

Interventions to Reduce Sexual Risk for the Human Immunodeficiency Virus in Adolescents, 1985-2000

A Research Synthesis

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Objective: To summarize studies that have tested the efficacy of human immunodeficiency virus (HIV) sexual risk-reduction interventions in adolescents.

Data Sources: Reports were gathered from computerized databases, by contacting individual researchers, by searching conference proceedings and relevant journals, and by reviewing reference sections of obtained articles.

Study Selection: Studies were included if they investigated any educational, psychosocial, or behavioral intervention advocating sexual risk reduction for HIV prevention; used experimental designs (or other designs with adequate comparison groups); had behavioral-dependent measures relevant to sexual risk; sampled adolescents (age range, 11-18 years); and had sufficient information to calculate effect size (ES) estimates. Data from 44 studies and 56 interventions (N=35 282 participants) that were available as of January 2, 2001, were included.

Data Extraction: Study information was coded, and individual ESs were calculated in SD units (the difference between the intervention and comparison condition means, divided by the pooled SD), with ESs coded so that positive signs indicated greater risk reduction.

Data Synthesis: Across the studies, reductions in sexual risk were greater for adolescents who received the HIV risk-reduction intervention compared with those in the comparison conditions for 5 dimensions: condom use negotiation skills (mean ES, 0.50; 95% confidence interval [CI], 0.41-0.59), condom use skills (mean ES, 0.30; 95% CI, 0.09-0.51), communications with sexual partners (mean ES, 0.27; 95% CI, 0.19-0.36), condom use (mean ES, 0.07; 95% CI, 0.03-0.11), and sexual frequency (mean ES, 0.05; 95% CI, 0.02-0.09). Interventions achieved greater success with condom use (1) in noninstitutionalized populations, (2) when condoms were provided, (3) with more condom information and skills training, (4) when the comparison group received less HIV skills training, and (5) when the comparison group received more non-HIV-related sexual education.

Conclusion: Intensive behavioral interventions reduced sexual HIV risk, especially because they increased skill acquisition, sexual communications, and condom use and decreased the onset of sexual intercourse or the number of sexual partners.

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HUMAN IMMUNODEFICIENCY virus (HIV) infections continue to occur at a high rate in the United States and worldwide, with nearly half of all new infections in the United States occurring among young people between the ages of 13 and 24 years.¹ An essential step in controlling the pandemic of HIV is helping adolescents reduce or avoid sexual risk behavior. Providing adolescents with the information, motivation, and interpersonal skills needed to avoid sexual risk (eg, to abstain) and reduce risk (eg, use condoms) is an important aspect of reducing the spread of HIV.²

Behavioral interventions to reduce the sexual risk of contracting HIV typically involve interactions between physicians or educators and participants in contexts in

which exposure to risk-reduction messages is ensured (eg, clinics or classrooms). Risk-reduction strategies vary from broad and diffused dispersion of factual information about HIV to frank discussions of condom use for reducing HIV risk to small-group interventions to enhance motivation and relevant skills. Such motivation- and skills-based strategies best match the tenets of theories of HIV risk reduction.²⁻⁵

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In the present study, we used meta-analytic techniques^{4,6} to examine the extent to which the numerous HIV risk-reduction interventions have been successful at modifying behaviors that place adolescents at risk for HIV. An in

dication of successful risk reduction was taken from self-reports of behaviors such as condom use, sexual activity, communication with sexual partners, and other behavioral markers, and from objective measurements of skills (at using condoms or at the ability to negotiate condom use with partners). This study also tested predictions that risk reduction should improve in same-sex groups, with messages matched to the participants' needs, in non-school-related settings, and with larger intervention doses. We also examined the extent to which effectiveness depends on participant features, such as sex and race or ethnicity. Knowing the relative effectiveness for different sex and ethnic groups will help to describe whether extant interventions are meeting the needs of different subgroups of adolescents.

METHODS

SAMPLE OF STUDIES

We searched for relevant studies through the simultaneous use of several strategies: (1) searching electronic reference databases (MEDLINE, PsychINFO, AIDSLINE, CINAHL, Dissertations Abstracts Online, and ERIC) through December 15, 2000, (2) requests for papers sent to individual researchers and to e-mail list serves, (3) searching reference sections of obtained articles, (4) manually searching through conference proceedings (eg, those of the American Public Health Association), and (5) manually searching through recent issues of journals likely to publish intervention results (eg, *AIDS Education and Prevention: Official Publication of the International Society for AIDS Education*; *American Journal of Public Health*; *Archives of Pediatrics & Adolescent Medicine*; *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*; *Journal of Consulting and Clinical Psychology*; and *JAMA: The Journal of the American Medical Association*). Studies that matched the selection criteria and that were available as of January 2, 2001, were included.

SELECTION CRITERIA

To qualify for the sample, studies or portions of studies had to (1) evaluate an intensive educational, psychosocial, or behavioral intervention advocating sexual risk reduction for HIV prevention; (2) use a randomized controlled trial or a quasi-experimental design with rigorous controls; (3) have specific behavioral-dependent measures relevant to sexual risk; (4) have sampled from adolescents (precollege); and (5) provide sufficient information to calculate effect size (ES) estimates. Excluded were interventions that did not emphasize HIV content (eg, some abstinence programs, pregnancy prevention programs, and interventions conducted before the HIV pandemic) and extremely brief interventions for which message exposure was not ensured (eg, pamphlet studies). Also omitted were measures that were not specific to a particular sexual behavior (eg, general composite measures). In 22 studies, information was not sufficient to calculate ESs, but queries to these authors were generally successful, so 12 (55%) of these studies were retained. One report remained under embargo and is, therefore, not included in the analyses; the results were not significantly altered by its exclusion. Use of these criteria resulted in 45 independent studies,⁷⁻³¹ which included 56 separate interventions using 35 282 participants. Each intervention was treated as an individual study.

