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Sexual Risk Reduction Interventions for HIV Prevention among South African Youth: A Meta-Analytic Review

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Abstract

Objectives—To examine the efficacy of sexual risk reduction interventions among South African youth.

Methods—Electronic databases were searched to identify studies published between 2007 and early 2013. Studies were eligible if they (1) targeted youth age 9–26, (2) evaluated sexual risk reduction interventions and (3) reported at least one behavioral outcome. Independent raters coded study characteristics, and intervention content. Weighted mean effect sizes were calculated; positive effect sizes indicated less sexual risk behavior and incident STIs.

Results—Ten studies (k = 11, N = 22,788; 54% female; 79% Black-African) were included. Compared to controls, interventions were successful at delaying sexual intercourse and, among sexually active youth, at increasing condom use. A single study found reductions in the incidence of herpes simplex virus-2, but not HIV.

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CONFLIC OF INTEREST

None of the authors have any conflicts that might be interpreted as influencing the research.

AUTHOR CONTRIBUTIONS

Authors contributed to the manuscript in the following manner:

Study concept and design: Scott-Sheldon, Kalichman, Carey

Acquisition of data: Scott-Sheldon, Walstrom

Analysis and interpretation of data: Scott-Sheldon, Walstrom, Harrison, Kalichman, Carey

Drafting of the manuscript: Scott-Sheldon

Critical revision of the manuscript: Scott-Sheldon, Walstrom, Harrison, Kalichman, Carey

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Study supervision: Scott-Sheldon

Conclusions—Implementing behavioral interventions to delay sexual debut and improve condom use can help to reduce the transmission of HIV among South African youth.

Keywords

HIV; intervention; meta-analysis; sex; South Africa; youth

INTRODUCTION

South African youth between the ages of 15 and 24 experience the highest prevalence of HIV of any other region in the world with more than 20% of youths living with HIV.[1] Unprotected penile-vaginal sex is the primary mode of HIV transmission in South Africa.[1] School-aged girls and young women are disproportionately affected by HIV. Gender disparities in the prevalence of HIV continue as girls age; young women aged 20 to 24 continue to be disproportionately affected by HIV (21% vs. 5% of young men 20 to 24 years of age).[1]

Adolescent and adult women are more vulnerable to the transmission of HIV due to sociocultural factors (e.g., sexual coercion and violence, and multiple partnerships with older men, who are more likely to be HIV-infected) as well as biological factors (e.g., more mucosal surfaces for HIV to attach to; and reproductive changes during adolescence).[2] Partner drinking also increases young women's risk for HIV.[3] A national survey of South Africans found 33% of young men and 11% of young women (15 to 24 years of age) report current alcohol use with 18% of young men and 3% of young women reporting hazardous or harmful levels of alcohol consumption.[4] Although the association between alcohol consumption and risky sexual risk behaviors are similar for young men and women, sexual coercion occurs most often when sex is preceded by alcohol consumption underscoring young women's limited power in relationships [3, 5, 6] Determining the extent to which interventions can significantly impact gender inequalities, gender violence, and alcohol use among South African youth is critical for understanding the extent to which the context of sexual risk can be changed to reduce the incidence of HIV.

Prior reviews of the literature have focused on evaluating the efficacy of behavioral HIV interventions among youth in developed and developing countries. These reviews suggest that behavioral HIV interventions targeting youth are successful at delaying sexual activity, reducing condom use, and averting sexually transmitted infections in developed countries.[7, 8] Conversely, the success of youth-based interventions to reduce sexual risk behaviors in developing countries has been mixed.[9, 10] These reviews tend to focus on interventions targeting adolescents in developing countries, more broadly, or in specific geographical regions such as sub-Saharan Africa. In a narrative review of interventions for South African youth, Harrison et al. described the intervention features but, based on the range of available data, could not determine the efficacy of those interventions.[11] The efficacy of interventions specifically targeting South African youth, including factors that moderate intervention efficacy, has received limited attention. Few reviews have attended to intervention features that address gender inequalities or alcohol use. Developing, implementing, and evaluating effective HIV prevention programs for South African youth

that address the context in which sexual risk occurs is a public health priority. Understanding *which* interventions work and *why* is critical for the development of effective interventions that are targeted and tailored to South African youth.

