Sexual Risk Reduction for Persons Living With HIV

Research Synthesis of Randomized Controlled Trials, 1993 to 2004

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Objective: To conduct a meta-analytic review of interventions to reduce HIV$^+$ individuals' sexual risk.

Design: Studies were included if they examined a deliberate sexual risk-reduction strategy in a sample that included HIV$^+$ participants, used a randomized controlled trial design, measured condom use or number of sexual partners after the intervention, and provided sufficient information to calculate effect size (ES) estimates.

Method: Reports were gathered from computerized databases, by contacting individual researchers, by searching relevant journals and conference proceedings, and by reviewing reference sections of obtained papers. Data from 15 studies (N = 3234 participants) available as of November 30, 2004 were included. ES estimates were standardized mean differences.

Results: Across the studies, intervention participants exhibited lowered sexual risk relative to control participants on condom use (mean ES = 0.16, 95% confidence interval [CI]: 0.08 to 0.25) but not for number of sexual partners (mean ES = −0.01, 95% CI: −0.16 to 0.14). Interventions were more successful at increasing condom use if the sample included fewer men who have sex with men (MSM) or younger participants and when interventions included motivational and skills components.

Conclusions: Behavioral interventions reduced sexual risk especially if they included motivational and skills components. Such interventions have been less effective for older samples, suggesting the need for further refinement to enhance their efficacy. Motivation- and skill-based interventions have not yet been tested with HIV$^+$ MSM who, in general, seem to have benefited less from extant risk-reduction interventions.

Key Words: HIV prevention, public health, evaluation, meta-analysis, research synthesis, sexual transmission of HIV, behavioral intervention, secondary prevention

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Persons infected with HIV can now routinely expect to live longer and healthier lives. With extended longevity, however, comes the challenge of adopting safer sexual practices for many years. Evidence suggests that most HIV$^+$ persons do reduce their risk behavior once they learn that they are infected with HIV. For example, Weinhardt et al's[1] meta-analysis of HIV counseling and testing (CT) programs found that, subsequent to HIV CT, HIV$^+$ participants increased condom use and reduced unprotected intercourse more than did HIV$^-$ and untested participants. A more recent survey of 3723 HIV$^+$ people yielded similarly encouraging results. In this study, nearly 85% of HIV$^+$ persons reported that they did not engage in risk behavior with uninfected partners.[2]

Although many HIV$^+$ persons reduce risk behaviors subsequent to learning that they are infected, a few HIV$^+$ persons find this challenge difficult. For example, in Weinhardt et al's[2] sample, 13% to 19% reported unprotected vaginal or anal intercourse with partners whose serostatus was negative or unknown. Moreover, 18% of injection drug users reported that they had shared injection needles with other partners. Other studies have reported that a few HIV$^+$ persons continue risky sexual or drug use practices[3]; other individuals who are not aware of their serostatus may also transmit the disease. The route of sexual transmission is the leading cause of the approximately 40,000 new infections in the United States annually[4,5]; sexual intercourse between men and women results in most HIV-1 infections acquired by adults in sub-Saharan Africa.[6] Transmission through blood transfusions, injections with infected needles, and scarification are thought to represent only a few infections.[6]

Risk-reduction programs for HIV$^+$ persons have been implemented in many settings, but an evaluation of these programs provides mixed evidence of their efficacy. For example, Cleary et al[7] tested an informational and supportive intervention promoting behavior change with 271 HIV$^+$ blood donors and reported no advantage of the risk-reduction intervention relative to a control condition. In contrast, Rotheram-Borus et al[8] evaluated a multisession group-based intervention for HIV$^+$ adolescents and reported that adolescents reduced the number of HIV$^-$ sexual partners by 50% and decreased the number of unprotected sexual acts by 82%.

The current meta-analysis integrates the available evidence to determine the degree to which prevention programs for HIV$^+$ persons are efficacious. We located controlled intervention studies that addressed risk reduction in samples that included HIV$^+$ persons and obtained effect size (ES) estimates of intervention efficacy. Our primary goal was to determine whether sexual risk reduction programs for HIV$^+$

persons help participants to reduce the number of sexual partners and/or increase condom use. Our secondary goal was to identify moderators of intervention efficacy, including intervention components that warrant inclusion and subgroups for which the interventions need further tailoring. Such information can provide needed guidance for intervention development and prevention research.

