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Behavioral Interventions for African-Americans to Reduce Sexual Risk of HIV: A Meta-Analysis of Randomized Controlled Trials

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Abstract

Context—African-Americans constitute 13% of the U.S. population yet account for nearly 50% of new HIV infections. Implementation of efficacious behavioral interventions can help reduce infections in this vulnerable population.

Objective—To examine the efficacy of behavioral interventions to reduce HIV for African-Americans among 78 randomized controlled trials that sampled at least 50% African-Americans (N = 48,585, 81% African-American), measured condom use or number of sexual partners, and provided sufficient information to calculate effect sizes.

Methods—Independent raters coded participant characteristics, design and methodological features, and intervention content. Weighted mean effect sizes, using both fixed- and random-effects models, were calculated; positive effect sizes indicated *more* condom use and *fewer* sexual partners.

Results—Compared to controls, participants who received a HIV risk reduction intervention improved condom use at short-, intermediate-, and long-term assessments; change was better among MSM and people already infected with HIV, and when interventions provided intensive content across multiple sessions. Intervention participants reduced their number of sexual partners in interventions with intensive interpersonal skills training and in younger samples, especially at delayed intervals.

Conclusions—Sexual risk reduction interventions for African-Americans increased condom use without increasing the number of sexual partners. Translating these interventions and further enhancing them continue as a high priority.

Keywords

HIV/STD; African-American; condom; sex; meta-analysis; behavior; prevention

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INTRODUCTION

African-Americans are disproportionately affected by HIV/AIDS. African-Americans comprise about 13% of the U.S. population yet account for half of all new HIV diagnoses.¹ Subgroups of African-Americans such as men who have sex with men (MSM), women, and adolescents account for the vast majority of new AIDS cases.² In addition, regions in the U.S. with higher concentrations of African-Americans report substantial increases in AIDS cases compared with other U.S. regions.³ Estimated deaths of persons living with AIDS from 2001 to 2005 were greater among African-Americans (53%) than any other racial/ethnic group.² The HIV/AIDS epidemic among African-Americans prompted the CDC to call for a heightened response from government agencies, researchers, and the African-American community to reduce the incidence of HIV in this population subgroup.⁴

Effective HIV prevention for the African-American community requires research on the efficacy of behavioral interventions, and examination of participant and intervention characteristics that moderate the success of these protocols. This research can facilitate the development, tailoring, and refinement of extant risk-reduction interventions. In a recent meta-analytic review of 38 HIV-prevention trials among African-Americans, Darbes and colleagues⁵ found that behavioral risk reduction interventions reduced unprotected intercourse; incident sexually transmitted diseases (STDs) also appeared to decrease but this outcome but was not statistically significant. Although they obtained no significant moderation patterns for these outcomes, they suggested that efficacious interventions included cultural tailoring, promoted social norms for safe sex behavior, used peer education, provided skills training on correct use of condoms and communication skills needed for negotiating safer sex, and provided multiple sessions and opportunities to practice learned skills. Darbes and colleagues' synthesis was thorough, but it was based on a relatively small sample of studies and it may have been underpowered to detect both overall trends and moderators of intervention efficacy.^{6, 7} Moreover, their review did not address numbers of sexual partners, which is important for STD transmission.⁸⁻¹⁰ Finally, by sampling narrowly (i.e., they selected only those trials with at least 80% African-Americans), this review could not assess the extent to which findings generalize across more diverse samples.

The current meta-analysis extends Darbes et al.'s contribution by addressing the aforementioned limitations with a similar goal, namely, to examine the success of sexual risk reduction interventions for African-American participants. Intervention success was measured with three outcomes: (a) condom use, (b) number of sexual partners, and (c) incident STDs. We hypothesized that African-American participants who received a risk reduction intervention would show increases in condom use and report fewer sexual partners and STDs relative to control group participants. We also evaluated the durability of these improvements over time as well as whether improvements depended on such participant features as gender, age, HIV serostatus, risk characteristics, and such intervention features as dose, tailoring, and content.

METHODS

Search Strategy and Study Selection

Studies were selected from: (1) electronic databases (e.g., PubMed, PsycINFO; Boolean search: (HIV OR AIDS OR (human AND immu* AND virus) OR (acquired AND immu* AND deficien* AND syndrome)) AND (prevent* OR interven*) AND ((african AND american) OR black) AND (condom* OR sex*)), (2) databases and document depository of HIV-related interventions held by the NIMH-funded Syntheses of HIV/AIDS Risk Reduction Project (SHARP, which has accumulated a database of published and

unpublished HIV-related interventions, 1981 to 2006) at the University of Connecticut, and (3) recent issues of professional journals and reference sections of obtained articles. Unpublished papers (e.g., dissertations) were included to avoid the file-drawer effect (i.e., stronger effects reported in published vs. unpublished studies).¹¹ Studies that fulfilled the selection criteria and were available by June 1, 2006 were included.