The purpose of this meta-analysis was to determine the state-of-the-science concerning the success of behavioral interventions to reduce sexual risk behaviors and the incidence of STIs among South African youth. Intervention success at modifying sexual behaviors was inferred from studies' reports of delaying sexual activity and, among sexually active youth, increased condom use as well as reduced number of sexual partners and incident STIs. Therefore, we hypothesized that South African youth who received a behavioral sexual risk reduction or educational intervention would delay sexual intercourse and, among those who are sexually active, would increase condom use, decrease the number of sexual partners, and lower the incidence of STIs compared to control participants. We evaluated the durability of the improvements over time as well as whether these improvements were influenced by sample characteristics, intervention duration, and content. We expected that interventions (vs. controls) would be more successful in reducing sexual risk behaviors when they sampled (a) men, due to young South African women's limited power in relationships,[12] (b) fewer alcohol users as alcohol use, including abuse and dependence, is associated with sexual risk-taking behaviors,[13, 14] and (c) youth engaging in lower levels of risk at baseline (i.e., fewer sexual partners, protected vaginal/anal sex). In evaluating the intervention content, we focused on identifying the extent to which interventions addressed contextual issues (e.g., gender inequalities, alcohol use) associated with risky sexual behavior among youth in South Africa.

METHODS

Search Strategy, Inclusion Criteria, and Study Selection

We searched electronic reference databases (*PubMed*, *Global Health*, *PsycINFO*, *CINAHL*, *ERIC*, *Sociological Abstracts*, and the *Cochrane Library*) using a Boolean search strategy: (South *AND* Africa*) *AND* (youth *OR* adolescent*) *AND* (alcohol *OR* drink* *OR* binge) *AND* (HIV *OR* AIDS *OR* (human *AND* immu* *AND* virus) *OR* (acquired *AND* immu* *AND* deficien* *AND* syndrome) *OR* STI *OR* STD *OR* (sexually transmitted infection*) *OR* (sexually transmitted disease*) *OR* condom *OR* sex* *OR* risk*). The electronic reference databases were searched during January 2013. Studies were included if they (1) targeted South African youth aged 9–26 with a mean age ≥12 years to ensure that the studies targeted youth rather than children, (2) evaluated a behavioral sexual risk reduction intervention (3) reported at least one risk-related outcome (e.g., unprotected sex), (4) provided sufficient information to calculate effect sizes, and (5) were published (including electronic publications) between 2007 and early 2013. Because we were interested in determining the efficacy of current behavioral HIV interventions, we included studies published in the past 5 years. Reference sections of relevant manuscripts (including published reviews obtained through the electronic reference database search) were also reviewed. Studies that fulfilled the inclusion criteria and were available through the end of December 2012 were included. When authors reported details and/or outcomes of the intervention in multiple manuscripts, the studies were linked in the database and represented as a single study. The manuscript

reporting the main trial outcomes was selected as the primary study; the publication date from the primary study was used to determine eligibility. Thus, we included 10 studies (k = 11) obtained from 9 published manuscripts (Figure 1).[15–23]

Coding and Reliability

Two independent coders [LAJSS, PW] rated the study information, sample characteristics (e.g., gender), design and measurement specifics (e.g., recruitment strategy), and length and content of control and intervention condition (e.g., number of sessions). Study quality was assessed using 17 items (e.g., random assignment) from validated measures;[24–26] total possible quality score is 25. Inter-rater reliability was determined. For the categorical variables, raters agreed on 85% of the judgments (mean Cohen's κ = .58). Reliability for the continuous variables (calculated using the intraclass correlation coefficient; ρ) yielded an average ρ = .97 across categories (median = 1.00). Disagreements between coders were resolved through discussion.

Study Outcomes and Effect Sizes

Effect sizes were calculated for behavioral and biological outcomes. *Behavioral* outcomes included abstinence/delay of sex, condom use, multiple sexual partners, and substance use (alcohol, drugs). *Biological* outcomes included STIs, including HIV. For each outcome, effect size estimates were calculated as the mean difference between the treatment and control group divided by the pooled standard deviation [27]. If means and standard deviations were not provided, other statistical information (e.g., odds ratio) was used to estimate the effect sizes using standard procedures [28, 29]. From the 10 studies that met the inclusion criteria, 11 interventions were analyzed. All of the studies reported at least one behavioral outcome (10 abstinence/delay of sex, 11 condom use, 4 multiple partners, 2 alcohol use, 2 drug use). One study (k = 2) reported herpes simplex virus-2 (HSV-2) and HIV incidence.[18] Multiple effect size estimates were calculated from individual studies when they reported more than one outcome variable, multiple intervention conditions, or when outcomes were separated by sample characteristics (e.g., gender). Estimates were adjusted for baseline differences when pre-intervention measures were available [30]. Effect sizes were corrected for sample size bias [31]. Positive effect size estimates indicate that an intervention was successful in reducing sexual and/or other health behaviors and lowered the incidence of STIs, including HIV, relative to controls.

Statistical Analyses

Timing of post-intervention assessments varied with the first assessment occurring between 0 to 78 weeks (k = 10), the second between 26 and 104 weeks (k = 8), and a third assessment at 52 weeks (k = 2). To avoid violating the assumption of study independence and as a strategy to examine all study assessments, effect sizes were clustered into two intervals: (a) early assessments (<52 weeks; 0 to 32 weeks, median = 26) and (b) late assessments (≥ 52 weeks; 52 to 104 weeks, median = 78). Because some studies included only a single post-intervention assessment, a final assessment interval (0 to 104 weeks, median = 52) was created to determine the overall impact of the study trials.