METHODS

Sample of Studies

We searched for randomized controlled trials (RCTs) using 3 strategies. First, we searched electronic reference databases (MEDLINE, PsycINFO, AIDSLINE, CINAHL, Dissertation Abstracts Online, and ERIC) using search terms related to HIV interventions (eg, risk reduction, prevention, seropositive) and sexual risk behavior (eg, condom use). Second, we used the same search terms in Internet search engines such as Yahoo! and Google through May 26, 2004. Third, we checked HIV-related listservs and the National Institutes of Health (NIH) database of grant awardees (CRISP), and we sent requests for papers to individual researchers conducting interventions with seropositive individuals. The goal of these supplemental strategies was to ensure the comprehensiveness of the reference database searches. Studies that fulfilled the search criteria and were available as of November 30, 2004 were included. In some cases, information about study interventions was taken from several publications or unpublished reports. All studies included in our final sample were published reports, although we considered published and unpublished studies in our search.

Selection Criteria

Studies or portions of studies were included if they (1) examined a conventional means of sexual risk-reduction in a sample that included HIV^+ participants, (2) used an RCT design, (3) measured condom use or number of sexual partners, and (4) provided sufficient information to calculate ES estimates. Studies were excluded if the intervention(s) focused on perinatal transmission contexts[9] or if they used only time-series designs.[10] Consistent with these criteria, studies that did not clearly focus on sexual risk reduction were excluded. Several RCTs with HIV^+ participants were excluded because (1) they did not provide critical statistics necessary for the meta-analysis,[11] (2) did not have a sexual risk-reduction component,[12] or (3) did not report condom use or number of partners.[13] For example, although Coates et al's[12] study targeted HIV^+ individuals, its intervention focused on coping and made no mention of sexual risk reduction. Studies with samples of HIV^- and HIV^+ participants were included if the number of HIV^+ participants was $\geq$30 and if separate ESs could be calculated for the HIV^+ participants. If the latter were not available in the original reports, we contacted the authors of such studies and requested separate analyses for the HIV^+ individuals in their sample; these requests resulted in 4 reports that are not typically known to the literature on prevention with seropositive individuals.[14–17] Inclusion of these results allowed comparison of whether efforts focused on HIV^+ individuals differ from those focused on HIV^- individuals or individuals whose HIV serostatus was unknown.

These criteria yielded 15 studies (Fig. 1). At the first follow-up, 3234 HIV^+ individuals participated, reflecting a retention rate of 79%. Consistent with meta-analytic convention,[1,18] each intervention was treated as an individual study during analysis.

Study Information

Two raters independently coded the qualitative content of each study to describe the studies and to determine whether variation in ESs could be attributed to features of the studies. Studies were coded for the following dimensions: (1) sample characteristics (eg, ethnicity, gender, sexual orientation), (2) risk characteristics (eg, sex trade, drug use, proportion of entire sample HIV^+), (3) design and measurement specifics (eg, number of follow-ups), and (4) content of control and intervention condition(s) (eg, number of sessions, training of session leaders). Because leading HIV prevention experts recognize the importance of developing interventions based on a conceptual model of risk behavior,[19] we also coded studies according to whether they provided informational, motivational skills, and/or behavioral skills components, this coding reflected our interest in testing whether the IMB model of HIV risk behavior could explain results across studies.[20]

Across all study- and intervention-level categoric dimensions, coders agreed on 60% to 100% of judgments. Categoric variables that were used only for descriptive purposes and were not included as explanatory variables in the current analyses were coded with 90% agreement and average κ values of 0.84. Variables that served as explanatory variables were coded with 93% agreement and average κ values of 0.86. Disagreements were resolved through discussion.