Studies were included if they examined a HIV-risk-reduction strategy in a sample of greater than 50% African-Americans; used a randomized controlled trial (RCT) design; measured condom use (unspecified, vaginal, or anal) or number of sexual partners; and provided sufficient information to calculate effect sizes. Studies were excluded if the intervention(s) focused on perinatal transmission or if they used time-series-only designs. Of the initially relevant reports, seven had insufficient information for the calculation of effect sizes; requests sent to these study authors were unsuccessful. When multiple papers evaluated intervention efficacy in the same sample of participants, the more comprehensive report was used in analyses. Seventy-eight independent studies (from 76 reports), which included 114 separate interventions (*k*), met the selection criteria and were included in the meta-analysis (see Figure, Supplemental Digital Content 1).

Coding and Reliability

Two independent raters coded study information (e.g., location), sample characteristics and risks (e.g., ethnicity, gender, age), design and measurement specifics (e.g., recruitment method, number of follow-ups), and content of control and intervention condition(s) (e.g., number of sessions, intervention content). Interrater reliability for categorical variables was calculated as Cohen's kappa (κ).¹² Mean κ was 0.66 (median = 0.76) and the mean agreement was 89%, which comprised high reliability. For continuous variables, we calculated the Spearman-Brown correlation value,¹³ which takes into account the mean interrater correlation and the number of raters; the mean effective reliability was 0.90. Disagreements between coders were resolved through discussion.

Study Outcomes and Calculation of Effect Sizes

For each study, effect size estimates for condom use, number of sexual partners, and incident STDs were calculated. Trials varied widely in their measures of *condom use* (e.g., percent of condom-protected sexual events; number of unprotected events; condom use at last intercourse); thus outcomes included protected or unprotected vaginal, anal, or unspecified intercourse across a wide array of contexts. Because the majority of the RCTs reported continuous measures, effect sizes (*d*) were defined as the mean difference between the treatment and control groups divided by the pooled standard deviation.¹⁴ (The standardized mean difference is meant for comparisons of continuous outcomes.) In the absence of means and standard deviations, other statistical information (e.g., *t* or *F* test) was used.^{6, 7} If a study reported dichotomous outcomes (e.g., frequencies), we calculated an odds ratio and transformed it to *d* using the Cox transformation.¹⁵ If no statistical information was available (and could not be obtained from the authors) and the study reported a non-significant or significant between-group difference, we estimated that effect size to be zero or calculated an effect size based on the minimum statistically significant *P*-value (i.e., *P* = .05), respectively.⁶ In calculating *d*, we controlled for significant baseline differences between the intervention and control condition(s) when pre-intervention measures were available. All effect sizes were corrected for sample size bias;¹⁶ positive effect sizes indicated the treatment group increased its condom use or decreased number of partners compared to controls.

Multiple effect sizes were calculated from individual studies when they had more than one outcome, multiple intervention conditions, or when outcomes were separated by sample

characteristics (e.g., gender). Effect sizes calculated for each intervention and by sample characteristic were analyzed as a separate study.⁶ When a study contained multiple measures of the same outcome (e.g., vaginal and anal condom use measured using separate items), the effect sizes were averaged. Consequently, the 78 studies provided 114 intervention- vs. control-group comparisons on either condom use or number of sexual partners. Because the timing of follow-ups varied widely across studies, we divided outcomes into three measurement intervals as a strategy to examine all study assessments: (a) short-term (≤ 13 weeks; $k = 71$), (b) intermediate (14 to 43 weeks; $k = 63$), and (c) long-term (52 to 156 weeks; $k = 31$).

Fixed- and random-effects analyses were conducted in Stata 10.0.¹⁷ The homogeneity statistic, Q , was computed to determine whether each set of d_{+s} shared a common effect size. The homogeneity of variance statistics has an approximate chi-square distribution with the number of effect sizes (k) minus 1 degrees of freedom;¹⁸ a significant Q indicates a lack of homogeneity. To further assess the extent to which studies' outcomes were consistent, the I^2 index and its corresponding 95% confidence intervals (CIs) were calculated;^{19, 20} I^2 varies between 0 (homogeneous) and 100% (non-homogeneous).²¹ If the CI around an I^2 index includes zero, effect size is considered homogeneous. To explain variability in the effect sizes that lack homogeneity, the relation between study characteristics and the magnitude of the effects was examined using modified least squares regression analyses with weights equivalent to the inverse of the variance for each effect size. So that studies were not omitted from multiple-moderator models, missing values of significant univariate moderators were imputed from the mean of other studies that reported the information. Analyses with and without imputation revealed the same general trends; therefore, only the analyses with imputation are presented. For subgroups (i.e., percent MSM, HIV+, IDU), missing information was coded as zero; this assumption is relatively conservative statistically. To reduce multicollinearity in multiple-moderator models, all significant continuous moderators were mean centered. Significant univariate moderators were then entered simultaneously into a multiple regression model in order to determine which dimensions explained unique variance.