Data analyses were conducted with Stata 12 [32] using published macros [29, 33]. Weighted mean effect size, d_+, were calculated using fixed- and random-effects procedures [29]. The 95% confidence intervals (CIs) surrounding a weighted mean effect size were calculated; CIs indicate the degree of precision as well as the significance of the mean effect size [29]. The homogeneity statistic, *Q*, was calculated; a significant *Q* indicates a lack of homogeneity and an inference of heterogeneity. To assess the extent to which outcomes were consistent across studies, the I^2 index and its corresponding 95% CIs were calculated [34, 35]. I^2 varies between 0 (homogeneous) and 100% (heterogeneous) [36]. If the CIs around I^2 include a zero, the set of effect sizes is considered homogeneous.

To explain variability in effect size, the association between sample or intervention characteristics and the magnitude of the effects were examined using a modified weighted regression analysis (following fixed-effects assumptions) with weights equivalent to the inverse of the variance for each effect size [29, 37]. Regression analyses examined *a priori* determined moderators. Sample characteristics (4: proportion women, proportion alcohol users, proportion of participants with multiple partners, proportion of participants reporting protected vaginal/anal sex), intervention dose (2; number of sessions, total intervention dose, number and type of facilitators), and content (3; e.g., gender inequalities, alcohol use) were examined as potential moderators of the interventions. Weighted regression analyses were conducted only for outcomes with sufficient studies (i.e., > 5 studies).

RESULTS

Study, Sample, and Intervention Characteristics

Study, sample, and intervention characteristics of the 10 included studies are provided in Table 1. Studies were conducted in several provinces: Western Cape,[19–22] Eastern Cape, [16–18] KwaZulu-Natal,[15] Gauteng,[23] and Limpopo.[21] South African youth were typically recruited through school or college (80%); two studies recruited youth, at least in part, from the community.[18, 19] Studies were published in peer-reviewed journals between 2007 and 2013 (date of publication: November 2007 through March 2013) with a median publication date of 2011; data were collected between 2002 and 2009. Methodological quality (MQ) of the studies ranged from 9 to 22 (mean = 15, SD = 4). Neither publication date (r = .35, $P = .33$) nor year of data collection (r = .18, $P = .62$) was correlated with MQ.

Of the 22,788 youth who consented to participate in the studies, more than half were female (54%), most were Black-African (79%), 14 years of age (6 out of 10 studies reported the mean age of the sample), and not sexually active (66%). Retention was 71% at follow-up. Among the participants who were sexually active at baseline, 17% reported having multiple partners (4 out of 10 studies reporting) but 52% reported any protected vaginal or anal sex (9 out of 10 studies reporting). Of the studies reporting substance use, 26% and 7% of the studies sampled youth who used alcohol or drugs, respectively. Only two studies reported sexual coercion; of these studies, 15% of participants had experienced forced or coerced sex.

Most studies randomized participants to the intervention group (70%); 3 studies used a quasi-experimental design. Interventions were typically conducted over 16 sessions (range =

4 to 36) with each session lasting a median of 66 minutes (range = 35 to 180). On average, the total dose of the intervention was a median of 17 hours (range = 6 to 51). The intervention was typically led by a single facilitator (range = 1 to 5); facilitators were professionals (e.g., teachers, nurses; 55%), peers (9%), professionals-in-training (e.g., clinical graduate student; 9%) or a combination of facilitators (27%). Facilitators delivered the interventions most often in groups with a median of 20 participants. All of the interventions provided education regarding sexual risk behaviors and HIV, 55% provided alcohol education, and 36% provided other education (e.g., reproductive health). Many interventions addressed HIV-related attitudes (63%), social norms (36%), or motivational factors (63%). Most interventions encouraged the identification of high-risk situations (82%) or barriers to safer sex (45%). Each intervention provided some skills training either in communication (82%), self-management (82%), or condoms (63%). Gender power inequalities and violence (e.g., relationship power, rape myth beliefs, intimate partner violence) were addressed in 55% of the interventions. None of the interventions reported providing alcohol skills training. Less than half (45%) reported asking youth to set risk-reduction goals. Condoms were provided in 18% of the interventions.

Control conditions were an active comparison (55%; e.g., brief form of the intervention) or an assessment-only control (45%). Active comparisons were delivered in small groups by a median of 1 facilitator over 4 sessions (range = 1 to 12) with each session lasting a median of 90 minutes (range = 35 to 150). Total dose for the active comparison conditions ranged from 2.5 to 12 hours.