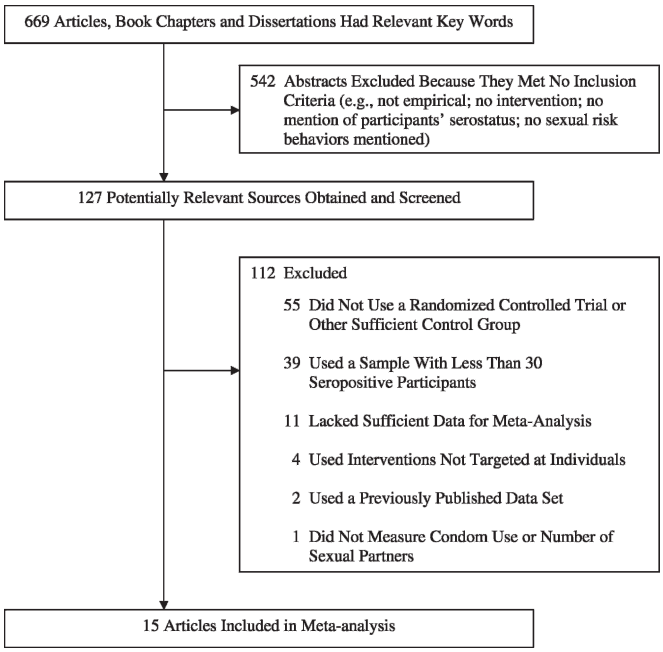

FIGURE 1. Selection process of study inclusion in the meta-analysis.

Effect Size Derivation

We calculated individual ESs for relevant measures reported in each of the separate interventions. Specifically, we analyzed 2 self-reported sexual outcomes: condom use (unspecified, vaginal, anal, or oral) and (2) number of partners. Because results from the 4 condom use varieties converged closely, ESs were averaged for the primary analyses of condom use. For the purpose of this review, condom use was inferred from any measure that implied it (eg, unprotected acts). Studies nearly always defined outcomes in continuous rather than dichotomous terms; thus, the ES calculated was the standardized mean difference (*d*). The pooled standard deviation (SD) served as the denominator in the ES calculation; in a few cases, the denominator was, instead, another form of SD (eg, the SD of the paired comparisons), because the pooled SD was unavailable and could not be calculated from the report. The sign of each ES was set so that it was positive when the outcome favored risk reduction, and ESs were corrected for sample size bias.[21] One report offered intervention statistics separately by gender[7] and another by ethnicity[14]; these reports were treated as individual studies. ESs were calculated on the measures provided at the first follow-up after the intervention to reduce method variance across studies. We averaged the ESs from multiple measures of the same outcome. When 2 or more intervals were assessed (eg, condom use in the previous week vs. the previous 30 days), we used the interval that most closely matched the time since the intervention ended.

When a study offered a statistic controlling for baseline differences as well as for statistics that were not adjusted, we used the former. If a statistic did not control for baseline, but baseline results were reported, Becker's[22] strategy was used, wherein the postintervention ES is corrected for any differences between the groups at baseline. When studies reported odds ratios, we transformed them to *d* using the Cox transformation according to published guidelines.[23] Analyses were performed with fixed-effects and random-effects assumptions; analyses to examine whether features of the studies explained variability in the ESs used fixed-effects assumptions.[24,25] Because at least 1 of the fixed-effects models of study features fully explained the variability in condom use effects, there was no need to incorporate random-effects assumptions in analyses.

RESULTS

Description of Studies

Table 1 lists the studies and their main descriptive features. The studies in the sample appeared between 1993 and 2004. Eleven studies included only HIV^+ individuals, whereas the remaining 4 studies focused on HIV^- individuals but also included some participants who were HIV^+ (M = 14% HIV^+ participants in these 4 samples). The samples in the studies were primarily males (64%) of African-American background (49%) and averaged 35 years of age. Fourteen (93%) studies were conducted in the United States, with most (73%) of these conducted in medium to large cities. Only 2 studies sampled those who were known to engage in sex trading or commercial sex work (13%), and only 1 sampled HIV^+ persons who were in drug treatment (7%); no study included incarcerated samples. More frequently, studies sampled populations of men who have sex with men (MSM; 7 [47%]) and those who use recreational drugs (12 [80%]).

All studies used random assignment, with most studies (14 [93%]) assigning individuals (rather than intact groups) to conditions. All studies used a pre- and posttest design and included an average of 2.3 (SD = 1.0) follow-ups after baseline data collection. The initial follow-up, the focus of this synthesis, occurred at a mean of 19.00 weeks after intervention (range: 0–47 weeks). Only 3 studies took measures immediately, and their interventions averaged 22.00 weeks in length; the interventions of the other studies lasted an average of 11.71 weeks. All interventions provided participants with HIV/AIDS information. Thirteen (65%) provided motivational components (eg, social support), and 12 (60%) provided behavioral skills training (eg, for condom use). Interventions included an average of 5 participants who met for 6 sessions that averaged 98 minutes each. Controls were typically a waiting list (8 interventions [40%]) or an HIV/AIDS education comparison (7 interventions [35%]). The latter were typically matched for time and/or contact or provided an abbreviated form of the intervention condition; they averaged 5 participants who met for 3 sessions of 77 minutes each.

