson KW. Effectiveness of a risk reduction intervention among African American women who use crack cocaine. *AIDS Educ Prev*. 2003;15:15-32.
  107. Suarez-Al-Adam M, Raffaelli M, O'Leary A. Influence of abuse and partner hypermasculinity on the sexual behavior of Latinas: results from an HIV preventive intervention. *AIDS Educ Prev*. 2000;12:263-274.
  108. Swanson JM, Dibble SL, Chapman L. Effects of psycho-educational interventions on sexual health risks and psycho-social adaptation in young adults with genital herpes. *J Adv Nurs*. 1999;29(4):840-851.
  109. Thomas N. *The Effectiveness of a Peer-led, Self-management Program on Reducing AIDS Risk in College Students* [dissertation]. Pullman, WA: Washington State University; 1997.
  110. Thompson SC, Kyle D, Swan J, Thomas C, Vrungos S. Increasing condom use by undermining perceived invulnerability to HIV. *AIDS Educ Prev*. 2002;14(6):505-514.
  111. Tudiver F, Myers T, Kurtz RG, et al. The talking sex project. *Eval Health Prof*. 1992;15(4):26-42.
  112. Turner J, Korpita E, Mohn L. Reduction in sexual risk behaviors among college students following a comprehensive health education intervention. *J Am Coll Health*. 1993;41:187-193.
  113. Turner JC, Garrison CZ, Korpita E, et al. Promoting responsible sexual behavior through a college freshman seminar. *AIDS Educ Prev*. 1994;6(3):266-277.
  114. Walter HJ, Vaughan RD. AIDS risk reduction among a multiethnic sample of urban high school students. *J Am Med Assoc*. 1993;270(6):725-730.
  115. Warren WK, King AJC. Social Program Evaluation Group. *Development and Evaluation of an AIDS/STD/Sexuality Program for Grade 9 Students*. Kingston: Queen's University; June 1994. NHRDP 6613-1502 and 6613-1503.
  116. Weeks K, Levy S, Gordon A, Handler A, Perhats C, Flay B. Does parental involvement make a difference? The impact of parent interactive activities on students in a school-based AIDS prevention program. *AIDS Educ Prev*. 1997;9(suppl A):90-106.
  117. Wenger NS, Linn LS, Epstein M, Shapiro MF. Reduction of high-risk sexual behavior among heterosexuals undergoing HIV antibody testing: a randomized clinical trial. *Am J Public Health*. 1991;81(12):1580-1585.
  118. Wenger NS, Greenberg JM, Hilborne LH, Kusseling F, Mangotich M, Shaprio MF. Effect of HIV antibody testing and AIDS education on communication about HIV risk and sexual behavior. *Ann Intern Med*. 1992;117(11):905-911.
  119. Wight D, Raab GM, Henderson M. Limits of teacher delivered sex education: interim behavioral outcomes from randomized trial. *Br Med J*. 2002;324(7351):1430-1433.
  120. Wilson D, Zondo S, Lavell S. An experimental evaluation of a high fear AIDS education tool: a colour atlas of AIDS in the tropics. Presented in International Conference on AIDS; July 19-24, 1992; Netherlands.
  121. Wilson D, Mparadzi A, Lavelle S. An experimental comparison of two AIDS prevention interventions among young Zimbabweans. *J Soc Psychol*. 1992;132:415-417.
  122. Xiaoming S, Yong W, Choi KH, Lurie P, Mandel J. Integrating HIV prevention education into existing family planning services: results of a controlled trial of a community-level intervention for young adults in rural China. *AIDS Behav*. 2000;4(1):103-110.
  123. Zemke SE. *The Effects of Leading an HIV Intervention Group: Do Peer Leaders Practice What They Preach?* [dissertation]. Pullman, WA: Washington State University; 1997.
  124. Zimmers E, Privette G, Lowe RH, Chappa F. Increasing use of the female condom through video instruction. *Percept Mot Skills*. 1999;88:1071-1077.
  125. Crepez N, Hart TA, Marks G. Highly active antiretroviral therapy and sexual risk behavior. *J Amer Med Assoc*. 2004;292:224-236.
  126. Weinhardt LS, Carey MP, Johnson BT, Bickham NL. Effects of HIV counseling and testing on sexual risk behavior: a meta-analytic review of published research, 1985-1997. *Am J Public Health*. 1999;89:1397-1405.
  127. Johnson BT, Carey MP, Marsh KL, Levin KD, Scott-Sheldon LAJ. Interventions to reduce sexual risk for the human immunodeficiency virus in adolescents, 1985-2000. *Arch Pediatr Adolesc Med*. 2003;157:381-388.
  128. Johnson BT. *DSTAT 1.10: Software for the Meta-analytic Review of Research Literatures*. Hillsdale, NJ: Erlbaum, 1993.
  129. Sanchez-Meca J, Marin-Martinez F, Chacon-Moscoso S. Effect-size indices for dichotomized outcomes in meta-analysis. *Psychol Methods*. 2003;8:448-467.
  130. Hedges LV, Olkin I. *Statistical Methods for Meta-analysis*. Orlando, FL: Academic Press, 1995.
  131. Lipsey MW, Wilson DB. *Practical Meta-Analysis*. Thousand Oaks, CA: Sage Publications, 2001.
  132. Johnson BT, Eagly AH. Quantitative synthesis of social psychological research. In: Reis HT, Judd CM, eds. *Handbook of Research Methods in Social and Personality Psychology*. New York: Cambridge University Press, 2000:496-528.
  133. Kalichman SC, Carey MP, Johnson BT. Prevention of sexually transmitted HIV infection: a meta-analytic review and critique of the theory-based intervention outcome literature. *Ann Behav Med*. 1996;18:6-15.
  134. Logan TK, Cole J, Leukefeld C. Women, sex, and HIV: social and contextual factors, meta analysis of published interventions, and implications for practice and research. *Psychol Bull*. 2002;128:851-885.
  135. Mullen PD, Ramirez G, Strouse D, Hedges LV, Sogolow E. Meta-analysis of the effects of behavioral HIV prevention interventions on the sexual risk behavior of sexually experienced adolescents in controlled studies in the United States. *J Acquir Immune Defic Syndr*. 2002;30:94-105.
  136. Neumann MS, Johnson WD, Semaan S, Flores SA, Peersman G, Hedges LV, Sogolow E. Review and meta-analysis of HIV prevention intervention research for heterosexual adult populations in the United States. *J Acquir Immune Defic Syndr*. 2002;30:106-117.
  137. Johnson BT, Carey MP, Chaudoir SR, Reid AE. Sexual risk reduction for persons living with HIV: research synthesis of randomized controlled trials, 1993-2004. *J AIDS*. In press.