Impact of Interventions Compared with Controls

The weighted mean effect sizes, d_+, for the 11 studies examining differences between intervention and control conditions are provided in Table 2. South African youth participating in an intervention reported delaying sexual intercourse (fixed-effects: d_+s =0.07, 0.15), increasing their condom use (fixed-effects: d_+s =0.17, 0.19), and reducing the number of sexual partners (fixed-effects: d_+s =0.95, 0.44) relative to those in a control condition. No differences in alcohol or drug use were found. The pattern of results was generally consistent using fixed- or random-effects assumptions except for multiple sexual partners. Differences between the common intervention effect (fixed-effects assumptions) and the estimate of the actual effect (random-effects assumptions) for multiple sexual partners is largely due to the strong treatment effects (ds >1.00) observed for Jemmott et al. [17] When the studies' last available assessments were considered, youth participating in the interventions reported delaying sexual intercourse (fixed-effects: $d_+ = 0.04$, 95% CI = 0.01, 0.08), increasing condom use (fixed-effects: $d_+ = 0.13$, 95% CI = 0.09, 0.18), and reduced the number of sexual partners (fixed-effects: $d_+ = 0.43$, 95% CI = 0.34, 0.53) compared to controls. There was an overall trend for interventions to lower the incidence of HSV-2 (k = 2, $d_+ = 0.17$, 95% CI = 0.09, 0.25) but this was reported in only a single study reporting outcomes separated by gender ($d_{\text{young men}} = .22$; $d_{\text{young women}} = .12$). No differences in HIV were found between intervention and control participants.

All of the effects were heterogeneous except for HSV-2 and HIV at last assessments. Examination of I^2 confirmed moderate to high levels of heterogeneity. Moderator tests were

conducted to examine whether *a priori* determined sample (proportion of the participants who were female, alcohol users, have multiple partners, and had protected vaginal or anal sex), intervention facilitators and dose (number and type of facilitators, number of sessions and total dose), and intervention content (gender inequalities, alcohol use, condom skills-training, and social norms) related to the variability in effect sizes (reported below). Due to insufficient sample size ($k \leq 5$), moderator tests were conducted only for delay in sexual intercourse and condom use at last assessment.

Moderators of Behavioral Outcomes

Moderators of intervention impact on the delay in sexual intercourse and condom use at the last assessment are reported in Table 3. Interventions were successful in delaying sexual intercourse when (a) sampling youth who used alcohol and (b) more facilitators were used to deliver the intervention but were less successful when the (c) facilitators were professionals (e.g., teachers, nurses), (d) intervention was delivered in longer doses, and the intervention content addressed (e) social norms, (f) gender inequalities, and (g) alcohol or provided (h) condom skills training. Intervention dose was not a significant moderator of the delay in sexual intercourse after adjusting the *p*-value for the number of statistical tests (Bonferroni corrected *p*-value: $P < .005$). Interventions were more successful in increasing condom use when (a) sampling youth already engaging in fewer risk-taking behaviors (i.e., fewer sexual partners, protected vaginal or anal sex), (b) more facilitators were used to deliver the intervention, and (c) the intervention delivery was less intensive (i.e., delivered in fewer sessions and over a briefer period of time). Interventions that provided condom-skills training or addressed gender inequalities were more successful; including an alcohol component reduced the success of the intervention to improve condom use. None of the intervention components (i.e., condom skills-training, gender inequalities, and alcohol education/risks) were significant after adjusting the *p*-value for the number of statistical tests (Bonferroni corrected p-value: $P < .004$).

DISCUSSION

The HIV epidemic has had a devastating impact on South African young people who bear the heaviest HIV burden of any age group.[1] In an effort to reduce the incidence of HIV among youth, the South African government mandated an education program, Life Orientation, that encompasses a broad range of topics including HIV prevention, for all 8th grade classes in 2002.[54] Life Orientation is now required for all secondary school students, grade 8 to 11.[55] Multiple sociodemographic, cultural, and social challenges has affected the implementation quality (i.e., fidelity) of the Life Orientation program.[56, 57] Teaching safer sex practices, other than abstinence, created a moral challenge for many educators; in addition, students report being uninterested in the didactic components of the curriculum, preferring the role-plays, but these were often omitted due to time constraints.[56, 57] Alternative or supplementary school-based and community-level HIV intervention programs to reduce sexual risk-taking among South African youth have been developed, implemented, and evaluated in recent years. Studies included in the current meta-analysis were published between 2007 and 2013 with data collection occurring between 2002 and

2009. Most of these studies consisted of alternative interventions (80%) but two studies used or supplemented the mandated Life Orientation program for the intervention.[20, 22]

