REVIEW ARTICLE

# Interventions to Reduce Sexual Risk for Human Immunodeficiency Virus in Adolescents

## *A Meta-analysis of Trials, 1985-2008*

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**Objective:** To provide an updated review of the efficacy of behavioral interventions to reduce sexual risk of human immunodeficiency virus (HIV) among adolescents.

**Design:** We searched electronic databases, leading public health journals, and the document depository held by the Synthesis of HIV/AIDS Risk Reduction Project. Studies that fulfilled the selection criteria and were available as of December 31, 2008, were included.

**Setting:** Studies that investigated any behavioral intervention advocating sexual risk reduction for HIV prevention, sampled adolescents (age range, 11-19 years), measured a behavioral outcome relevant to sexual risk, and provided sufficient information to calculate effect sizes.

**Participants:** Data from 98 interventions (51 240 participants) were derived from 67 studies, dividing for qualitatively different interventions and gender when reports permitted it.

**Main Outcome Measures:** Condom use, sexual frequency, condom use skills, interpersonal communication skills, condom acquisition, and incident sexually transmitted infections (STIs).

**Results:** Relative to controls, interventions succeeded at reducing incident STIs, increasing condom use, reducing or delaying penetrative sex, and increasing skills to negotiate safer sex and to acquire prophylactic protection. Initial risk reduction varied depending on sample and intervention characteristics but did not decay over time.

**Conclusions:** Comprehensive behavioral interventions reduce risky sexual behavior and prevent transmission of STIs. Interventions are most successful to the extent that they deliver intensive content.

*Arch Pediatr Adolesc Med. 2011;165(1):77-84*

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ADOLESCENTS CONTINUE TO be at considerable risk for human immunodeficiency virus (HIV) and other sexually transmitted infections (STIs). Adolescents account for 4% of new HIV diagnoses in the United States (aged 13-19) and 45% of the diagnoses worldwide (aged 15-24).[1,2] Furthermore, approximately half of all new STIs in the United States occur among adolescents between the ages of 15 and 24.[3] Factors that place adolescents at greater risk for STIs include an early age of sexual debut, inconsistent or incorrect use of condoms, and experimentation with alcohol and other substances.[4] A recent US school-based survey showed that approximately one-half of adolescents are sexually active and 15% have had 4 or more sexual partners[5]; frequent and concurrent partners are associated with STI incidence in adolescents.[6] Although correct and consistent condom use provides an effective method of disease prevention,[7-10] at least 39% of adolescents report that they did not use a condom the last time they had sex,[5] and those who use condoms often do so inconsistently[11] or incorrectly.[12,13]

To reduce the incidence of HIV and other STIs among adolescents, social, behavioral, and public health experts have developed interventions to reduce sexual risk among this population. Providing adolescents with the information, motivation, and skills needed to eliminate (through abstinence) or reduce risk (eg, through partner reduction and condom use) is an important aspect of reducing the incidence of HIV and other STIs.[14] 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 allowing interaction and role-playing to enhance motivation and relevant skills. Theory[14] as well as primary level research[15-17] suggest that interventions that include motivational and skills-based strategies are the most likely to promote risk reduction.

Previously, Johnson and colleagues[18] synthesized the intervention literature and found that interventions are successful in decreasing sexual encounters and increasing condom use among adolescents; they also found that intervention content, and especially the provision of condom use skills, facilitated condom use. Since then, many new trials assessing sexual risk reduction interventions have appeared in the literature, making it important to determine whether the state of the science has changed. Therefore, in the meta-analysis reported here, we examined the extent to which sexual risk reduction interventions have been successful at modifying behaviors that place adolescents at risk for HIV and other STIs. Consistent with the previous review,[18] successful risk reduction was inferred from self-reports of sexual frequencies as well as protected penetrative sexual behavior and communications with sexual partners, objective measurements of skills (at using condoms or at the ability to negotiate condom use with partners), and biological markers (STI diagnosis). We also examined the extent to which efficacy depends on participant or intervention characteristics and whether beneficial effects persist following an intervention.

## METHODS

### SAMPLE OF STUDIES

We updated the previous database[18] using several strategies: (1) electronic database searches (MEDLINE, PsycINFO, CINAHL, Dissertations Abstracts, and ERIC); (2) requests for articles sent to researchers and electronic list serves; (3) review of reference sections of articles obtained in the searches; and (4) searches of journals likely to publish intervention results (eg, *American Journal of Public Health* and *JAMA*). Studies matching the selection criteria and available as of December 31, 2008, were included.