Efficacy of the Interventions

Fourteen interventions were evaluated using only condom use, 2 interventions were evaluated using only number of partners, and 5 used both measures. ESs for studies that reported both measures were highly correlated (r = 0.73). Across the 19 interventions that assessed condom use, interventions increased condom use relative to controls (d = 0.16, 95% CI: 0.08 to 0.25; Table 2). Yet, the ESs varied widely around this mean value ($Q(18) = 55.15$; $P < 0.001$; Fig. 2). An examination of intervention efficacy within the 4 types of condom measures (unspecified, vaginal, anal, and oral) confirmed this overall result. These results were parallel using fixed-effects or random-effects assumptions. Seven of the studies assessed the number of sexual partners; relative to controls, intervention participants did not decrease the numbers of partners they reported ($d = -0.01$, 95% CI: −0.16 to 0.14). These effects were homogeneous ($Q(6) = 4.62$; $P = 0.593$; see Table 2).

Intervention Features Associated With Increased Condom Use

Analyses revealed 3 features of the studies that were associated with smaller or larger efficacy as gauged by condom use (Table 3). First, interventions were more successful to the extent that they sampled younger rather than older participants. Second, interventions were more successful to the extent that MSM were not included in the sample; interventions with 100% MSM exhibited no significant change. Third, interventions that included motivational and behavioral skills components increased condom use compared with interventions that had only 1 of these components or neither; unless informational, motivational, and behavioral skills components were included, interventions had no effect on condom use. Model fit was excellent in the case of the MSM model

TABLE 1. Descriptive Features of Studies in Sample

Study	Sample	Setting and Location	Intervention(s), Focus, Duration	Time to Follow-up	Outcomes Measured
Cleary et al[7]	271 Blood donors 100% HIV+ 78% Men 55% MSM 45% White 31% Black 23% Hispanic	Blood center: New York, NY	Structured Intervention Program† (6 weeks) HIV/AIDS information Focus on sexual risk reduction	46 weeks	Proportion sexually active Condom use for vaginal sex, vaginal sex during menses, anal receptive and active sex, and oral sex Oral-anal sex
Dushay et al[14]	1300 Drug users* 17% HIV+ 73% Men 50% Black 50% Hispanic	Community outreach centers: Hartford, CT	African-American Culturally Competent Enhanced Intervention (3 weeks) HIV/AIDS information Motivation Behavioral skills Equal focus on sexual and drug risk reduction Puerto Rican Culturally Competent Enhanced Intervention (3 weeks) HIV/AIDS information Motivation Behavioral skills Equal focus on sexual and drug risk reduction	20 weeks	Number of sexual partners and IDU sex partners
El-Bassel et al,[15] Witte[35]‡	217 Heterosexual couples* 21% HIV+ 55% Black 39% Hispanic	Primary health care setting: New York, NY	Couples Relationship-Based Intervention (6 weeks) HIV/AIDS information Motivation Behavioral Skills Focus on sexual risk reduction Woman-Alone Relationship-Based Intervention (6 weeks) HIV/AIDS information Motivation Behavioral Skills Focus on sexual risk reduction	13 weeks	Frequency unprotected sex acts Proportion protected sex acts Number of sexual partners
Fogarty et al,[36] Gielen et al[37]‡	322 Women 100% HIV+ 43% Involved in sex trading 6% White 91% Black 1% Hispanic	Outpatient and pediatric HIV clinics and a primary HIV care facility: Baltimore, MD	Enhanced Intervention (26 weeks) HIV/AIDS information Behavioral skills Focus on sexual risk reduction	Immediately	Condom use with main male sex partner
Kalichman et al[38]	328 patients seeking HIV/AIDS care 100% HIV+ 70% Men 22% White 74% Black	Recruitment from clinics and ASOs, intervention in community: Atlanta, GA	Transmission Risk-Reduction Intervention (2.5 weeks) HIV/AIDS information Motivation Behavioral skills Focus on sexual risk reduction	13 weeks	Number of sexual partners Frequency of intercourse and unprotected sexual acts Condom use
Kelly et al[39]	115 depressed men 100% HIV+ 94% MSM 62% White 29% Black	Mental health study clinic: Milwaukee, WI	Cognitive-Behavioral Group Intervention (8 weeks) HIV/AIDS information Focus on sexual risk reduction Social Support Group Intervention (8 weeks) HIV/AIDS information Focus on sexual risk reduction	13 weeks	Instances and number of participants reporting unprotected insertive & receptive anal intercourse