This meta-analysis examined 10 studies (obtained from 9 manuscripts) that evaluated a behavioral HIV intervention to reduce sexual risk among 22,788 South African youth between the ages of 9 and 26. Our results show that behavioral HIV interventions are successful at delaying sexual intercourse and increasing condom use at early and late assessments. Moreover, intervention success for delaying sexual intercourse and condom use was sustained over 104 weeks (average of 52 weeks) with effect size of small to medium magnitude (d_+s = 0.04 to 0.43). The magnitude of the weighted mean effect sizes for delaying sexual intercourse and condom use were stronger than those obtained in a meta-analysis of behavioral HIV interventions among youth in sub-Saharan Africa more broadly.[9] The stronger effects observed in the current meta-analysis could be due to a number of factors such as targeted sample (i.e., South Africa vs. sub-Saharan Africa), school and/or community setting, as well as an increase in methodologically strong, theory-driven behavioral HIV interventions being implemented in South Africa. For example, Jemmott et al. [17] conducted a randomized controlled trial to assess the efficacy of a theory-driven school-based HIV intervention among sixth-grade students living in South Africa and showed that the intervention was successful in reducing unprotected vaginal sex, vaginal sex, and multiple partners. Supplemental analyses (not shown) confirm our assumption that methodologically stronger interventions were more successful in increasing condom use (P = .014).

Moderator tests suggest that sample (e.g., prior alcohol use, sexual risk behaviors at baseline) and intervention features (e.g., facilitators and dose; interventions that address social norms, condom skills, gender inequalities, and alcohol) enhance the impact of the intervention on delaying sexual intercourse or increasing condom use. Alcohol use is associated with risky sexual behavior among young people in South Africa [58, 59] and a higher incidence of HIV among adolescents and adults in Africa.[60] Because alcohol use is a risk factor for HIV, we expected that alcohol users would be less likely to delay sexual intercourse or increase condom use. Contrary to our expectations, alcohol use was associated with an *increase* in the delay of sexual intercourse but did not moderate the impact of the intervention on condom use. Only 5 of the 10 studies provided baseline data on alcohol use; data for these studies were collected between 2002 and 2004. More recent studies did not report the proportion of youth who consumed alcohol. Our finding that alcohol use moderated the efficacy of the intervention to delay sexual intercourse may be spurious; that is, it may be a failure of more recent studies to measure and/or report alcohol consumption. Consistent with our hypothesis, we found that youth engaging in lower levels of sexual risk-taking were more likely to use a condom following the intervention. Exposure to a behavioral HIV intervention most likely reaffirmed already established protective behaviors (cf. confirmatory bias [61]). Thus, providing an intervention to young people who are currently engaging in safer sex behaviors may serve as a “booster.”

Consistent with prior reviews [11, 62], our meta-analysis does not fully support the use of peer-led interventions. Our moderator tests also show that using professionals (e.g., health educators, teachers, nurses) alone vs. peers or a combination of professionals and peers

moderated the efficacy of the intervention on both delay of sexual intercourse and condom use but the direction of our findings differed by outcome. That is, interventions that were facilitated by peers or a combination of peers and professionals are more successful at delaying sexual intercourse (peers/combo: $d_+ = 0.18$, 95% CI, 0.11, 0.23; professionals: $d_+ = -0.03$, 95% CI, −0.08, 0.01) but intervention facilitated by professionals (vs. peers or a combination of peers and professionals) was more successful at increasing condom use (professionals: $d_+ = 0.39$, 95% CI, 0.28, 0.50; peers/combo: $d_+ = 0.06$, 95% CI, −0.02, 0.13). This is a novel finding that will need to be explored in future meta-analyses with a larger set of studies. Nonetheless, our findings suggest that peers may play an important role in promoting abstinence (unrelated to peer social norms regarding HIV risk) while professionals (e.g., teachers) may be required to provide condom education and skills-training to sexually active students. Consistent with this finding, we show that interventions providing condom skills-training were more successful at increasing condom use but less successful at delaying sexual intercourse.

Gender inequality and violence have long been recognized as critical structural barriers to HIV prevention.[63] School-age girls and young women between the ages of 15 and 24 more than twice as likely to be infected by HIV than young men.[64] One important reason for the higher HIV prevalence among young women is the frequent practice of age-discrepant partnering, in which older men, who are more likely to be infected with HIV, form sexual relationships with younger women.[65–67] Young women in relationships with older men are less able to negotiate safer sex, and in fact may be subjected to violence for insisting on condom use.[3, 68] This discrepancy highlights the pervasive gender power imbalance, particularly with many young women engaging in age-discrepant sexual relationships, putting them at greater risk for HIV infection. Few interventions have systematically addressed gender inequalities and violence including relationship power and sexual coercion.[69] Of the interventions reviewed for this meta-analysis, approximately one-half (55%) addressed gender-related issues as a component of the intervention. Moderator analyses revealed that addressing gender inequalities improved the intervention impact on condom use (although, this finding was not significant after applying the Bonferroni correction) but *reduced* the intervention impact on the number of youth who delayed sexual intercourse. Addressing gender inequalities may reduce young men's perpetration of sexual violence and may empower women to engage in protected sex (cf. Stepping Stones [18, 70]). Addressing gender inequalities is unlikely be to be key motivator of delaying sexual intercourse. (cf.[71]). In contrast, interventions were less successful at delaying sex and increasing condom use when the intervention provided alcohol education and/or addressed alcohol-related risks (e.g., sex under the influence of alcohol). This finding may be due to low baseline rates of alcohol use (i.e., of the 5 studies reporting baseline alcohol use, 26% reporting consuming alcohol). Nonetheless, our findings are consistent with a systematic review of interventions to prevent sexual risk-taking and substance use among youth from any region.[72] Further research is necessary to determine the efficacy of interventions that include an alcohol component, especially among youth with high rates of alcohol use.