138. Center for Disease Control. HIV/AIDS Among African Americans. Available at: <http://www.cdc.gov/hiv/pubs/facts/afam.htm>. Accessed August 17, 2005.
139. Carey MP, Braaten L, Jaworski B, Durant L, Forsyth AD. HIV and AIDS relative to other health, social, and relationship concerns among low-income urban women. *J Womens Health Gen Based Med*. 1999;8:657-661.
140. Kalichman SC, Cain D. Perceptions of local HIV/AIDS prevalence and risks for HIV/AIDS and other sexually transmitted infections: preliminary study of intuitive epidemiology. *Ann Behav Med*. 2005;29:100-105.
141. Fishbein M, Triandis HC, Kanfer FH, Becker M, Middlestadt SE, Eichler A. Factors influencing behavior and behavior change. In: Baum A, Revenson TA, Singer JE, eds. *Handbook of Health Psychology*. Mahwah, NJ: Erlbaum, 2001:3-17.
142. Miller WR, Rollnick S. *Motivational Interviewing: Preparing People to Change Addictive Behavior*. New York: Guilford Press; 2001.
143. Carpenter MJ, Hughes JR, Solomon LJ, Callas PW. Both smoking reduction with nicotine replacement therapy and motivational advice increase future cessation among smokers unmotivated to quit. *J Consult Clin Psychol*. 2004;72:371-381.
144. Borsari B, Carey KB. Effects of a brief motivational intervention with college student drinkers. *J Consult Clin Psychol*. 2000;68:728-733.
145. Dunn C, Deroo L, Rivara FP. The use of brief interventions adapted from motivational interviewing across behavioral domains: a systematic review. *Addiction*. 2001;96:1725-1742.
146. Tevyaw TO, Monti PM. Motivational enhancement and other brief interventions for adolescent substance abuse: foundations, applications and evaluations. *Addiction*. 2004;99:63-75.
147. Carey MP, Braaten LS, Maisto SA, Gleason JR, Forsyth AD, Durant LE, Jaworski BC. Using information, motivational enhancement, and skills training to reduce the risk of HIV infection for low-income urban women: a second randomized clinical trial. *Health Psychol*. 2000;19:3-11.
148. Belcher L, Kalichman S, Topping M, Smith S, Emshoff J, Norris F, Nurss J. A randomized trial of a brief HIV risk reduction counseling intervention for women. *J Consult Clin Psychol*. 1998;66:856-861.
149. Kalichman SC. *Preventing AIDS: A Sourcebook for Behavioral Interventions*. Hillsdale, NJ: Erlbaum, 1998.
150. Kelly JA. *Changing HIV Risk Behavior: Practical Strategies*. New York: Guilford Press, 1995.
151. Kalichman SC, Cain D, Weinhardt LS, Benetsch E, Presser K, Zweben A, Bjodstrup B, Swain G. Experimental components analysis of brief theory-based HIV-AIDS risk reduction counseling for sexually transmitted infection patients. *Health Psychol*. 2005;24:198-208.