### SELECTION CRITERIA

Replicating the inclusion criteria used in our initial review, studies or portions of studies had to (1) evaluate an educational, psychosocial, or behavioral intervention advocating sexual risk reduction and using interpersonal contact; (2) use a randomized controlled trial or a quasi-experimental design with rigorous controls; (3) have behavioral-dependent measures relevant to sexual risk; (4) sample adolescents (ie, pre-university); and (5) provide information needed to calculate effect sizes (ESs). 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). In 26 studies, information was insufficient to calculate ESs; queries to these authors permitted retaining 13 of these studies (50%). Use of these criteria resulted in 67 independent studies including 9 that contained supplemental information (eg, intervention details and outcomes from follow-up assessments), which included 98 separate interventions and sampled 51 240 participants.[17,19-93] Each intervention was treated as an individual study (eFigure; http://www.archpediatrics.com).

### STUDY INFORMATION

Four raters (L.A.J.S.-S., T.B.H.-M., and 2 others) independently coded the content of each study for the purposes of describing the studies and determining, in stratified analyses, whether variation in ESs can be attributed to features of the sample, intervention, or method used in the studies. Methodological quality was assessed using 12 items (eg, random assignment, attrition, and follow-up rate) from validated measures[94,95]; scores ranged from 0 to 17. A subset of studies was randomly selected to evaluate the interrater reliability. Across the study- and intervention-level categorical dimensions, coders agreed on 73% to 95% of judgments, with average κvalues 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. Reliability for the continuous variables was calculated using the Spearman-Brown formula, which takes into account the mean interjudge correlation as well as the number of judges[96]; reliability was very good, ranging from 0.86 to 1.00, with an average across categories of 0.91.

Outcome measures were transformed into a standardized mean difference (*d*) as an ES index, using the pooled standard deviation as the denominator; this ES was designed for continuous outcome measures,[97] which was the case in the vast majority of the studies. For cases in which the means and standard deviations were not reported, transformations from inference tests were used.[97] When both the independent and the dependent variables were categorical, odds ratios were converted into *d* using the Cox transformation.[98] If no statistical information was available (and could not be obtained from the authors) and the study reported a nonsignificant between-group difference, we estimated that ES to be zero.[97] Effect sizes were corrected for bias due to sample size and baseline differences.[99,100] Positive ES values reflected greater risk reduction. If more than 1 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).

We calculated multiple ESs from an individual study when it had more than 1 behavioral measure or results separated by gender. We analyzed self-reported and objective outcomes. Self-reported outcomes included (1) condom use (for anal, vaginal, or unspecified sex) and (2) sexual frequency (numbers of occasions or sex frequency indexes, number of sexual partners, delay, or abstinence). Objective outcomes included (1) condom use skills, (2) interpersonal communication skills (eg, negotiating condom use assertively in role-plays), (3) indirect behavioral markers (eg, acquired condoms), and (4) incident STIs. Effect sizes gauged by more than 1 measure of the same dimension were averaged (eg, condom use measured using separate items for steady and casual partner type) and, when more than 1 follow-up had occurred, the last available interval was used.

Effect sizes were analyzed following random-effects meta-analytic assumptions.[97,99] Each ES was weighted by the inverse of its variance to produce mean ESs, and 95% confidence intervals were also calculated. Model fit of means was estimated following fixed-effects assumptions (ie, $I^2$ index).[101] To examine moderators, we used weighted least-squares regression models of the condom use ES values. The significant predictors were entered into a weighted multiple-regression model (ie, "meta-regression") following mixed-effects assumptions, which are known to have more conservative statistical power under heterogeneity,[102] and nonsignificant dimensions were trimmed. In multiple predictor models, missing study information was imputed