RESULTS

Study, Sample, and Intervention Details

A descriptive summary of the 78 RCTs included in the meta-analysis can be found in Supplemental Digital Content 2. Of the 78 studies reviewed, most were conducted in medium to large cities (94%), in the Northeast (28%) or Southeast (27%). Samples were obtained via the community (38%) or were recruited through clinics (36%). A total of 48,585 individuals participated, with a retention rate of 75% at follow-up. Participants were predominately female (60%), African-American (81%), 28 years of age ($SD = 9.4$; range, 11-41), and sexually active (84%). Of the studies reporting substance use, 73% and 43% of the studies sampled participants who used illegal drugs (including intravenous drugs) or alcohol, respectively.

All studies randomly assigned individuals or groups to conditions. The control condition was most often HIV education (41%), but 36% used a more intensive comparison condition (e.g., brief or altered form of intervention) and 23% used an assessment-only control. The median number of post-intervention follow-ups was two (range, 1-5). The first follow-up occurred an average of 12 weeks ($SD = 14.6$, range, 0-104 weeks) after the intervention, the next assessment took place 24 weeks ($SD = 20.3$ range, 2-104 weeks) post-intervention, the third averaged 44 weeks ($SD = 24.6$; range, 4-104 weeks) post-intervention, and the fourth averaged 53 weeks ($SD = 16.8$; range, 43-104 weeks) post-intervention, with a single follow-up reported at 156 weeks. (Some multiple-week interventions had initial assessments

after their last session, 0 weeks.) Because the timing of follow-ups varied widely across studies, we divided outcomes into three measurement intervals as a strategy to examine all study assessments: (a) short-term (≤ 13 weeks; $k = 71$), (b) intermediate (14 to 43 weeks; $k = 63$), and (c) long-term (52 to 156 weeks; $k = 31$).

From the 78 studies included, 114 separate intervention conditions were evaluated. Interventions were typically conducted in community (41%) or clinical settings (36%) and delivered to a group (76%), an individual (18%), or a combination of individual and group sessions (6%). Group interventions met for a median of 5 sessions of 94 minutes each with a median of 2 facilitators and 8 participants per session; individual interventions met for a median of 1.5 sessions of 30 minutes each with 1 facilitator. Facilitators were paraprofessionals (e.g., person with a BA degree or less; 54%), professionals (e.g., MDs; 18%), peer (5%) or a combination (23%). The 60 studies that used an active comparison group met for a median of 2 sessions of 60 minutes each with a median of 1.5 facilitators and 5 participants. All interventions provided HIV-related education; most provided active skills training (i.e., with rehearsal and feedback) relating to interpersonal (e.g., partner negotiation; 61%), condom-specific (e.g., placing condoms on model; 50%), and/or intrapersonal (e.g., self-management; 46%) aspects of risk reduction. Some interventions (36%) provided condom information and demonstrations whereas 25% provided passive skills training (i.e., didactic only without rehearsal) and 22% included counseling and testing. Condoms were provided in 30% of the interventions.

Overall Efficacy of the Interventions

Table 1 provides a summary of the weighted mean effect sizes, d_+ , by assessment interval. These analyses indicate that, overall, sexual risk reduction intervention participants improved condom use but neither increased nor decreased number of sexual partners compared to controls. For condom use, d_+ s ranged from 0.12 to 0.20 over the various assessment intervals. At each interval and at the studies' final assessments, the effects associated with condom use lacked homogeneity indicating that sample, methodological, or intervention characteristics may explain variability in the magnitude of effect sizes. In contrast, the effects associated with number of sexual partners were homogeneous at each post-intervention assessment except for long-term (≥ 52 weeks) assessment. When the studies' last available assessments were considered, there was an overall trend for interventions to lower the numbers of partners, although these effect sizes also lacked homogeneity.

Moderators of Intervention Impact on Condom Use

Overview—Univariate regression analyses examined potential moderators of condom use effect sizes at all assessment occasions. These variables were individually examined in models (Table 2): date the intervention commenced, participant gender and age, participant subgroup (i.e., MSM, participants with HIV, IDU, those known to engage in sex trading or prostitution), retention rate, intervention dose, use of formative research (e.g., focus groups), and intervention component (i.e., counseling and testing, interpersonal skills training, intrapersonal skills training, condom use demonstration and/or skills training, motivation). Results for significant moderators appear below. The percentage of sample that was African-American did not relate significantly to any outcome and therefore is not considered further.

Short-term (≤ 13 weeks)—Participants achieved greater condom use if the intervention content included intrapersonal skills training (i.e., self-management).