# In This Issue...

## BASIC SCIENCE

- Influence of Peak Viral Load on the Extent of CD4<sup>+</sup> T-Cell Depletion in Simian HIV Infection
- Density-Dependent Decay in HIV-1 Dynamics
- Cystatin A and HIV-1 p24 Antigen Expression in Tonsillar Lymphoid Follicles During HIV-1 Infection and During Highly Active Antiretroviral Therapy

## CLINICAL SCIENCE

- Efficacy of Antiretroviral Therapy Adherence Interventions: A Research Synthesis of Trials, 1996 to 2004
- Partial Treatment Interruption of Protease Inhibitor-Based Highly Active Antiretroviral Therapy Regimens in HIV-Infected Children

- Oxandrolone in the Treatment of HIV-Associated Weight Loss in Men: A Randomized, Double-Blind, Placebo-Controlled Study
- Repeated Measures Longitudinal Analyses of HIV Virologic Response as a Function of Percent Adherence, Dose Timing, Genotypic Sensitivity, and Other Factors
- Minimizing Resistance Consequences After Virologic Failure on Initial Combination Therapy: A Systematic Overview
- Neuroactive Antiretroviral Drugs Do Not Influence Neurocognitive Performance in Less Advanced HIV-Infected Patients Responding to Highly Active Antiretroviral Therapy
- Brief Report: Trends in Antiretroviral Drug Resistance and Clade Distributions Among HIV-1-Infected Blood Donors in Sao Paulo, Brazil

## EPIDEMIOLOGY & SOCIAL SCIENCE

- Conspiracy Beliefs About the Origin of HIV/AIDS in Four Racial/Ethnic Groups

- Molecular Analysis of gp41 Sequences of HIV Type 1 Subtype C From India
- The Calculated Genetic Barrier for Antiretroviral Drug Resistance Substitutions Is Largely Similar for Different HIV-1 Subtypes
- Trends in HIV Prevalence Among Pregnant Women in Italy, 1994 to 2002
- Nonnegligible Increasing Temporal Trends in Unprotected Anal Intercourse Among Men Who Have Sexual Relations With Other Men in Montreal
- Low HIV-1 Incidence Among Married Serodiscordant Couples in Pune, India
- Sexual Risk Reduction Interventions Do Not Inadvertently Increase the Overall Frequency of Sexual Behavior: A Meta-Analysis of 174 Studies With 116,735 Participants
- Correlates of Self-Reported Nonadherence to Antiretroviral Therapy in HIV-Infected Patients: The Swiss HIV Cohort Study



LIPPINCOTT  
WILLIAMS & WILKINS

EDITORS-IN-CHIEF

David D. Ho, M.D. • Paul A. Volberding, M.D. • William A. Blattner, M.D.