TABLE 1. (*continued*) Descriptive Features of Studies in Sample

Study	Sample	Setting and Location	Intervention(s), Focus, Duration	Time to Follow-up	Outcomes Measured
MacNeil et al[40]	154 newly diagnosed HIV+ individuals 100% HIV+ 66% Women 100% Black	Counseling center or homes of participants: Semi-urban Tanzania, Africa	Enhanced Care and Support Intervention (13 weeks) HIV/AIDS information Focus on sexual risk reduction	13 weeks	Disclosed serostatus to sexual partner Condom use for last sexual intercourse Sex with person other than spouse/main partner
Margolin et al[41]	90 IDU patients in drug treatment 100% HIV+ 70% Men 36% White 49% Black 16% Hispanic	Inner-city methadone maintenance program: New Haven, CT	HIV+ Harm Reduction Program (26) HIV/AIDS information Motivation Behavioral skills Equal focus on sexual and drug risk reduction	Immediately	Unprotected penetrative sex
NIMH[16]	3706 STD clinic patients* 2.5% HIV+ 58% Women 74% Black 25% Hispanic	Inner city, community based clinics: New York, NY; Northern NJ; Baltimore, MD; Atlanta, GA; Milwaukee, WI; Los Angeles, Orange, San Bernardino counties, CA	Small-Group HIV Risk Reduction Program (3 weeks) HIV/AIDS information Motivation Behavioral skills Focus on sexual risk reduction	9 weeks	Frequency of unprotected vaginal or anal intercourse Proportion of condom use Consistent condom use or abstinence
Richardson et al[42]	886 sexually active patients seeking HIV treatment 100% HIV+ 74% MSM 86% Men 41% White 16% Black 37% Hispanic 82% HAART	HIV clinics: CA	Gain-Framed Safer-Sex Intervention (45 weeks) HIV/AIDS information Focus on sexual risk reduction Loss-Framed Safer-Sex Intervention (45 weeks) HIV/AIDS information Focus on sexual risk reduction	Less than 30 weeks	Unprotected insertive or receptive anal or vaginal intercourse
Roffman et al[17]	548 gay and bisexual men* 14% HIV+ 100% MSM 84% White 7% Black 9% Latino	Telephone intervention: US, Puerto Rico, and Canada	Cognitive-Behavioral Group Counseling Intervention (14 weeks) HIV/AIDS information Motivation Focus on sexual risk reduction	Immediately	Unprotected anal and oral intercourse Proportion of all anal and oral events unprotected
Rotheram-Borus et al[8]	310 HIV+ youths, ages 12–24 100% HIV+ 72% Men 19% White 27% Black 37% Hispanic	Adolescent clinic care sites: Los Angeles, CA; San Francisco, CA; New York, NY; Miami, FL	"Stay healthy" and "Act Safe" Intervention (26 weeks) HIV/AIDS information Motivation Behavioral skills Equal focus on sexual and drug risk reduction	13 weeks	Number of sexual partners Unprotected sex acts No sexual risk pattern
Rotheram-Borus et al[43]	151 HIV+ youths, ages 16–29 100% HIV+ 69% MSM 78% Men 23% White 26% Black 42% Hispanic 50% HAART	Community agencies: Los Angeles, CA; San Francisco, CA; New York, NY	Telephone Intervention (18 weeks) HIV/AIDS information Motivation Behavioral skills Equal focus on sexual and drug risk reduction In-Person Intervention (18 weeks) HIV/AIDS information Motivation Behavioral skills Equal focus on sexual and drug risk reduction	47 weeks	Number of HIV-partners Protected sex acts with all partners, HIV-partners 100% condom use or abstinence

(*continued on next page*)