Intermediate (14 to 43 weeks)—Intervention efficacy was more likely when the interventions included (a) more HIV+ participants or MSM, and fewer IDU, (b) had higher

retention rates, (c) tailored content to participants, (d) provided more sessions of longer duration, (e) included interpersonal skills training, and (f) did not include counseling and testing. When entered simultaneously, sampling HIV+ participants, more MSM, higher retention rates, and intervention length remained significant, and explained 26% of the variability in study outcomes.

Long-term (52 to 152 weeks)—Interventions succeeded in improving condom use when (a) sampling more HIV+ participants, younger people, and females, (b) had higher retention rates, (c) tailored content to participants, (d) offered more sessions of longer duration, (e) included interpersonal skills training, and (f) did not include counseling and testing. When significant univariate predictors were simultaneously considered, two predictors remained significant: sampling more HIV+ participants and offering more sessions of longer duration. This model explained 60% of the variability in study outcomes.

Because analyses revealed that significant moderation patterns appeared at later assessments (Table 2), further models examined each study's final assessment of condom use. In addition to offering a larger sample ($k = 100$), this strategy also afforded a direct assessment of interactions of study dimensions with time interval, as the patterns in the preceding analyses suggest. All moderator dimensions that significantly related to variability in earlier analyses were included, in addition to the follow-up duration and the interactions of these terms; non-significant terms were trimmed from the model. As Table 3 shows, intervention efficacy increased in samples with more HIV-infected individuals and more MSM. In addition, three variables interacted with time interval to explain variability in effect sizes, namely: (a) retention of participants interacted with time interval such that it played a larger role at later weeks, post-intervention; (b) dose (i.e., number and duration of sessions) also interacted with time interval such that dose was more predictive at later intervals; and (c) interpersonal skills training interacted with time interval such that it had a larger impact at early intervals than at later intervals. This model explained 41% of the variability in study outcomes; moreover each of these patterns remained intact when the sample was restricted to trials with at least 80% African-Americans, except that the MSM pattern became non-significant. (When added, a methodological factor, type of control group, was not significant.) Moreover, when more conservative mixed-effects assumptions were assumed, adding a random-effects constant, the patterns described here retained significance ($P_s < .05$) except for percentage of MSM ($P = .20$) and the interaction of interpersonal skills training with time interval ($P = .08$).

Moderators of Intervention Impact on Number of Partners

Because few studies assessed number of partners at long-term ($k = 9$), we examined each study's final assessment ($k = 47$). As Table 4 shows, interventions succeeded in reducing the number of partners to the extent that the dose of interpersonal skills training was higher, younger samples were examined at points more delayed from the intervention, retention rates were higher at short-term intervals following the intervention, and retention rates were lower at long-term intervals. This model explained 37% of the variability in study outcomes and was well-specified, $Q_{\text{Residual}}(40) = 49.64$, $P = .14$, $I^2 = 19.42$. Using more conservative mixed-effects assumptions, we added a random-effects constant and found that each pattern just described was no longer significant ($P_s > .15$). It should be noted that because the number of cases is approximately 50% lower than that for condom-use effect sizes, statistical power is reduced.

Intervention Impact on Incident STDs

To investigate the extent to which trials succeeded in averting STDs, we examined STD diagnoses at final assessment. STD diagnoses were reduced in intervention participants compared to controls ($d_+ = 0.08$, 95% CI = 0.05, 0.12; $Q(13) = 65.75$, $P < .001$, $I^2 = 80.23$).

DISCUSSION

This meta-analytic review provides the most sophisticated examination to date of factors that may moderate the success of interventions to reduce sexual risk behavior in broad sample of African-Americans. In contrast to a recent review that concluded efficacy maintained at least as long as 6 months,⁵ we found that sexual risk reduction interventions were efficacious in increasing condom use over durations as long as 3 years post-intervention (Table 1). The overall effect size, $d_+ = 0.17$ (equivalent OR = 1.33) is similar in magnitude to intensive HIV prevention interventions as obtained in meta-analyses of many other population subgroups.²² Results also showed that intervention efficacy varied across studies. Condom use improved more when studies sampled more people living with HIV, more MSM, and when intervention content was extensive and contained interpersonal skills training (Table 3). Under ideal circumstances, intervention success increased at longer intervals after the intervention. In particular, interventions with multiple sessions and more time per session as well as those that achieved high-retention rates exhibited greater efficacy at long intervals (e.g., $d_+ = 0.33$, equivalent OR = 1.72, at 52 weeks after the intervention). Moreover, the evidence suggests that interventions increase condom use and, for young samples assessed at long-term intervals, interventions succeeded in *decreasing* the number of partners (Table 4). This evidence provides encouragement that intensive risk reduction programs benefit African-Americans, who have suffered disproportionately from the HIV epidemic.⁴