**Table 1. Weighted Mean Effect Sizes and Related Statistics at Final Available Assessment for Interventions Targeting Adolescents, Following Random Effects Assumptions**

| Outcome | *k* | $d_+$ (95% CI)[a] | OR (95% CI)[a] | Homogeneity of *d*s $I^2$ (95% CI)[b] |
|---|---|---|---|---|
| Incident STI | | | | |
| STI diagnosed | 19 | 0.33 (0.20 to 0.47) | 1.72 (1.39 to 2.17) | 84.90 (77.71 to 89.76) |
| Sexual behavior | | | | |
| General index of sex frequency | 17 | 0.11 (0.04 to 0.18) | 1.20 (1.07 to 1.35) | 25.95 (0.00 to 58.76) |
| No. of partners | 34 | 0.11 (0.06 to 0.17) | 1.20 (1.10 to 1.32) | 54.97 (33.72 to 69.41) |
| Abstinence or delay of intercourse | 62 | 0.11 (0.05 to 0.17) | 1.20 (1.09 to 1.32) | 80.96 (76.11 to 84.83) |
| Sex frequency, averaged | 85 | 0.11 (0.07 to 0.15) | 1.20 (1.11 to 1.28) | 75.52 (69.90 to 80.09) |
| Condom use, unspecified sex partner | 82 | 0.14 (0.07 to 0.21) | 1.26 (1.13 to 1.41) | 81.77 (77.85 to 85.00) |
| Condom use, anal partner | 8 | 0.01 (–0.11 to 0.13) | 1.02 (0.83 to 1.24) | 0.00 (0.00 to 0.00) |
| Condom use, vaginal partner | 11 | 0.13 (0.02 to 0.24) | 1.24 (1.03 to 1.49) | 46.61 (0.00 to 73.44) |
| Condom use, averaged | 91 | 0.13 (0.07 to 0.19) | 1.24 (1.13 to 1.37) | 79.25 (74.87 to 82.87) |
| Behavioral skills | | | | |
| Condom use skill | 2 | 0.94 (0.47 to 1.41) | 4.72 (2.17 to 10.24) | 90.12 (63.86 to 97.30) |
| Safer sex communication skill | 11 | 0.36 (0.13 to 0.59) | 1.81 (1.24 to 2.65) | 82.85 (70.67 to 89.97) |
| Condom purchases, acquisitions | 11 | 0.43 (0.20 to 0.65) | 2.03 (1.39 to 2.92) | 81.83 (68.67 to 89.47) |

Abbreviations: CI, confidence interval; $d_+$, weighted mean effect size; $I^2$, consistency of effect sizes; *k*, number of interventions; OR, odds ratio; STI, sexually transmitted infection.

[a] Estimates of effect size values are greater than 0 ($d_+$) or than 1 (OR) for differences in favor of reduced risk for the treatment group relative to the control group and follow random-effects assumptions (full-information maximum likelihood).

[b] Values vary from 0 (homogeneous) to 100 (lack of homogeneity), assessed using fixed-effects assumptions; significance implies a rejection of the hypothesis of homogeneity.

with mean replacement; no more than 15% of the values for any given dimension required imputation and most (88%) required no imputation. All analyses were conducted in Stata 10.0,[103] using macros provided by Lipsey and Wilson.[97]

## RESULTS

### DESCRIPTIVE OUTCOMES

Of the 67 studies (eTable) included in the meta-analysis, most (90%) were published between 1990 and 2008. Studies were typically conducted in the United States (78%), in medium to large cities (89%), and 49 recruited adolescents from school or community contexts (73%). Studies were of moderate quality with a median methodological quality rating of 9.00 (range, 3-15 of 17 points possible); these ratings have improved over time, with $r = 0.19$, $P = .001$. More than half of the studies (55%) attempted to control bias by increasing the confidentiality of the participants or by using nonintervention personnel to collect responses. Studies were generally successful in retaining participants from consent to follow-up (mean retention rate, 79%).

The studies sampled 51 240 adolescents with a mean (SD) age of 15.0 (2.0) years, and 45% of participants were African American or of African background. Many participants (56%) were already sexually active. Only rarely did studies sample adolescents who were known to engage in sex trading (6%), to be incarcerated (6%), to have a mental illness (1%), or to be HIV-positive (5%). More commonly, the studies sampled adolescents who drank alcohol (33%) or used illegal drugs (30%).