STUDY INFORMATION

Two raters independently coded each study to describe the studies and to determine in stratified analyses whether variation in

ESs can be attributed to features of the studies. Across the study- and intervention-level categorical dimensions, coders agreed on 73% to 95% of judgments, with average κ values of 0.54 for variables coded with 80% or less agreement and 0.75 for variables coded with greater than 80% agreement. 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.⁵² The effective reliability was good, ranging from 0.86 to 1.00, with an average across categories of 0.91.

Estimates of the ES for each study were calculated from the information provided in the report or from the authors. Effect sizes were calculated in SD units because studies nearly always used parametric statistical tests with continuous measures of intervention effectiveness (eg, number of partners in the past 3 months).³³ Specifically, the ES was calculated as the difference between the intervention and comparison groups, divided by the pooled SD; ESs were corrected for sample size bias.^{53,54} Signs of ESs were set so that positive values implied greater risk reduction. If more than one comparison group was available in the study, we used as the comparison the one most similar to the modal comparison group in the literature (eg, a wait list control group rather than a weakened-dose HIV risk-reduction intervention).

We calculated multiple ESs from individual studies when they had more than one behavioral measure or results separated by sex. We analyzed 2 categories of behavioral outcomes, one resulting from self-reports and one resulting from objective measures. The self-reported outcomes included (1) condom use (for anal, vaginal, or unspecified sex), (2) sexual frequency (general sex frequency or occasions, number of sexual partners, and delay or abstinence), and (3) communication (regarding sexual risk). The objective outcomes included (1) condom use skills or interpersonal communication skills (eg, negotiating condom use assertively by role-playing) and (2) indirect behavioral markers (acquired preventative prophylactics, tests for HIV, and tests for other sexually transmitted diseases). We averaged the ESs resulting from multiple measures of the same outcome.

We analyzed ESs using conventional fixed-effects meta-analytic procedures for each category of outcomes.^{53,55} Thus, each ES was weighted by the inverse of its variance to produce a weighted mean ES; we calculated 95% confidence intervals for each mean ES and estimated the homogeneity of the set of ESs that compose the mean. For ease of interpretation, the captions to **Figure 1** and **Figure 2** provide the equivalent odds ratio (OR), the ratio of the proportion of adolescents in the intervention condition who reduced risk relative to the comparison condition, for each mean ES. This value is derived from the equation by Chinn⁵⁶: $OR = \text{exponential}(ES \times 1.81)$. We used least squares regression models of the condom use ES values, weighting for inverse of the variance of each ES, to examine whether variability in ES values depended on studies' use of certain methods or participants. We then pursued a multiple regression model, which controls for intercorrelations among the maintained study dimensions. In multiple regression models, missing study information was imputed with mean replacement; no more than 12% of the values for any given dimension required imputation, and most (81%) required no imputation.

RESULTS

DESCRIPTION OF THE STUDIES AND THEIR INTERVENTIONS

Of the 44 studies reviewed, 27 (61%) advocated behavioral theory to reduce risk, 38 (86%) were published in journals, and 37 (84%) were conducted in North America.