As a general trend across the entire literature, interventions had no impact on number of sexual partners ($d_+ = 0.04$; equivalent OR = 1.07), but again findings varied significantly across studies (Table 1). Parallel to condom use outcomes, interventions were successful at reducing numbers of sexual partners when they provided sufficient interpersonal skills training. For example, interventions without interpersonal skills training were not efficacious ($d_+ = 0.01$; OR = 1.02) whereas interventions with 3 hours per session of this training were more efficacious ($d_+ = 0.10$; OR = 1.18). Evidence also suggested that interventions lowered number of partners for younger but less so for older African-Americans, a pattern that emerges at relatively long intervals following the intervention. For example, in younger samples aged 15 years, a small but significant effect emerges by 52 weeks following the intervention ($d_+ = 0.24$; equivalent OR = 1.49). These trends remained significant even when controlling for studies' retention rates, a proxy for study quality (e.g., high-retention studies are more likely to have had NIH support). The size of these effects is equivalent to those revealed in a more general review of sexual risk reduction interventions.²³

The current results should not be taken to imply that brief interventions provide no benefit. To the contrary, single-session interventions with brief content (e.g., 15 minutes) were efficacious at shorter assessment occasions (as long as 43 weeks post-intervention; Table 2). We conclude that brief interventions are better-suited to short-term change whereas multiple-session interventions are better-suited for long-term behavior maintenance, regardless of sample and intervention features such as HIV-positive or MSM status and the trials' retention rates (Table 3). A strategy that may merit future investigation is the use of brief interventions followed by booster sessions. Such interventions may yield improved risk-reduction success over longer durations.

The fact that interpersonal skills training—providing content that assists participants to negotiate safer sex—lowered risk both in terms of condom use (Tables 3 and 4) and in terms of number of partners (Table 4) suggests the importance of a skills training component. Whereas the risk-reduction effect on condom use accrued regardless of dose, the effect on number of partners required a larger doses of interpersonal skills training (e.g., 90 minutes per session). Age of sample effects further qualify these trends. Because younger people tend to have more partners,²⁴ it is logical to expect larger intervention effects for younger samples. Indeed, at long-term (but not short-term) intervals, interventions exhibited greater efficacy for younger samples.

Some of our findings suggest that interventions including HIV counseling and testing were less successful at improving condom use in the intermediate or long-term than those without such components (Table 2). This finding should be interpreted with caution. The literature suggests that HIV counseling and testing is efficacious but only for those who are HIV-positive,²⁵⁻²⁷ and our meta-analytic review included few samples of individuals with HIV. Moreover, the counseling-and-testing dimension disappeared when controlling for other aspects of the interventions.

Limitations

Perhaps the most important limitation of this work involves the individual level of analysis. That is, the primary outcomes for this review were condom use and number of partners. Although both of these outcomes are important, they provide an incomplete understanding of HIV in the African-American community. A number of important social and economic issues also influence risk for African-Americans.²⁸ Poverty, homelessness, incarceration, limited access to quality health care, lack of medical coverage, and other socioeconomic issues create a context that confers considerable risk for HIV and other STDs. Stressful life circumstances often eclipse HIV as a health concern, with survival needs forcing people into riskier practices and transactional relationships.²⁹ The data available did not permit an evaluation of the effect of these social and structural forces, but it is important to recognize these contextual factors and their role in the domestic HIV epidemic.

A second limitation to the results on condom use and number of partners is that they are based on self-reports, which may not always be veridical and may be vulnerable to memory biases.³⁰ Fortunately, this limitation is attenuated given results regarding STDs, which were assessed with objective measures (e.g., new infections). If a trials' efficacy in terms of condom use and numbers of partners reflects reality, then reduced STDs should also result, and this pattern was obtained.

A third limitation of the literature is the small number of studies available to fully explore how these strategies impact African-Americans who are HIV-infected, who engage in transactional sex, inject drugs, or are MSM. There were few studies focused on these subgroups, and samples had relatively small proportions of individuals with these characteristics. We found only one study examining a sample of 100% HIV-infected individuals.³¹ Nonetheless, it is encouraging to see that condom use increases markedly in interventions that sample more African-American MSM or people living with HIV (Tables 3 and 4). These results are consistent with recent meta-analyses of interventions for people living with HIV^{32,33} and meta-analyses focused on MSM.^{34,35} The current results do not provide a clear picture about sexual risk reduction for African-American IDUs.

A final limitation is that these results pertain only to efficacy rather than effectiveness. RCTs are highly controlled in order to assure strong interval validity, but they usually include conditions that are not ordinarily present in a local community (e.g., incentives to return for multiple sessions).³⁶ Community evaluation trials take what is known from intervention

trials and attempt to translate these strategies into policies and organizational plans. Results may vary at the point of translation.