The interventions were typically guided by theory (68%), conducted in groups (74%), met for a median of 13 sessions of 75 minutes each, and had only 1 facilitator. Intervention content included HIV/AIDS education (91%), active interpersonal skills training (69%), self-management skills training (38%), condom information/demonstrations (38%), and motivational content (12%). Comparison conditions were most commonly either a wait-list/no treatment control (51%) or a standard HIV education intervention (29%). Active comparison conditions (eg, standard HIV education) met for a median of 4 sessions of 60 minutes each. Condoms were provided as part of the intervention for 19% of the experiments and 13% of the control conditions. For the present analyses, assessments occurred at a median of 13 weeks postintervention (range, 0-156 weeks).

### HOW WELL DID THE INTERVENTIONS WORK?

Relative to comparison conditions, interventions significantly enhanced 9 of the 10 examined outcomes (**Table 1**); the 1 for which no significant change appeared had a small sample of studies (condom use for anal sex). Of the other 10 outcomes, interventions significantly reduced (1) incident STIs (31% laboratory diagnosed and 69% self-reported), (2) general indexes of sexual frequencies, and (3) number of partners; interventions significantly increased (4) abstinence or delay of intercourse, (5) condom use with unspecified type of sex, (6) condom use with vaginal partners, (7) safer sex communication skills, and (8) acquisition of condoms. Interventions were also successful based on averages (9) of sexual frequency outcomes and (10) of condom use. Each of these sets of study outcomes lacked homogeneity except for the general index of sexual frequency, condoms for anal sex, and condom use for vaginal sex; in other words, study outcomes generally varied widely. Analyses continued regarding the average of sexual frequency and condom use indexes, which had sufficient cases to permit detailed models.

**Table 2. Estimates of Sexual Frequency Effect Sizes as a Function of Sample and Study Features[a]**

| Dimension and Level[b] | $d_+$ (95% CI)[c] | OR (95% CI)[c,d] | β Value | *P* Value |
|---|---|---|---|---|
| Institutionalized sample | | | | |
| Institutionalized | 0.30 (0.12 to 0.48) | 1.64 (1.22 to 2.21) | 0.25 | .01 |
| Not institutionalized | 0.05 (–0.01 to 0.11) | 1.09 (0.99 to 1.20) | | |
| Intervention focused on delay of sexual encounters | | | | |
| Abstinence focus present | 0.10 (–0.04 to 0.25) | 1.18 (0.94 to 1.51) | –0.19 | .02 |
| No abstinence focus | 0.25 (0.16 to 0.34) | 1.51 (1.30 to 1.75) | | |
| No. of intervention sessions | | | | |
| 1 | 0.13 (0.03 to 0.24) | 1.24 (1.05 to 1.49) | 0.27 | .001 |
| 14 | 0.18 (0.08 to 0.28) | 1.35 (1.13 to 1.59) | | |
| Irrelevant-content control group | | | | |
| Present | 0.22 (0.11 to 0.34) | 1.44 (1.20 to 1.75) | 0.15 | .054 |
| Absent | 0.13 (0.02 to 0.24) | 1.24 (1.03 to 1.49) | | |

Abbreviations: CI, confidence interval; $d_+$, weighted mean effect size; OR, odds ratio.

[a] Models used the inverse of the variance for each effect size as weights, following random-effects assumptions. Terms were zero centered or contrast coded prior to estimating values for each extreme, and missing values for number of sessions were imputed. $R=0.46$.

[b] Values represent extremes observed for each study dimension.

[c] Estimates of effect size values are greater than zero ($d_+$) or than 1 (OR) for differences that favor decreased sexual frequencies in the treatment relative to control group and are adjusted for the presence of the other study dimensions.

[d] A transformation of $d_+$ into its equivalent odds ratio.

## WHAT INTERVENTION DIMENSIONS EXPLAIN VARIATIONS IN SEXUAL FREQUENCY OUTCOMES?

Several study dimensions emerged as significant bivariate associates of the averaged ESs pertaining to sexual frequency, but only 4 dimensions were retained in a final model (**Table 2**). Specifically, interventions were successful at reducing the frequency of sexual behavior when (1) they were implemented with adolescents who were institutionalized, (2) had no focus on abstinence as a goal, (3) had greater numbers of intervention sessions, and (4) had control conditions with non-HIV content (eg, general health promotion); the latter predictor narrowly missed conventional statistical significance. On average, interventions did not succeed when the intervention focused on abstinence and when control groups included HIV-related content (eg, in diluted form). This model had a multiple *R* of 0.46 ($P<.001$).