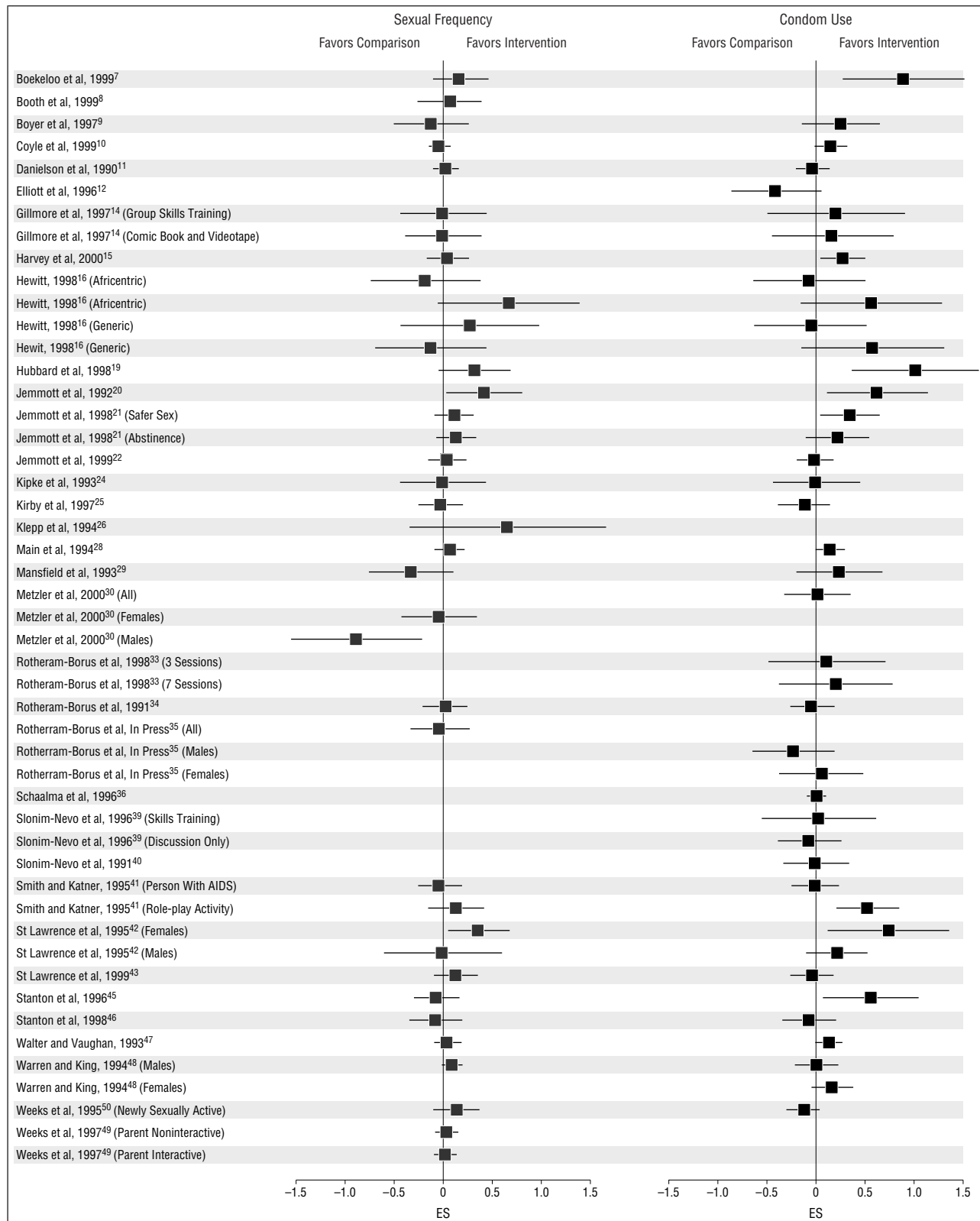


Figure 1. Forest plots of effect sizes (ESs) and their 95% confidence intervals (CIs) for the outcomes of sexual frequency (left) and condom use (right). For sexual frequency (38 interventions), the mean ES was 0.05 (95% CI, 0.02-0.09) ($P = .39$ for homogeneity); the odds ratio (OR) was 1.10 (95% CI, 1.04-1.17). For condom use (42 interventions), the mean ES was 0.07 (95% CI, 0.03-0.11) ($P < .001$ for homogeneity); the OR was 1.13 (95% CI, 1.06-1.21). AIDS indicates acquired immunodeficiency syndrome.

Thirty-four (77%) of the studies were conducted in medium to large cities, and 38 (86%) used primarily school or community contexts for their data collection. The age of the

samples averaged 15 years (range, 11-18 years); participants were predominately of African American or African background (52.7%) and sexually active (55.6%). Few