TABLE 1. (*continued*) Descriptive Features of Studies in Sample

Study	Sample	Setting and Location	Intervention(s), Focus, Duration	Time to Follow-up	Outcomes Measured
Wingood et al[44]	366 women 100% HIV+ 84% Black	HIV/AIDS clinics and health departments: Anniston, AL; Birmingham, AL; Montgomery, AL; Atlanta, GA	"Women Involved in Life Learning from Other Women" (WiLLOW) (4 weeks) HIV/AIDS information Motivation Behavioral skills Focus on sexual risk reduction	22 weeks	Frequency of unprotected vaginal sex Proportion who have never used condoms
Wolitski et al[30] Wolitski et al[45]	730 HIV+ MSM 100% HIV+ 51% White 23% Black 17% Latino 1% Asian	Community settings: New York, NY; San Francisco, CA	Seropositive Urban Men's Intervention Trial (SUMIT) (6 weeks) HIV/AIDS information Motivation Focus on sexual risk reduction	13 weeks	Unprotected anal and oral intercourse with HIV-or unknown-status partners

*Sample characteristics reported describe a mixed sample of both HIV-seropositive and -seronegative or -unknown participants.

†Intervention was administered to both men and women, but results were stratified into samples of men only and women only; this single intervention was treated as two separate interventions for our current analyses.

‡Two reports of one study were a available and were used to code the study features or to calculate effects sizes.

ASO indicates AIDS Service Organization, HAART, highly active antiretroviral therapy; IDU, injection drug user; MSM, Men who have sex with men; STD, sexually transmitted disease.

[$Q_{Residual}(10) = 12.16$; $P = 0.27$] but not as good for each of the age and intervention content models. It is worth noting that no study focused on MSM included all 3 of the content components.

We also evaluated whether studies that focused exclusively on HIV^+ individuals achieved greater efficacy than those that included individuals with unknown or negative serostatus; a comparison revealed no significant difference. Similarly, none of the patterns reported in the preceding paragraph changed when analyses were restricted to samples of 100% HIV^+ individuals. The following features of the studies also did not relate to the magnitude of condom use ESs: gender, racial composition, knowledge of serostatus, year of study, whether or not the intervention was designed to focus on HIV^+ individuals, whether or not participants were injection drug users, attrition, and time since the intervention ended.

Given the relatively brief follow-up intervals and because decay of intervention effects is an important consideration, an exploratory analysis included the additional condom use follow-up measurements that 5 studies provided. This analysis also showed no change in intervention efficacy over time ($\beta = 0.01$; $P = 0.93$). Finally, there was no tendency for the ESs to depend on the year in which the interventions were conducted ($\beta = -0.20$; $P = 0.14$).

DISCUSSION

This quantitative synthesis is the first to focus on the extent to which interventions can reduce sexual behavior among people who live with HIV. This review focused on condom use and number of partners, because these measures are the most commonly used markers of risk behavior. We synthesized RCTs because such studies provide the strongest evidence regarding the efficacy of HIV risk-reduction programs. In total, 15 RCTs and 21 interventions qualified for the review (see Table 1). Results showed that with only some exceptions as noted below, interventions led to reduced sexual risk behavior in people living with HIV as gauged by condom use (see Table 2). The magnitude of this risk-reduction effect is equivalent to or larger than the effects reported in earlier meta-analyses of HIV prevention trials conducted in HIV^- samples,[1,18,26–29] whose mean ESs range from 0.06[26] to 0.25.[27] The current meta-analysis revealed no tendency for the effect to decay across time, although at least one study[38] showed improved risk reduction after a delay.

TABLE 2. Efficacy of Interventions to Promote Risk Reduction at Studies' First Follow-Up Assessments

Outcome	*k* of Interventions	Weighted Mean *d* (and 95% confidence interval)		Homogeneity of Effect Sizes	
		Fixed Effects	Random Effects	*Q*	*P*
Condom use					
Unspecified context	15	0.16 (0.08 to 0.25)	0.16 (−0.05 to 0.37)	80.76	<0.0001
Vaginal	3	0.37 (0.20 to 0.54)	0.45 (0.14 to 0.77)	5.02	0.081
Anal	5	0.21 (0.09 to 0.33)	0.24 (0.04 to 0.45)	7.97	0.158
Oral	5	0.15 (0.03 to 0.26)	0.16 (0.01 to 0.30)	5.31	0.257
Averaged	19	0.16 (0.09 to 0.23)	0.19 (0.05 to 0.33)	55.15	<0.0001
Number of sexual partners	7	−0.01 (−0.16 to 0.14)	−0.01 (−0.16 to 0.14)	4.62	0.593