Dimensions that ceased being statistically significant when the preceding 4 dimensions were controlled included (1) date of study (quadratic function, in a pattern showing greater success leading up to the mid-1990s and declining since), (2) amount of condom skills training, (3) retention of participants in the trial, and (4) tailoring of intervention content. Of note, among the other moderators that did not reach significance, even on a bivariate basis, were (1) amount of interpersonal skills training, (2) geographic region of the study, (3) city size, (4) racial composition, (5) gender composition, (6) use of same-gender groups, (7) mean age of sample, (8) provision of condoms, (9) success at increasing use of condoms (ie, the averaged condom use ES), (10) interactions of sessions with intervention content variables, (11) study quality score, and (12) length of time elapsing following the intervention, which varied from 0 weeks (for long-duration interventions) to 156 weeks.

Exploratory analyses examined whether the 4 moderators shown in Table 2 interacted with either date of data collection or study quality. Two significant interactions emerged: (1) the tendency for irrelevant-content control groups to increase ESs was more pronounced in earlier than more recent studies (interaction $\beta=0.51$, $P<.001$) and (2) the tendency for interventions with institutionalized groups to achieve larger ESs was larger in higher-quality studies than in lower-quality studies (interaction $\beta=0.92$, $P<.001$).

## WHAT INTERVENTION DIMENSIONS EXPLAIN VARIATIONS IN CONDOM USE OUTCOMES?

Several study dimensions emerged with significant bivariate associations to the averaged ESs gauging condom use, but only 3 dimensions were retained in a final model (**Table 3**), which followed more conservative mixed-effects assumptions; all 3 were significant under fixed-effects assumptions. Specifically, interventions were more effective when (1) they provided a greater amount of condom skills training or (2) motivational training in each session, and (3) the intervention group reduced frequencies of sexual encounters relative to the control group; the latter dimension was not significant but was included to illustrate the joint impact of sexual frequencies and condom use. Although interventions generally succeeded in increasing condom use across the variation implied by these dimensions, interventions did not succeed when the intervention also failed to reduce frequencies of sexual interactions. This model had a multiple *R* of 0.32 ($P=.007$).

Dimensions that ceased being statistically significant when the preceding 3 dimensions were controlled included (1) date of study (linear function, in a pattern showing less success in more recent studies), (2) amount of interpersonal skills training, (3) irrelevant content control group, and (4) proportions of the samples that were African or African American (more success with these groups than with others). Of note, among the other moderators that did not reach significance even on a bivariate basis were (1) amount of interpersonal skills training, (2) geographic region of the study, (3) city size, (4) percentage of sample of Latin heritage, (5) gender com-

**Table 3. Estimates for Intervention Effects on Condom Use as a Function of Sample and Study Features[a]**

| Dimension and Level[b] | $d_+$ (95% CI)[c] | OR (95% CI)[c] | β Value | *P* Value |
|---|---|---|---|---|
| Condom skills training per session, minutes/session | | | | |
| 60 | 0.34 (0.11 to 0.56) | 1.75 (1.20 to 2.52) | 0.18 | .06 |
| 0 | 0.09 (0.02 to 0.16) | 1.16 (1.04 to 1.30) | | |
| Motivation training per session, minutes/session | | | | |
| 46 | 0.45 (0.18 to 0.73) | 2.10 (1.35 to 3.34) | 0.22 | .02 |
| 0 | 0.11 (0.05 to 0.17) | 1.20 (1.08 to 1.32) | | |
| Intervention (vs control reduction in sex frequencies) | | | | |
| Intervention group members have much less ($d$=1.55) | 0.36 (0.0096 to 0.70) | 1.81 (1.02 to 3.17) | 0.12 | .21 |
| Intervention group has less ($d$=0.35) | 0.19 (0.09 to 0.28) | 1.37 (1.16 to 1.59) | | |
| The same amount ($d$=0.00) | 0.14 (0.08 to 0.19) | 1.26 (1.14 to 1.37) | | |
| Control group members have less than intervention ($d$=–0.35) | 0.09 (–0.01 to 0.18) | 1.15 (0.98 to 1.35) | | |

Abbreviations: CI, confidence interval; $d_+$, weighted mean effect size; $k$, number of studies; OR, odds ratio (transformed from $d_+$).