Conclusion

This meta-analytic review provides evidence that interventions significantly reduce sexual risk behavior. African-Americans who participate in behavioral interventions increase condom use over a range of intervals following the intervention, and younger recipients reduce their number of sexual partners. Efficacious interventions seem to work because they strengthen participants' self-management skills; the durability of the benefits observed is related to the use of intervention dose, that is, multiple sessions promote more long-lasting effects. Results from this meta-analysis suggest that prevention activities can lower long-term risk for a group that has been disproportionately affected by the HIV epidemic. Although rates of HIV among African-Americans primarily been attributed to risk characteristics such as high-risk heterosexual behaviors, male-to-male sexual contact, and intravenous drug use, economic issues as well as social and structural influences directly or indirectly puts African-Americans at risk. Moreover, health disparities, barriers to medical care, distrust of medical establishment, and stigma about HIV prevents African-Americans from obtaining a HIV test that not only benefits the individual being tested but can also protect their partners from contracting HIV.^{1, 28} Any attempts to implement a successful intervention among African-Americans must address social and structural issues relevant to the community.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Weighted mean effect sizes and related statistics by assessment interval for interventions targeting African-Americans.

Outcome	Interval*	k	d_+ (95% CI)		Homogeneity of d_s		
			Fixed effects	Random effects	Q	P	I^2 (95% CI)
Condom use	Short-term	68	0.20 (0.17, 0.24)	0.21 (0.16, 0.26)	138.01	<.001	51% (36%, 63%)
	Intermediate	59	0.12 (0.09, 0.14)	0.13 (0.07, 0.18)	227.87	<.001	75% (67%, 80%)
	Long-term	28	0.17 (0.13, 0.20)	0.21 (0.12, 0.30)	131.87	<.001	80% (71%, 86%)
Final assessment reported		100	0.13 (0.11, 0.15)	0.16 (0.11, 0.21)	363.18	<.001	73% (67%, 78%)
Number of sexual partners	Short-term	28	0.00 (-0.04, 0.05)	0.01 (-0.04, 0.07)	36.62	.10	26% (0%, 54%)
	Intermediate	32	0.04 (0.00, 0.07)	0.04 (-0.01, 0.08)	33.84	.33	8% (0%, 39%)
	Long-term	9	0.07 (-0.01, 0.15)	0.12 (-0.04, 0.28)	28.44	<.001	75% (45%, 86%)
Final assessment reported		47	0.04 (0.01, 0.07)	0.04 (-0.07, 0.09)	78.31	.002	41% (17%, 59%)
Sexually transmitted diseases	Short-term	7	0.08 (0.03, 0.12)	0.08 (0.03, 0.12)	0.61	.996	0%
	Intermediate	8	0.07 (0.03, 0.11)	0.07 (0.01, 0.14)	14.53	.043	52% (0%, 78%)
	Long-term	7	0.12 (0.08, 0.17)	0.23 (0.09, 0.37)	51.54	<.001	88% (78%, 94%)
Final assessment reported		14	0.08 (0.05, 0.12)	0.13 (0.04, 0.22)	65.75	<.001	80% (68%, 88%)

Note. Weighted mean effect sizes (d_+) are positive for differences that favor the treatment group relative to the control group. k , number of interventions; d_+ , weighted mean effect size; CI, confidence interval; Q , homogeneity statistic; I^2 , consistency of effect sizes.

* Post-intervention assessment interval; short-term, ≤ 13 weeks; short-term; intermediate, 14 to 43 weeks; long-term, 52 to 156 weeks.

Table 2

Condom use effect sizes related study features at differing intervals.