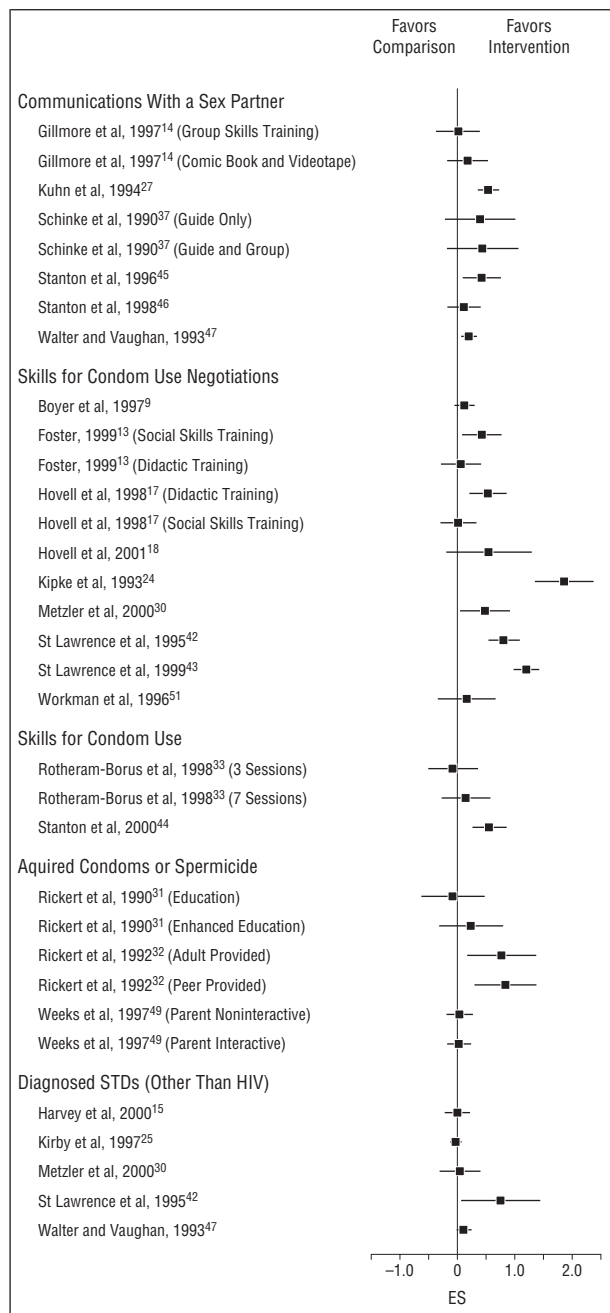


Figure 2. Forest plots of effect sizes (ESs) and their 95% confidence intervals (CIs) for 5 outcomes. For communications with a sex partner (8 interventions), the mean ES was 0.27 (95% CI, 0.19-0.36) ($P=.06$ for homogeneity); the odds ratio (OR) was 1.64 (95% CI, 1.40-1.93). For skills for condom use negotiations (11 interventions), the mean ES was 0.50 (95% CI, 0.41-0.59) ($P<.001$ for homogeneity); the OR was 2.47 (95% CI, 2.09-2.92). For skills for condom use (3 interventions), the mean ES was 0.30 (95% CI, 0.09-0.51) ($P=.04$ for homogeneity); the OR was 1.72 (95% CI, 1.18-2.53). For acquired condoms or spermicide (6 interventions), the mean ES was 0.13 (95% CI, -0.01 to 0.26) ($P=.02$ for homogeneity); the OR was 1.25 (95% CI, 0.98-1.60). For diagnosed sexually transmitted diseases (STDs) (other than the human immunodeficiency virus [HIV]) (5 interventions), the mean ES was 0.03 (95% CI, -0.04 to 0.11) ($P=.13$ for homogeneity); the OR was 1.06 (95% CI, 0.93-1.22).

studies sampled adolescents who were known to engage in the sex trade (4 [9%]), to be incarcerated (2 [5%]), or to have a mental illness (1 [2%]). More commonly, the studies sampled adolescents who used illegal drugs (17 [39%]) or who drank alcohol (16 [36%]). Thirty-four

(77%) of the studies used randomization to achieve experimental control; the control condition was most often a wait list (23 [52%]), but a sexual education comparison was also common (13 [30%]). Nearly half of the studies (20 [45%]) attempted to control bias by increasing the anonymity of the participants or by using nonintervention personnel to collect responses. For the present analyses, the measures were taken at a mean of 14.1 weeks from the point of the intervention (range, 0-88 weeks).

Interventions averaged about 12 participants in a session, met for a median of 4 sessions of 50 minutes each, and had a median of 1 facilitator. Most of the comparison groups (31 [70%]) were no-treatment, irrelevant-content, or wait-list controls, and they did not meet during the evaluation period; however, 13 studies (30%) used an alternative intervention as a comparison group and, for these interventions, the median number of sessions was 1, with a mean length of 54 minutes. All interventions (100%) provided HIV-related education, and often provided simple condom information and demonstrations (32 [59%]) and/or active interpersonal skills training (37 [68%]). Interventions only infrequently emphasized active condom-use (14 [25%]) and intrapersonal skills (17 [36%]). Similarly, only 14 (25%) of the interventions measured actual skills; of these, 11 assessed skills at communicating with sexual partners about risks and 3 assessed skills at using condoms. Only 13 (30%) of the reports stated that preliminary research was used to tailor the intervention's content to the participants, and only 12 (22%) explicitly matched the ethnicity of the facilitator to that of the participants. Finally, only 10 (18%) of the interventions provided condoms as part of the intervention or in the comparison group, but when they did provide condoms, they nearly always provided them to both groups.

DID THE INTERVENTIONS WORK?

Relative to comparison conditions, interventions significantly enhanced (1) participants' skills for sexual risk communications, (2) skills for condom use, (3) the quantity of sexual risk communications, and (4) participants' condom use; interventions also reduced sexual frequency outcomes (Figures 1 and 2).

Only 12 studies examined behavioral markers; in these studies, there was no constant intervention effect on acquisitions of condoms or spermicide, being diagnosed as having a sexually transmitted disease other than HIV, or, in the single study¹⁰ that examined this outcome, obtaining tests for HIV. Across all studies and outcomes, only 1 result (from 115 comparisons) significantly favored the comparison condition.³⁰

WHAT INTERVENTION DIMENSIONS EXPLAIN VARIATIONS IN CONDOM USE OUTCOMES?

Because condom use is a key prevention strategy, and because this category of outcomes exhibited significant heterogeneity and presented sufficient studies, we concentrated further analyses on identifying methodological and participant characteristics that explain variability in the magnitude of ESs. No significant relations of the following dimensions appeared: group size, use of primarily one-

on-one vs group processes, stated use of pretesting to tailor the intervention's content to the participants, matching the ethnicity of facilitators to participants, matching the sex of facilitators to participants, using same-sex groups, using peers as facilitators, the sex or racial composition of the sample, use of a randomized controlled design, the amount of attrition in the intervention group, the degree of self-selection among participants, the mean age of each sample, and use of classroom vs nonclassroom settings. Effect sizes also were unrelated to the interval that passed between the intervention's end and the first measurement of condom use outcomes.

Seven factors were related to the success of the interventions in improving condom use; however, 2 were reduced to nonsignificance when other factors were controlled (ie, sample size and use of the behavioral theory to design the intervention). The remaining 5 study dimensions together explained 35% of the variation in the ESs, leaving only a marginally significant amount of variation in ESs unexplained ($P = .06$ for homogeneity). Adjusted mean ESs from this model show how intervention success depended on each of these 5 dimensions, holding variation on the other dimensions constant (**Table**). First, interventions implemented with institutionalized adolescents showed no change relative to the comparison group, whereas those with noninstitutionalized participants exhibited significant risk reduction. Second, interventions that provided condoms to participants improved condom use in the intervention group relative to the comparison group, whereas those that did not provide condoms showed no significant improvement. Third, as studies spent more time per intervention session on active condom instruction and training, they achieved greater success. The last 2 factors concerned the forms and dosage of training in the comparison conditions. Thus, fourth, studies in which the comparison groups spent more time per session in HIV-related skills training were associated with less intervention success. Finally, studies with comparison conditions that spent more time per session on non-HIV content (generic sex education) were associated with increased risk reduction.