[a] Models used the inverse of the random-effects variance for each effect size as weights (under fixed-effects, all terms were significant at $P<.001$). Terms were zero centered or contrast coded prior to estimating values for each extreme, and missing values were imputed. These study or sample features reduced the relations of several other carriers to nonsignificance, including racial composition of the sample, date of study (linear function), dosage of interpersonal skills training, and irrelevant content control group. Studies without observations on sex frequencies were imputed at zero. $R$=0.32.

[b] Levels are extremes observed for the study dimension in question.

[c] Estimates of effect size values are greater than zero ($d_+$) or than 1 (OR) for differences that favor increased condom use in the treatment relative to control group and are adjusted for the presence of the other study dimensions.

position, (6) use of same-gender groups, (7) mean age of sample, (8) provision of condoms, (9) assessment of anal condom use, (10) tailoring of intervention content, (11) number of sessions (and the interactions of sessions with intervention content variables), (12) retention of participants in the trial, (13) study quality score, and (14) length of time elapsing following the intervention, which varied from 0 weeks (for long-duration interventions) to 156 weeks.

Exploratory analyses examined whether the 3 moderators shown in Table 3 interacted with either date of data collection or study quality score. Two patterns emerged, both concerning the amount of motivational training per session. First, motivational training had a marked relation in studies conducted through 1995 (β=0.57, $P<.001$) but no relation in studies conducted since 1996 (β=0.01, $P$=.96; interaction β=–0.40, $P<.001$). The second of these patterns was that motivational training had a marked relation in studies above the median score of study quality (β=0.57, $P<.001$) but none in those with lower study quality (β=0.01, $P$=.93; interaction β=0.20, $P$=.005). The 3 carriers listed in Table 3 (motivation, condom skills, and reduced sexual frequency) provided far better collective explanation in higher-quality studies ($R$=0.65) than in lower-quality studies ($R$=0.24).

## COMMENT

This meta-analysis summarizes new evidence concerning behavioral interventions to reduce the risk of HIV and other STIs among adolescents. Results support the conclusion that behavioral interventions reduce adolescents' risk for STIs more broadly, increase condom use, reduce or delay frequencies of penetrative sex, and increase skills to negotiate safer sex and to acquire condoms. There was no evidence of unintended or iatrogenic effects from such interventions.[18,104] Although intervention success varied across studies, benefits were durable for as long as 3 years postintervention, with success generalizing across such aspects as gender and geographic region. Variation in intervention outcomes depended on sample and intervention dimensions.

The overall ES of an intervention's effect on sexual frequency dimensions, such as number of partners, number of sexual occasions, and delay of intercourse, was small ($d$=0.11, odds ratio=1.04). Effects were larger to the extent that the sample of adolescents was institutionalized (eg, runaways and detainees), the intervention had more sessions, and the intervention did *not* emphasize abstinence (Table 2). Success was also greater to the extent that the comparison group received an intervention that included content unrelated to HIV. Because many studies used a diluted HIV risk-reduction intervention as a comparison condition, it is likely that the findings reported herein underestimate the magnitude of sexual change that interventions prompt.

These meta-analytic results regarding sexual frequencies corroborate prior (narrative) reviewers' conclusions that abstinence-based interventions lack efficacy.[105] Interventions emphasizing abstinence failed to reduce the frequency of sexual interactions relative to controls (Table 2), and more comprehensive interventions were more successful at reducing sexual frequencies than those that attempted to promote abstinence. After our meta-analysis was completed, a more recent trial found that abstinence-only education delayed sexual debut in young, inner-city teens during a 2-year period.[106] Our meta-analysis was not designed to assess all forms of abstinence-only interventions such as this trial because it required that interventions at least mention HIV; many abstinence interventions lack HIV content.[107] Thus, it is possible that a focus on abstinence can help to delay sexual debut; in addition, findings from this meta-analysis show that risk-reduction interventions (which typically include abstinence messages as well as risk-reduction messages) reduce the frequency of sex as well as increase condom use when teens become sexually active (Tables 1-3). Such findings support individuals who are concerned about abstinence-only education because it does not prepare teens to use condoms when they become sexually active.