Study dimension	Level*	Short-term			Intermediate			Long-term		
		d ₊ (95% CI)	β	P	d ₊ (95% CI)	β	P	d ₊ (95% CI)	β	P
Percent sample HIV-positive	0%	0.21 (0.17, 0.25)	0.15	.38	0.08 (0.05, 0.11) 0.44 (0.42, 0.46)	0.05	0.47 <.001 k = 29	0.12 (0.08, 0.17) 0.70 (0.68, 0.73)	0.72 <.001 k = 11	
	100%	0.30 (0.28, 0.32)		k = 29						
Mean age of sample	15 years	0.20 (0.14, 0.27)	0.00	.97	0.14 (0.08, 0.19)		.43	0.23 (0.16, 0.29)	0.18	.036
	41 years	0.21 (0.15, 0.26)			0.10 (0.06, 0.15)			0.11 (0.05, 0.18)		
Percent sample female	0%	0.20 (0.14, 0.26)	0.02	.78	0.11 (0.06, 0.15)	0.04	.56	0.07 (−0.002, 0.14)	0.23	.01
	100%	0.21 (0.20, 0.22)		k = 68	0.13 (0.12, 0.14)		k = 59	0.23 (0.22, 0.24)		k = 28
Percent sample MSM	0%	0.22 (0.18, 0.27)	0.01	.93	0.11 (0.07, 0.15) 0.27 (0.25, 0.29)	0.21 <.007 k = 35		0.14 (0.09, 0.19)	0.23	.06
	16%	0.23 (0.21, 0.25)		k = 43				0.33 (0.30, 0.36)		k = 16
Percent sample IDU	0%	0.17 (0.12, 0.22)	0.11	.43	0.13 (0.09, 0.17)	−0.26	<.001	0.14 (0.09, 0.18)	0.01	.94
	100%	0.40 (0.33, 0.47)		k = 36	0.05 (0.04, 0.06)		k = 30	0.14 (0.12, 0.16)		k = 12
Percent retention	42.5%	0.27 (0.25, 0.28)	−0.12	.17	−0.07 (−0.08, −0.05) 0.26 (0.25, 0.27)	0.38 <.001 k = 58		−0.29 (−0.32, −0.26)	0.55	<.001
	100%	0.17 (0.16, 0.18)		k = 68				0.41 (0.39, 0.43)		k = 27
Tailoring	Yes	0.18 (0.18, 0.19)	−0.10	.22	0.18 (0.17, 0.18)	0.30	<.001	0.23 (0.22, 0.24)	0.33	<.001
	No	0.22 (0.18, 0.26)			0.06 (0.03, 0.09)		k = 59	0.09 (0.03, 0.14)		k = 28
Total content	1 session @ 15 mins	0.21 (0.13, 0.29)	0.13 [†]	.53	0.08 (0.03, 0.14) 0.17 (0.01, 0.34) 0.05 (−0.01, 0.10) 0.28 (0.221, 0.35)	0.38 [†] <.001 k = 59		0.04 (−0.04, 0.12) 0.19 (−0.01, 0.40) 0.00 (−0.06, 0.07) 0.42 (0.34, 0.50)	0.75 [†] <.001 k = 28	
	1 session @ 420 mins	0.14 (0.01, 0.28)		k = 68						
	8 sessions @ 45 mins per session	0.18 (0.05, 0.32)								
	8 sessions @ 120 min per session	0.25 (0.18, 0.33)								

Study dimension	Level*	Short-term			Intermediate			Long-term		
		d ₊ (95% CI)	β	P	d ₊ (95% CI)	β	P	d ₊ (95% CI)	β	P
Intrapersonal skills training	Yes	0.23 (0.22, 0.24) 0.25 .004			0.12 (0.11, 0.12)	0.004	.95	0.15 (0.14, 0.16)	-0.14	.12
	No	0.12 (0.06, 0.19) k = 68			0.12 (0.07, 0.17)		k = 59	0.21 (0.15, 0.28)		k = 28
Interpersonal skills training	Yes	0.22 (0.21, 0.23)	0.09	.29	0.15 (0.15, 0.16)	0.20	.002	0.23 (0.22, 0.24)	0.39	<.001
	No	0.18 (0.13, 0.23)		k = 68	0.08 (0.04, 0.11)		k = 59	0.05 (-0.01, 0.11)		k = 28
Counseling and testing	Yes	0.18 (0.17, 0.18)	-0.13	.14	0.07 (0.06, 0.07)	-0.27	<.001	0.04 (0.03, 0.05)	-0.47	<.001
	No	0.22 (0.18, 0.26)		k = 68	0.17 (0.14, 0.21)		k = 59	0.25 (0.20, 0.30)		k = 28

Note. Weighted mean effect size values (*d*₊) are positive when condom use is higher for treatment relative to control group members. Models used the inverse of the variance for each effect size as weights; reported coefficients (B) are standardized. Bold-faced entries reflect significant moderation patterns(*P*s < .05). Within any measurement interval, boxes indicate moderation patterns that remained significant when controlling other dimensions that had exhibited significant univariate associations; those without boxes were non-significant on a univariate basis or became so when controlling for the dimensions in boxes.

* Values represent extremes of the study dimension in question.

† Represents the multiple R of number of sessions, length per session, and the interaction term. CI, Confidence interval. IDU, Injection drug users. *k*, number of studies. MSM, Men who have sex with men.

Table 3

Intervention efficacy at representative values of sample and intervention characteristics, with each study's last available assessment of condom use as the dependent variable and values adjusted for the presence of each dimension in the model.