COMMENT

Overall, the results of this review of controlled studies support the conclusion that behavioral interventions for HIV prevention in adolescents are successful at reducing the risk for acquiring HIV, as measured by condom use, sexual frequency outcomes (delay or abstinence from sexual intercourse), communication with sexual partners, and objectively measured condom use and negotiation skills. The results were relatively consistent for sexual frequency outcomes, but less consistent for most other study outcome dimensions (Figures 1 and 2). Although sexual risk reduction clearly occurred as a result of the behavioral interventions described in this literature, the magnitude of the reduction was small for the 2 most critical risk-reduction outcomes, sexual frequency (mean ES, 0.05; OR, 1.10) and condom use (mean ES, 0.07; OR, 1.13). These effects were small enough that across the entire literature, only 5 interventions yielded significant ESs for these measures.

Condom Use ESs as a Function of Participant and Study Characteristics*

| Study Dimension and Level† | Adjusted Mean ES (95% CI)‡ |
|------------------------------------------------------------------------|----------------------------|
| Used institutionalized participants | |
| Yes | .04 (-.10 to .17) |
| No | .20 (.10 to .30) |
| Provided condoms to participants | |
| Yes | 0.23 (0.04 to 0.41) |
| No | 0.01 (-0.06 to 0.07) |
| Provided condom skills training to the intervention group, min/session | |
| 0 | 0.08 (-0.02 to 0.18) |
| 30 | 0.25 (0.11 to 0.40) |
| 60 | 0.43 (0.18 to 0.68) |
| Provided HIV skills training to the comparison group, min/session | |
| 0 | 0.14 (0.03 to 0.24) |
| 15 | 0.00 (-0.14 to 0.14) |
| 30 | -0.14 (-0.37 to 0.09) |
| 45 | -0.27 (-0.61 to 0.06) |
| Provided generic sexual education to the comparison group, min/session | |
| 0 | 0.10 (-0.01 to 0.20) |
| 60 | 0.15 (-0.04 to 0.25) |
| 120 | 0.20 (0.06 to 0.33) |

Abbreviations: CI, confidence interval; ES, effect size; HIV, human immunodeficiency virus.

*Condom use ESs for 42 interventions were modeled as the dependent variable in a weighted least-squares multiple regression, with each listed study dimension simultaneously entered as an independent variable; weights are the inverse of each ES's variance. Positive ESs imply greater risk reduction for the intervention group than for the comparison group. The complete regression equation was as follows: $0.0781 - (0.0819 \times \text{institutionalization}) + (0.1089 \times \text{condoms provided}) + (0.3442 \times \text{number of hours per session of condom skills training in the intervention group}) - (0.5468 \times \text{number of hours of session of HIV skills training in the comparison group}) + (0.0498 \times \text{sexual education hours per session})$. In this equation, categorical dimensions were contrast coded for institutionalization; 1 indicates yes and -1, no; and for condoms provided, 1 indicates yes and -1, no.

†Levels represent discrete observed categories (first 2 dimensions) or representative values along the continuous levels observed (last 3 dimensions).

‡Adjusted (statistically controlling) for the presence of other study dimensions.

Given the modest reductions observed, it may be tempting to conclude that sexual risk reduction in adolescents is a singularly difficult matter; however, it first should be recognized that risk reduction and behavior change are nearly always challenging. Prior meta-analytic reviews of adolescent health promotion studies that have assessed behavioral outcomes have obtained effects of similar magnitude. For example, meta-analytic studies^{57,58} on adolescent smoking prevention programs have found ESs ranging from 0.04 to 0.39; values of 0.01 to 0.06 have been found for pregnancy prevention programs⁵⁹ and of 0.08 to 0.16 for drug prevention programs.⁶⁰ A separate review⁶¹ of the pregnancy prevention studies among adolescents showed nonsignificant reductions (eg, for the initiation of sexual intercourse, an ES of 0.09 was found for young women and -0.01 for young men). These findings, together with the present overall results, corroborate the notions that adolescents often do not recognize their vulnerability to health threats,

What This Study Adds

Many studies have evaluated behavioral interventions emphasizing risk-related information and skills training to reduce the sexual risk of HIV transmission in adolescents, but the efficacy of these interventions and the reasons for varying efficacy across studies have been unknown.

We performed a systematic meta-analytic review of controlled trials in the literature meeting strict selection criteria to examine the efficacy of behavioral interventions at reducing risk for HIV transmission. The results indicate that behavioral interventions (1) improved adolescents' skills in negotiating lower-risk sexual encounters, (2) increased the frequency of communications with sexual partners about safer sex, (3) promoted the acquisition of condoms or spermicides, (4) reduced sexual frequency outcomes, and (5) increased condom use. Condom use increased most among noninstitutionalized adolescents who were provided condoms and who received active training in the skills needed to use and negotiate condom use with a partner. Finally, behavioral interventions that pursue these strategies do not increase the frequency of sexual behavior, the number of sexual partners, or the onset of sexual debut.

including HIV, and that sexual exploration and some risk taking are developmentally normative.⁶²