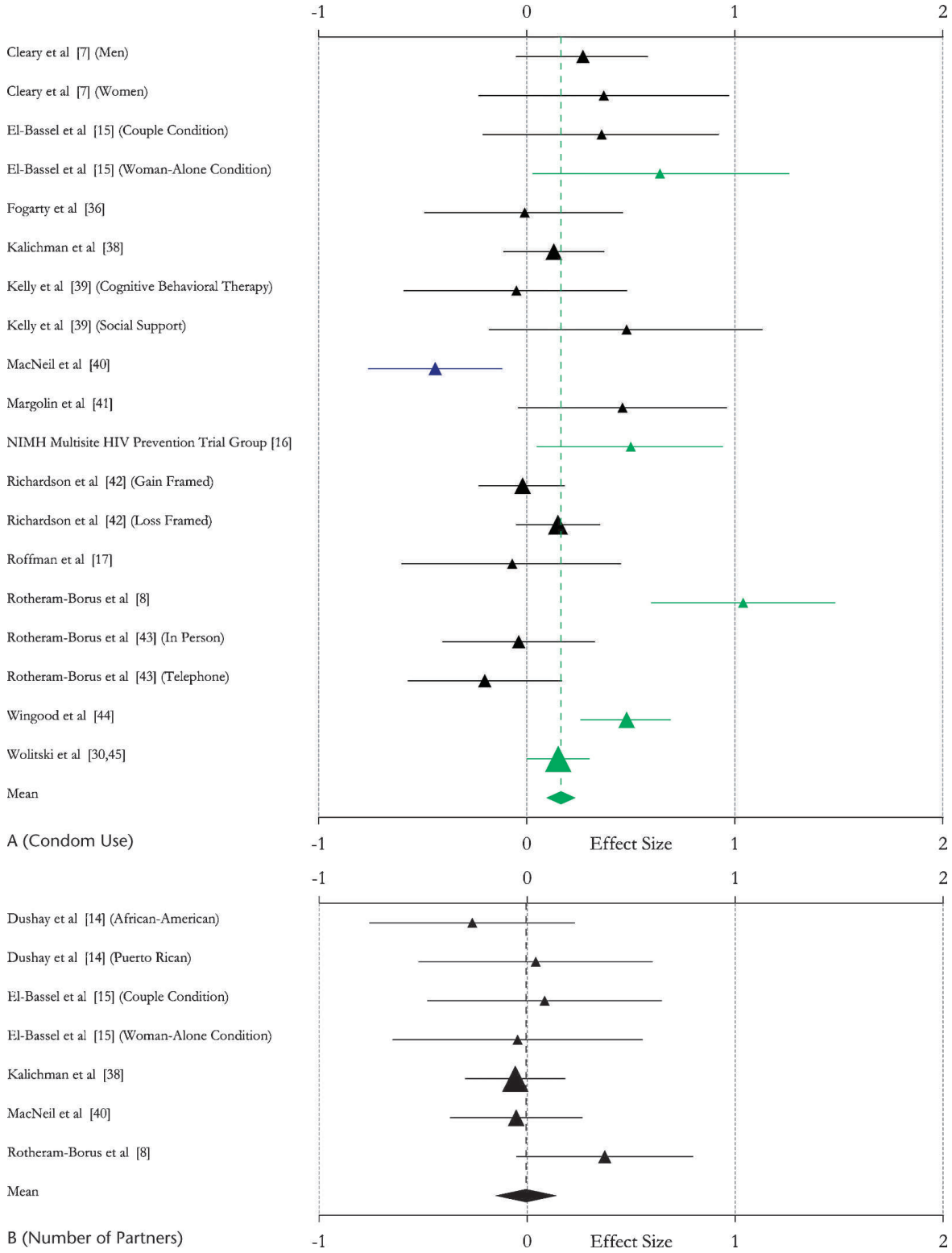

FIGURE 2. Forest plots of effect sizes for interventions that assessed condom use (top, A) or number of partners (bottom, B). The delta symbol for each effect size is sized proportionally to its weight in analyses. The confidence interval for each effect size is indicated by its line and for the mean by the width of its diamond. Zero values indicate exactly no difference between the two groups. Effect sizes that significantly favor the intervention appear in green (right side); those that favor the control group appear in blue (left side).