Study dimension	Level*	d, (95% CI)	Trials ≥50% African-Americans		Trials ≥80% African-Americans	
			β	P	β	P
Sample characteristics						
Percent sample HIV-positive	0%	0.16 (0.11, 0.20)	0.22	<.001	0.18	.019
	100%	0.46 (0.32, 0.59)				
Percent sample MSM	0%	0.16 (0.12, 0.21)	0.15	.007	-0.15	.048
	16%	0.29 (0.20, 0.39)				
Percent retention × Duration after intervention			0.24 [‡]	<.001	0.23	.052
13 weeks after intervention	42.5%	0.14 (0.01, 0.27)				
	100%	0.10 (-0.01, 0.20)				
52 weeks after intervention	42.5%	-0.01 (-0.20, 0.19)				
	100%	0.49 (0.38, 0.61)				
Intervention characteristics						
Total content × Duration after intervention			0.52 [‡]	.007	0.38	.020
13 weeks after intervention	1 session @ 15 mins	0.17 (0.07, 0.26)				
	1 session @ 420 mins	0.33 (0.13, 0.52)				
	8 sessions @ 45 mins per session	0.07 (-0.02, 0.16)				
	8 sessions @ 120 min per session	0.11 (0.02, 0.20)				
52 weeks after intervention	1 session @ 15 mins	0.11 (0.03, 0.20)				
	1 session @ 420 mins	0.18 (-0.01, 0.37)				
	8 sessions @ 45 mins per session	0.09 (0.02, 0.16)				
	8 sessions @ 120 min per session	0.33 (0.24, 0.41)				
Interpersonal skills training			-0.23 [§]	.007	-0.25	.037
1 week after intervention	Yes	0.12 (0.02, 0.22)				
	No	0.04 (-0.06, 0.15)				
52 weeks after intervention	Yes	0.27 (0.21, 0.34)				
	No	0.33 (0.24, 0.41)				

Note. Weighted mean effect size values (d_{+}) are positive for differences that favor increased condom use in the treatment relative to control group members and are adjusted for the presence of the other study dimensions. The model used the inverse of the variance for each effect size as weights and entered study dimensions simultaneously. The full regression equation is $0.18 + 0.015(\text{Interpersonal skills}) + 0.30(\text{proportion HIV-positive}) + 0.82(\text{proportion MSM}) + 0.23(\text{proportion retained}) + 0.015(\text{Interpersonal skills training}) + 0.0018(\text{weeks after intervention}) - 0.0025(\text{Interpersonal skills} \times \text{weeks}) + 0.024(\text{Retention} \times \text{weeks}) - 0.00066(\text{Number of sessions}) + 0.0014(\text{Minutes per session}) + 0.00015(\text{Sessions} \times \text{Minutes}) + 0.000031(\text{Minutes} \times \text{Weeks}) + 0.00010(\text{Sessions} \times \text{Minutes} \times \text{Weeks})$, where each continuous term was zero-centered and each categorical variable was contrast coded (+1 vs. -1).

* Values are representative of the study dimension in question.

[†] Number of weeks and retention were also entered as terms.

[‡] Number of weeks, number of sessions, and time per session were also entered as terms as were their interactions.

[§] Number of weeks and interpersonal skills training were also entered as terms. *CI*, Confidence interval. *IDU*, Injection drug users. *k*, number of studies. *MSM*, Men who have sex with men. β , standardized regression coefficient.

Table 4

Weighted mean effect sizes based on each study's last available assessment of number of partners as the dependent variable for trials with assessments as long as 102 weeks after the intervention, with values adjusted for the presence of the other study dimensions.

Dimension and Level*	d_+ (95% CI)	β	P
Interpersonal skills training		0.34	.005
0 minutes per session	0.01 (−0.03, 0.06)		
90 minutes per session	0.06 (0.02, 0.10)		
180 minutes per session	0.10 (0.03, 0.16)		
Mean age of sample × Duration after intervention		0.25 [†]	.046
At 13 weeks after intervention			
15 years	−0.02 (−0.15, 0.11)		
27 years	0.01 (−0.05, 0.07)		
41 years	0.04 (−0.04, 0.12)		
At 52 weeks after intervention			
15 years	0.24 (0.12, 0.36)		
27 years	0.12 (0.07, 0.17)		
41 years	−0.02 (−0.11, 0.08)		
Retention × Duration after intervention		−0.45 [‡]	<.001
At 13 weeks after intervention			
42.5% Retention	−0.12 (−0.24, 0.002)		
100% Retention	0.08 (−0.01, 0.16)		
At 52 weeks after intervention			
42.5% Retention	0.32 (0.16, 0.48)		
100% Retention	−0.01 (−0.09, 0.07)		

Note. Weighted mean effect size values (d_+) are positive for differences that favor increased condom use in the treatment relative to control group members and are adjusted for the presence of the other study dimensions; data after 39 weeks are not plotted because of insufficient observations (only 3 studies assessed number of partners after 52 weeks). Models used the inverse of the variance for each effect size as weights.

* Values represent extremes of the study dimension in question.

[†] Number of weeks and retention were also entered as terms.

[‡] Number of weeks, and minutes per session were also entered as terms as were their interactions. The full regression equation is $0.005 + 0.000671(\text{minutes/session of interpersonal skills training}) - 0.0033(\text{age}) + 0.0021(\text{number of weeks}) - 0.00031(\text{age} \times \text{weeks}) - .57(\text{proportion retention}) - 0.023(\text{proportion retention} \times \text{weeks})$; terms were zero-centered prior to estimating the model. *CI*, Confidence interval. *k*, number of studies. β , standardized regression coefficient.