Because we had substantially more studies than prior syntheses^{62,63} of the adolescent literature have sampled (45 studies rather than, for instance, 16⁶³), our review was able to detect factors that were associated with intervention success. In particular, our condom use results help to explain why studies may have produced small effects, and suggest strategies to enhance intervention efficacy. First, interventions succeed better with noninstitutionalized than with institutionalized participants. It is a significant hurdle in achieving risk reduction when the adolescents who take part in interventions are (involuntary) residents of centers for runaways or correctional facilities for juvenile offenders. Interventions tailored to the unique needs and circumstances of institutionalized youth need to be developed and evaluated. Second, providing condoms increases their use, but only when paired with a behavioral risk-reduction intervention; no such tendency was observed for the comparison group participants. Our analyses revealed that providing condoms did not accelerate the onset of sexual debut nor increase the number of sexual partners, corroborating others' findings⁶⁴ and allaying concerns about the iatrogenic effects of behavioral interventions to reduce risk.

Third, more condom skills training resulted in more condom use. Even though the intervention group received relatively brief amounts of training (eg, 15-20 minutes per session), the pattern was still observed and it remained regardless of the number of sessions in which participants received training. Adolescents are able to benefit even from a single skills-training session. Fourth, and paralleling the third finding, the amount of HIV risk training in the control group reduced the observed effect. Risk reduction was observed in those interventions that pro-

vided weakened doses of information or skills to their comparison groups.⁶⁵ Consequently, the comparison to the intervention group grew smaller than it would have been if the comparison groups received no such training. Finally, and perhaps most intriguingly, when those in the comparison conditions received only generic sexual education (ie, without specific HIV content), the magnitude of observed intervention effects actually increased. This result is our clearest indication that information alone is insufficient to alter condom use behavior.

Because no single study combined optimal levels of all 5 of these factors, it seems a reasonable inference that greater risk reduction is possible if a single intervention were to have optimal levels of each factor. For example, a study that samples noninstitutionalized adolescents and uses an intervention that provides condoms and 1 hour of active instruction in condom information and skills ought to improve condom use by 0.61 SDs (OR, 3.02) relative to a comparison group that receives no HIV-specific education or skills training.

The effects of the behavioral interventions were larger when measured by condom use skills (mean ES, 0.30; OR, 1.72), sexual communication skills (mean ES, 0.50; OR, 2.47), and communications outcomes (mean ES, 0.27; OR, 1.64) than by the other outcomes. These findings indicate that interventions are on average successful, but they leave a question: Why do sexual behavior measures, which are the most important public health outcomes, show less success than the skills or communications outcomes? Skills and communications are temporally before actual risk behavior and should predispose individuals to greater risk reduction. One answer to the question is that the skills assessments address only the individual half of the risk situation—sexual partners are omitted from the equation—whereas the other measures reflect the action of dyads. The communication measures reflect the dyadic interaction, but fall short of reflecting actual sexual behavior. Another answer is that it is simply easier to display condom use skills on intervention measures than to use them in the emotional and sexually charged context. Research to develop risk-reduction strategies tailored to such high arousal contexts is needed.

The present results are encouraging in that well-trained facilitators, regardless of their race or ethnicity, can assist adolescents in their risk-reduction efforts. As Jemmott and Jemmott⁶⁶ discussed, most interventions are designed to be culturally sensitive. Similarly, because African Americans are at generally greater risk for acquiring HIV than are white Americans, it is heartening to see that interventions succeeded as well with this subgroup as with others. Yet, with 36 (82%) of the studies deriving from the United States, it is desirable to conduct future trials in a wider range of geographical regions and risk contexts. Indeed, the development, implementation, and evaluation of behavioral interventions for adolescents should be a high priority in those African and Asian countries that have been hit hardest by the pandemic or that report an accelerating incidence of HIV. Such interventions—if informed by behavioral science theory and reasonably tailored to the local customs and traditions, sex, and developmental status—can be expected to avert many HIV infections among the world's most vulnerable youth.

In conclusion, recent HIV prevention theories emphasize behavioral skills as the most proximal determinant of risk behavior.² In this light, it is heartening that HIV risk-reduction interventions for adolescents clearly improve objectively measured skills, and lead to more self-reported sexual communications with partners. Fewer data are available to link skills acquisition with sexual behavior change and reduced incidence of sexually transmitted infections. Studies are needed to gather such data, but even while they are being conducted, the results of this meta-analysis are informative. Behavioral interventions that supplement accurate risk information and strengthen adolescents' interpersonal skills are most likely to reduce their risk for infection with HIV and other sexually transmitted infections.