TABLE 3. Features of Studies That Were Linked to the Efficacy of Interventions to Increase Condom Use

	Patterns		Test Statistics		
Study Dimension	**Level**	**Mean *d* (95% CI)**	***k***	**Statistic**	***P***
Age of sample	20 years	0.53 (0.22 to 0.84)	14	$\beta = -0.35$	0.018
	40 years	0.11 (0.02 to 0.20)			
Proportion of sample MSM	All MSM	0.04 (−0.07 to 0.15)	12	$\beta = -0.66$	0.002
	No MSM	0.42 (0.24 to 0.60)			
Inclusion of intervention elements	Only information	0.05 (−0.07 to 0.16)	7	$Q_B(2) = 10.98$	0.004
	Information plus either motivational or behavioral skills	0.12 (−0.02 to 0.26)	3		
	All three dimensions	0.32 (0.20 to 0.43)	9		

Analyses are based on fixed-effects assumptions; each effect size (*d*) was weighted by the inverse of its variance. Analyses were not undertaken on the sexual frequency outcomes.
MSM indicates men who have sex with men; CI, confidence interval; *k*, number of studies; *P*, probability; Q_B, homogeneity between categories; when statistically significant, implies differences among the means for the observed levels.

The tendency for interventions to increase condom use relative to controls depended to some extent on the features of the studies. Compared with controls, intervention group members' condom use improved to the extent that samples had fewer MSM and were younger and, importantly, when interventions included motivational and behavioral skills enhancements (see Table 3). Although the overall magnitude of the ES on condom use was small, it was larger for interventions that included motivational and skills enhancements, for those that had younger participants, and for those that did not sample MSM. Indeed, interventions had no significant impact when the sample was 100% MSM or when motivational and behavioral skills enhancements were omitted.

Only 7 studies examined the number of sexual partners as an outcome; these studies revealed no change for intervention members compared with control group members. This nonsignificant effect may reflect a restricted range (ie, floor effect) on this variable, reliance on condom use as a risk reduction strategy, lack of intervention efficacy on this variable, or other factors not addressed in our analyses. Another possibility is that those who test positive for HIV avoid HIV^- partners and prefer HIV^+ partners, a strategy known as serosorting.[2,30–32] Unfortunately, too few studies reported partner data in a manner that would permit such an analysis. One of the studies in our sample, which addressed MSM,[33] examined just this possibility and found a small but nonsignificant trend for intervention participants to be less likely to have unprotected intercourse with HIV^- partners or partners with HIV serostatus unknown. Future research should continue to address this important issue.

Previous meta-analyses suggested that individuals who test positive for HIV increase risk-reduction behaviors such as condom use,[1] especially with serodiscordant partners. As mentioned previously, interventions for MSM did not reduce sexual risk behavior compared with control interventions, a pattern that differs from that demonstrated in an earlier meta-analysis of studies with (presumably) HIV^- MSM.[28] Yet, because no study in the current meta-analysis provided motivational and behavioral skills to a sample of MSM, it is not presently possible to know whether such enhancements would prove successful with HIV^+ MSM. A recent review of the literature examining risk reduction for all MSM[45] strongly suggested that notable risk reduction can occur, however, especially when interventions have a strong skills training component, a conclusion that converges with the current review's findings. Yet, that review did not examine the extent to which serostatus related to success. Future research should test whether more comprehensive risk-reduction programs (ie, those with informational, skills, and motivational components) results in improved results with HIV^+ MSM.

The age-related results in the current analyses were unexpected. Contrary to earlier reviews, we found that interventions were more efficacious with younger rather than older samples.[18,27–29] We hypothesize that older samples may have had longer duration partnerships than those individuals in the younger samples, a factor that is known to increase resistance to change.[34] Future studies should investigate this hypothesis.

Perhaps the most surprising finding of this work is that more than 2 decades into the epidemic, there have been so few intervention RCTs that focus on people living with HIV. We located only 15 RCTs that addressed the needs of this important population. Of this number, only 11 had samples comprised solely of HIV^+ persons. Although there have been literally hundreds of studies conducted with uninfected populations, the relative paucity of controlled studies with infected persons indicates the urgent need for research in this area, as recognized by the Centers for Disease Control and Prevention when it launched "Advancing HIV Prevention: New Strategies for a Changing Epidemic." This initiative encourages early diagnosis of HIV, increased access for HIV care, and, most important to the current context, strengthened HIV prevention services for HIV^+ persons.

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