Limitations

Several limitations should be considered when interpreting our findings. First, as with any meta-analysis, using electronic bibliographic databases to identify relevant studies are restricted by publication source and authors' choice of keywords [73]. Second, our meta-analysis was restricted to studies sampling South African youth and thus may not be generalizable to youth in other regions (e.g., sub-Saharan Africa). Third, all outcomes, except for HSV-2 or HIV, involve self-reports, which are vulnerable to measurement, cognitive (e.g., memory), and social (e.g., self-presentation) biases.[74] Researchers typically use methods to minimize these biases and maximize data quality.[75] Fourth, few studies used a pure control condition; comparison with active conditions lessens observed effects. Fifth, only a single study measured biological outcomes.[18] It is unclear whether incident STIs, including HIV, are reduced following a behavioral HIV risk reduction intervention. Future studies will need to measure biological outcomes to determine whether behavioral changes reduce incidence of STIs. Finally, our moderator tests were limited to the data available in the individual studies. Several studies failed to measure and/or report critical participant characteristics (e.g., baseline alcohol use) that would allow us to fully explore potentially relevant moderators. Thus we were limited in our interpretation for some of the univariate moderator analyses and unable to conduct multiple moderator analyses that may elucidate our findings.

CONCLUSION

Behavioral HIV interventions are successful in reducing sexual risk-taking behaviors and the incidence of STIs. Only a single study found reductions in the incidence of herpes simplex virus-2, but not HIV. Future interventions should measure biological outcomes to determine whether behavioral changes are successful in reducing STIs, including HIV. Implementing behavioral HIV interventions to improve condom use, and ultimately reduce the transmission of HIV, should be a public health priority among South African youth. Despite the prevalence of HIV among youth, to date few interventions have been implemented among South African youth. These interventions should target youth living in the highest HIV prevalence settings (e.g., KwaZulu-Natal) and in areas where alcohol problems are pervasive (e.g., Western Cape and Eastern Cape). Addressing gender inequalities at multiple levels (e.g., individual and structural) will be important for reducing the incidence of HIV. [76, 77] Overall, interventions that exist are not yet targeted as effectively as they need to be to the sub-populations of youth who are at highest risk and in highest prevalence settings of South Africa.

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LIST OF ABBREVIATIONS

HSV-2 herpes simplex virus type 2

HIV	human immunodeficiency virus
STIs	sexually transmitted infections

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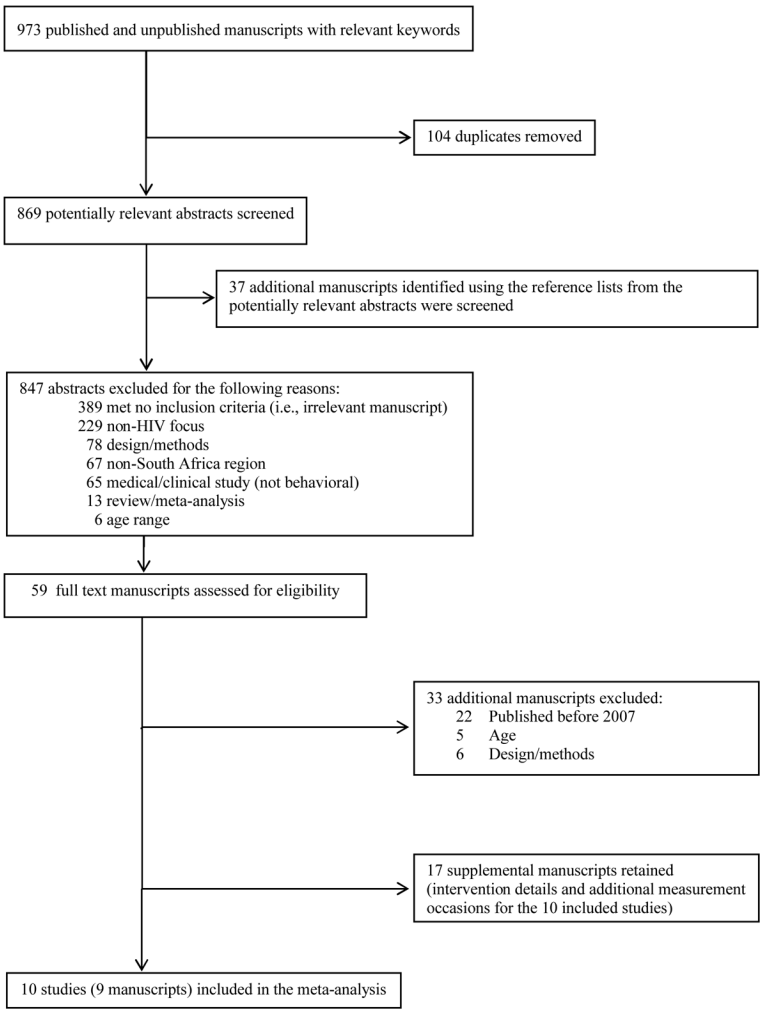