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REFERENCES

1. *Youth and HIV/AIDS 2000: A New American Agenda*. Washington, DC: White House Press Office; 2000.
2. Fisher JD, Fisher WA. Theoretical approaches to individual-level change in HIV risk behavior. In: Peterson JL, DiClemente RJ, eds. *Handbook of HIV Prevention: AIDS Prevention and Mental Health*. New York, NY: Kluwer Academic Publishers; 2000:3-55.
3. Fishbein M. The role of theory in HIV prevention. *AIDS Care*. 2000;12:273-278.
4. Marsh KL, Johnson BT, Carey MP. Conducting meta-analyses of HIV prevention literatures from a theory-testing perspective. *Eval Health Prof*. 2001;24:255-276.
5. Marsh KL, Johnson BT, Carey MP. HIV/AIDS, adolescence. In: Gullotta TP, Bloom M, eds. *Encyclopedia of Primary Prevention and Health Promotion*. New York, NY: Kluwer Academic Publishers; 2003:548-554.
6. 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, NY: Cambridge University Press; 2000:496-528.
7. Boekeloo BO, Schamus LA, Simmens SJ, et al. A STD/HIV prevention trial among adolescents in managed care. *Pediatrics*. 1999;103:107-115.
8. Booth RE, Zhang Y, Kwiatkowski CF. The challenge of changing drug and sex risk behaviors of runaway and homeless adolescents. *Child Abuse Negl*. 1999;23:1295-1306.
9. 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;32:25-42.
10. 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;69:181-188.
11. Danielson R, Marcy S, Plunkett A, Wiest W, Greenlick MR. Reproductive health counseling for young men: what does it do? *Fam Plann Perspect*. 1990;22:115-121.
12. Elliott L, Gruer L, Farrow K, Henderson A, Cowan L. Theatre in AIDS education: a controlled study. *AIDS Care*. 1996;8:321-340.
13. Foster EV. *Social Skills Training in Relation to Safer Sex Behaviors Among Mexican-American and European-American Adolescents* [dissertation]. San Diego, Calif: School of Professional Psychology; 1999.
14. Gillmore MR, Morsion DM, Richey CA, Balassone ML, Gutierrez L, Farris M. Effects of a skill-based intervention to encourage condom use among high risk heterosexually active adolescents. *AIDS Educ Prev*. 1997;9(1 suppl):22-43.
15. Harvey B, Stuart J, Swan T. Evaluation of drama-in-education programme to increase AIDS awareness in South African high schools: a randomized community intervention trial. *Int J STD AIDS*. 2000;11:105-111.
16. Hewitt NB. *Africentricity, HIV Behavioral Intervention, and HIV Risk-Associated Behavior Among African-American Adolescents: A Randomized Controlled Trial* [dissertation]. Princeton, NJ: Princeton University; 1998.
17. Hovell MF, Blumberg EV, Sipan C, et al. Skills training for pregnancy and AIDS prevention in Anglo and Latino youth. *J Adolesc Health*. 1998;23:139-149.
18. Hovell MF, Blumberg EV, Liles S, et al. Training AIDS and anger prevention social skills in at-risk adolescents. *J Couns Dev*. 2001;79:347-355.
19. Hubbard BM, Giese ML, Rainey J. A replication study of Reducing the Risk, a theory-based sexuality curriculum for adolescents. *J Sch Health*. 1998;68:243-247.
20. Jemmott JB, Jemmott LS, Fong GT. Reductions in HIV risk-associated sexual behaviors among black male adolescents: effects of an AIDS prevention intervention. *Am J Public Health*. 1992;82:372-377.
21. Jemmott JB, Jemmott LS, Fong GT. Abstinence and safer sex HIV risk-reduction interventions for African American adolescents. *JAMA*. 1998;279:1529-1536.
22. Jemmott JB, Jemmott LS, Fong GT, McCaffree K. Reducing HIV risk-associated sexual behavior among African American adolescents: testing the generality of intervention effects. *Am J Community Psychol*. 1999;27:161-187.
23. Kindeberg T, Christensson B. Changing Swedish students' attitudes in relation to the AIDS epidemic. *Health Educ Res*. 1994;9:171-181.
24. Kipke MD, Boyer C, Hein K. An evaluation of an AIDS Risk Reduction Education and Skills Training (ARREST) program. *J Adolesc Health*. 1993;14:533-539.
25. 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.
26. Klepp K, Ndeki SS, Seha AM, et al. AIDS education for primary school children in Tanzania: an evaluation study. *AIDS*. 1994;8:1157-1162.
27. Kuhn L, Steinberg M, Matthews C. Participation of the school community in AIDS education: an evaluation of a high school programme in South Africa. *AIDS Care*. 1994;6:161-171.
28. 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.
29. Mansfield CJ, Conroy ME, Emans SJ, Woods ER. A pilot study of AIDS education and counseling of high-risk adolescents in an office setting. *J Adolesc Health*. 1993;14:115-119.
30. 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;31:27-54.
31. Rickert VI, Gottlieb AA, Jay MS. A comparison of three clinic-based AIDS education programs on female adolescents' knowledge, attitudes, and behavior. *J Adolesc Health*. 1990;11:298-303.
32. Rickert VI, Gottlieb AA, Jay MS. Is AIDS education related to condom acquisition? *Clin Pediatr (Phila)*. 1992;31:205-210.
33. Rotheram-Borus MJ, Gwadz M, Fernandez MI, Srinivasan S. Timing of HIV interventions on reductions in sexual risk among adolescents. *Am J Community Psychol*. 1998;26:73-96.
34. Rotheram-Borus MJ, Koopman C, Haignere C, Davies M. Reducing HIV sexual risk behaviors among runaway adolescents. *JAMA*. 1991;266:1237-1241.
35. Rotheram-Borus MJ, Song J, Gwadz M, Lee M, Van Rossem R, Koopman C. Reduction in HIV risk among runaway youths. *Prev Sci*. In press.
36. Schaalma HP, Kok G, Bosker RJ, et al. Planned development and evaluation of AIDS/STD education for secondary school students in the Netherlands: short-term effects. *Health Educ Q*. 1996;23:469-487.
37. Schinke SP, Gordon AN, Weston RE. Self-instruction to prevent HIV infection among African-American and Hispanic-American adolescents. *J Consult Clin Psychol*. 1990;58:432-436.
38. Siegel D, DiClemente R, Durbin M, Krasnovsky F, Saliba P. Change in junior high school students' AIDS-related knowledge, misconceptions, attitudes, and HIV-preventive behaviors: effects of a school-based intervention. *AIDS Educ Prev*. 1995;7:534-543.
39. Slonim-Nevo V, Auslander WF, Ozawa MN, Jung KG. The long-term impact of AIDS-preventive interventions for delinquent and abused adolescents. *Adolescence*. 1996;31:409-421.