Behavioral interventions also succeeded in creating more condom use relative to controls. Such effects were larger to the extent that interventions included greater amounts of condom skills training and included more motivational training. Contrary to other reviewers' conclusions that the amount of intervention content does not matter,[108] the results of the meta-analysis reported here found that maximal efficacy results from intervention sessions that provide more condom skills and motivational training per session (eg, 1 hour[17,73,74]). These patterns did not hinge on the number of sessions that took place in the interventions. Evidently, then, even relatively brief interventions may create sufficient motivation and skills to encourage condom use. As previously noted, with sexual frequencies, more sessions are needed to achieve efficacy, although the content of the interventions was less important.

The importance of condom skills training was a pattern shown in the earlier review,[18] a conclusion that appeared even more markedly in the meta-analysis presented here. Finding that motivational training is also useful is new and may have emerged because the literature now available is larger and offers greater variability in intervention content. Across the history of relevant research, studies have shown that adolescents appear to lack both sufficient skills to use condoms correctly as well as sufficient motivation to use them.[16] Two other trends qualified these conclusions.First, motivational interventions appeared to have had less of an impact in recent years than previously, suggesting that risk perception may have increased over time. Alternatively, it may be that recent studies have not emphasized motivational components. Second, motivational training was shown to have a larger effect on condom use in studies with higher judged methodological quality. Logically, studies with greater methodological quality offer greater precision than those with lower quality, permitting a clearer picture of the sources underlying observed variation. We found that more recent studies have higher quality, a trend we would like to see continue. Some reviewers have concluded that interventions are more successful at decreasing the frequency of sex for younger rather than older adolescents.[109] The sample population in this meta-analysis ranged from 10.8 to 19 years of age, and this variability did not predict efficacy for either condom use or sexual frequencies. In fact, the average ESs obtained in the current study are smaller than those typically seen in HIV prevention studies with adults.[110] Similarly, some have concluded that interventions that target high-risk adolescent subgroups have smaller effects than do those focused on subgroups with less risk.[108] In contrast, our meta-analysis shows a larger effect on frequency of sex for institutionalized samples relative to noninstitutionalized samples. Such comparisons indicate the utility of meta-analysis for distilling details of literatures that may be difficult to discern without statistical integration.

Our prescriptions for informational, motivational, and skills-based content and conduct of interventions support leading behavioral science theories, but some limitations should be noted. Few studies evaluated adolescents who engage in sex trading, are incarcerated, have mental illness, or are HIV positive. Finer-grained analyses of intervention content may yield better explanation of efficacy. There are also relatively few studies conducted outside of the United States, although our analyses did not detect differences across these geographical settings. The research discussed here may best be described as gauging best practice prevention for adolescents who are HIV negative and are from a variety of racial and ethnic backgrounds. Including more than 20 years of research on adolescents, our review confirms the efficacy of behavioral interventions to prevent sexually transmitted acquisition of HIV in a group that may have the most to profit by remaining HIV-free.

**Accepted for Publication:** June 9, 2010.
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**Author Contributions:** Drs Johnson, Scott-Sheldon, and Huedo-Medina had full access to all the data and share responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Johnson and Carey. *Acquisition of data:* Johnson, Scott-Sheldon, and Huedo-Medina. *Analysis and interpretation of data*: Johnson, Scott-Sheldon, Huedo-Medina, and Carey. *Drafting of the manuscript*: Johnson, Scott-Sheldon, and Huedo-Medina. *Critical revision of the manuscript for important intellectual content*: Johnson, Scott-Sheldon, Huedo-Medina, and Carey. *Statistical analysis*: Johnson, Scott-Sheldon, and Huedo-Medina. *Obtaining funding*: Johnson and Carey. *Administrative, technical, or material support*: Scott-Sheldon and Carey. *Study supervision*: Johnson and Carey.
**Financial Disclosure:** None reported.
**Funding/Support:** This research was funded by grant R01-MH58563 from the National Institutes of Health (Drs Johnson and Carey).
**Online-Only Material:** The eFigure and eTable are available at http://www.archpediatrics.com.
**Additional Contributions:** We thank the study authors who provided additional information for this investigation and other SHARP (Synthesis of HIV/AIDS Research Project) team members who contributed to the article. In particular, we thank Jennifer Ortiz, BA, and Amanda Snook, BA, both with the University of Connecticut at the time of the study, for providing assistance in the coding of studies. Both Mss Ortiz and Snook received compensation for this role. In addition, we thank all the study authors who provided additional information for this investigation.

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