Figure 1.
Selection process for study inclusion in the meta-analysis

Table 1

Study, sample, and intervention characteristics of the 10 studies (k = 11) included in the meta-analysis.

Citation	Sample	Baseline Sexual Behaviors†	Setting	Intervention Characteristics*					Control	MQ
				Facilitators	Delivery Method	Intervention Level	Sessions	Total minutes		
Cupp et al. [15, 38, 39]	N = 1,057; 53% F; Ages 13 to18; Alc Use=36%	Partners: NR PVA: 89%	Schools in KwaZulu-Natal	Peers; Teachers	Technology-Assisted FTF	GRP	15	525	RCNM	15
Heeren et al. [16]	N=201; 53% F; Mean age=21; Alc Use = 36%	Partners: 20% PVA: NR	University in Eastern Cape Province	Postgraduate University Student Trainees	FTF	GRP	4	360	IRCM	22
Jemmott et al.[17, 40]	N=1,057; 53% F; Mean age=12; Alc Use = NR	Partners: 14% PVA: 80%	Schools in Mdantsane and Berlin, Eastern Cape Province	Project Staff	FTF	GRP	12	720	IRCM	18
Jewkes et al.[41–43]	N=2,776; 51% F; Ages 15 to 26; Alc Use=14%	Partners: 30% PVA: 41%	Community Volunteers and STD Clinic Patients in Mthatha, Eastern Cape Province	Planned Parenthood Association of South Africa Staff	FTF	GRP	17	3060	RCNM	17
Mash and Mash [19, 44]	N=1,352; 64%F; Mean age=15; Alc Use = NR	Partners: NR PVA: 58%	Church youth groups in Western Cape Province	Peers; Youth Group Leaders	FTF	GRP	20	1800	WL/NT	9
Mason-Jones et al.[20]	N=3,934; 57% F ; Ages 15 to 16; Alc Use=NR	Partners: NR PVA: 69%	Schools in Western Cape Province	Peers	FTF	GRP/IND	NR	NR	IRCNM	14
Mathews et al.[21, 45–49]	Cohort #1 N=5352; 53% F; Mean age=13 Alc Use=NR	Partners: NR PVA: 45%	Schools in Cape Town, Western Cape Province	Teachers; Nurses	FTF	GRP	16	1020	WL/NT	18
	Cohort #2 N=2590; 55% F; Mean age=13; Alc Use=NR	Partners: NR PVA: 30%	Schools in Mankweng, Limpopo Province	Teachers; Nurses	FTF	GRP	10	660	WL/NT	17
Tibbits et al.[22, 50–53]	N=251; 51% F; Mean age=14 ; Alc Use=15%	Partners: NR PVA: 51%	Schools in Mitchell's Plain Township near Cape Town, Western Cape Province	Teachers	FTF	GRP	36	1800	WL/NT	15
Visser et al.[23]	N=1,918; 54% F ; Ages 13 to 20; Alc Use=26%	Partners: 12% PVA: 52%	Schools in Tshwane, Gauteng Province	Peers; Teachers; Postgraduate University Student Trainees	FTF	GRP	NR	NR	WL/NT	9

Note. NR = not reported; N, number of participants who consented to participate in the study; F, females; Alc, alcohol; PVA, protected vaginal or anal sex; FTF, face-to-face; GRP, group; IND, individual; RCM relevant content matched for time; RCNM, relevant content not matched for time; IRCM, irrelevant content matched for time; IRCNM, irrelevant content not matched for time; WL/NT, wait-list/no treatment/assessment only control; MQ, methodological quality.

*In some case, intervention details (number of sessions and/or total minutes) were estimated based on range of values and/or details reported.

†Baseline sexual behaviors are provided as the (1) proportion of participants with multiple sexual partners and (2) proportion of participants who reported engaging in protected vaginal or anal sex (PVA).