40. Slonim-Nevo V, Ozawa MN, Auslander WF. Knowledge, attitudes and behaviors related to AIDS among youth in residential centers: results from an exploratory study. *J Adolesc.* 1991;14:17-33.
41. Smith MU, Katner HP. Quasi-experimental evaluation of three AIDS prevention activities for maintaining knowledge, improving attitudes, and changing risk behaviors of high school seniors. *AIDS Educ Prev.* 1995;7:391-402.
42. St Lawrence JS, Brasfield TL, Jefferson KW, et al. Cognitive-behavioral interventions to reduce African American adolescents' risk for HIV infection. *J Consult Clin Psychol.* 1995;63:221-237.
43. St Lawrence JS, Crosby RA, Belcher L, Yazdani N, Brasfield TL. Sexual risk reduction and anger management interventions for incarcerated male adolescents: a randomized controlled trial of two interventions. *J Sex Educ Ther.* 1999;24:9-17.
44. Stanton BF, Li X, Galbraith J, et al. Parental underestimates of adolescent risk behavior: a randomized, controlled trial of a parental monitoring intervention. *J Adolesc Health.* 2000;26:18-26.
45. Stanton BF, Li X, Ricardo I, et al. A randomized, controlled effectiveness trial of an AIDS prevention program for low-income African-American youths. *Arch Pediatr Adolesc Med.* 1996;150:363-372.
46. Stanton BF, Xiaoming L, Kahihuata J, et al. Increased protected sex and abstinence among Namibian youth following a HIV risk-reduction intervention: a randomized, longitudinal study. *AIDS.* 1998;12:2473-2480.
47. Walter HJ, Vaughan RD. AIDS risk reduction among a multiethnic sample of urban high school students. *JAMA.* 1993;270:725-730.
48. Warren WK, King AJC. *Development and Evaluation of an AIDS/STD/Sexuality Program for Grade 9 Students.* Kingston, Ontario: Queen's University; 1994.
49. Weeks K, Levy SR, Gordon AK, et al. 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.
50. Weeks K, Levy SR, Zhu C, Perhats C, Handler A, Flay BR. Impact of a school-based AIDS prevention program on young adolescents' self-efficacy skills. *Health Educ Res.* 1995;10:329-344.
51. Workman GM, Robinson WL, Cotler S, Harper GW. A school-based approach to HIV prevention for inner-city African-American and Hispanic adolescent females. *J Prev Intervent Community.* 1996;14:41-60.
52. Rosenthal R. *Meta-analytic Procedures for Social Research.* Thousand Oaks, Calif: Sage Publications; 1991.
53. Hedges LV, Olkin I. *Statistical Methods for Meta-analysis.* Orlando, Fla: Academic Press Inc; 1995.
54. Fleiss JL. Measures of effect size for categorical data. In: Cooper H, Hedges LV, eds. *The Handbook of Research Synthesis.* New York, NY: Russell Sage Foundation; 1994:245-260.
55. Johnson BT. *DSTAT 1.10: Software for the Meta-analytic Review of Research Literatures.* Hillsdale, NJ: Lawrence Erlbaum Associates; 1993.
56. Chinn S. A simple method for converting an odds ratio to effect size for use in meta-analysis. *Stat Med.* 2000;19:3127-3131.
57. Bruvold WH. A meta-analysis of adolescent smoking prevention programs. *Am J Public Health.* 1993;83:872-880.
58. Rooney BL, Murray DM. A meta-analysis of smoking prevention programs after adjustment for errors in the unit of analysis. *Health Educ Q.* 1996;23:48-64.
59. Guyatt GH, DiCenso A, Farewell V, Willan A, Griffith L. Randomized trials versus observational studies in adolescent pregnancy prevention. *J Clin Epidemiol.* 2000; 53:167-174.
60. Tobler NS. Meta-analysis of adolescent drug prevention programs: results of the 1993 meta-analysis. *NIDA Res Monogr.* 1997;170:5-68.
61. DiCenso A, Guyatt G, Willan A, Griffith L. Interventions to reduce unintended pregnancies among adolescents: systematic review of randomized controlled trials. *BMJ.* 2002;324:1426-1430.
62. Huba GJ, Melchoir LA, Panter AT, et al. Risk factors and characteristics of youth living with, or at high risk for HIV. *AIDS Educ Prev.* 2000;12:557-575.
63. 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(suppl 1):S94-S105.
64. Guttmacher S, Lieberman L, Ward D, et al. Condom availability in New York City public high schools: relationships to condom use and sexual behavior. *Am J Public Health.* 1997;87:1427-1433.
65. Albarracín D, McNatt PS, Findley-Klein C, Ho R, Mitchell A, Kumkale GT. Persuasive communications to change actions: an analysis of behavioral and cognitive impact in HIV prevention. *Health Psychol.* In press.
66. Jemmott JB, Jemmott LS. HIV behavioral interventions for adolescents in community settings. In: Peterson JL, ed. *Handbook of HIV Prevention: AIDS Prevention and Mental Health.* New York, NY: Kluwer Academic Publishers; 2000:103-127.