Table 2

Weighted mean effect sizes and homogeneity statistics by follow-up interval*

	d_+ (95% CI)		d_+ (95% CI)		Homogeneity of effect sizes		
Outcome	***k***	**Fixed effects**	***k***	**Random effects**	**Q**	***P***	I^2 (95% CI)
Early Assessments (<52 weeks)							
Abstinence/delay of sex	6	**0.07 (0.02, 0.12)**	6	0.15 (−0.05, 0.36)	82.47	<.001	94% (89, 97)
Condom use‡	7	**0.17 (0.11, 0.23)**	7	**0.23 (0.03, 0.44)**	56.14	<.001	89% (80, 94)
Multiple partners	3	**0.95 (0.83, 1.07)**	3	0.31 (−0.75, 1.36)	67.38	<.001	97% (94, 98)
Late Assessments (≥ 52 weeks)							
Abstinence/delay of sex	6	**0.15 (0.11, 0.20)**	6	**0.19 (0.05, 0.33)**	43.79	<.001	89% (78, 94)
Condom use‡	6	**0.19 (0.13, 0.25)**	6	**0.18 (0.01, 0.36)**	36.16	<.001	86% (72, 93)
Multiple partners	3	**0.44 (0.35, 0.53)**	3	0.18 (−0.77, 1.14)	181.15	<.001	99% (98, 99)
Alcohol use	2	0.06 (−0.03, 0.15)	2	−0.03 (−0.37, 0.30)	9.28	.002	89% (60, 97)
Drug use	3	0.05 (−0.02, 0.12)	3	0.04 (−0.16, 0.24)	14.13	.001	86% (59, 95)
HSV-2	2	**0.17 (0.09, 0.25)**	2	**0.17 (0.07, 0.26)**	1.31	.253	23% (0, 67)
HIV	2	−0.10 (−0.19, 0.02)	2	−0.10 (−0.24, 0.03)	2.56	.110	61% (0, 93)
Last Assessment†							
Abstinence/delay of sex	10	**0.04 (0.01, 0.08)**	10	0.12 (−0.01, 0.24)	121.18	<.001	93% (88, 95)
Condom use‡	10	**0.13 (0.09, 0.18)**	10	**0.17 (0.04, 0.29)**	60.68	<.001	85% (74, 91)
Multiple partners	4	**0.43 (0.34, 0.53)**	4	0.09 (−0.75, 0.93)	183.95	<.001	98% (97, 99)
Alcohol use	2	0.06 (−0.03, 0.15)	2	−0.03 (−0.37, 0.30)	9.28	.002	89% (60, 97)
Drug use	3	0.03 (−0.04, 0.10)	3	0.04 (−0.36, 0.44)	51.90	.001	96% (92, 98)
HSV-2	2	**0.17 (0.09, 0.25)**	2	**0.17 (0.07, 0.26)**	1.31	.253	23% (0, 67)
HIV	2	−0.10 (−0.19, 0.02)	2	−0.10 (−0.24, 0.03)	2.56	.110	61% (0, 93)

*Weighted mean effect sizes, $d+$, for which the 95% confidence interval does not include a zero are significant. Effect sizes are based on fixed- and random-effects assumptions. *k*, number of interventions. Boldface text highlights significant values.

†On average, the last assessment occurred 65 weeks post-intervention and ranged from 0 to 104 weeks (median = 78 weeks).

‡HealthWise [22, 51–53] was not included in the analyses for condom use because effect sizes could not be calculated from the report.

Table 3

Moderators of delay in sexual intercourse and condom use at last assessment.

	Delay in Sex		Condom Use	
	β	*P*	β	*P*
Sample Characteristics				
Young women (%)	.064	.479	.046	.719
Alcohol use, % at baseline	**.996**	**.000**	.292	.566
Multiple partners, % at baseline	NA	NA	−**.463**	**.003**
PVA, % at baseline	NA	NA	**.406**	**.002**
Intervention Facilitators and Dose				
Facilitators (no.)	**.768**	**.000**	**.499**	**.001**
Paraprofessional (vs. others)	−**.513**	**.000**	**.310**	**.016**
Sessions (no.)	−.095	.316	−**.545**	**.000**
Intervention dose (total)	−**.242**	**.011**	−**.543**	**.000**
Intervention Components				
Social norms	−**.428**	**.000**	−.172	.182
Skills, condom use	−**.513**	**.000**	**.300**	**.020**
Gender inequalities	−**.315**	**.001**	**.345**	**.007**
Alcohol education/risks	−**.345**	**.000**	−**.345**	**.007**

Note. Fixed-effects regression models used the inverse of the variance for each effect size as weights. Reported coefficients (β) are standardized. Bold typeface values are significant; values underlined are significant after adjusting the *p*-value for the number of statistical tests performed (Bonferroni; delay in sex: $P < .005$; condom use: $P < .004$). NA, not applicable.