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A Meta-Analysis of the Efficacy of HIV/AIDS Prevention Interventions in Asia, 1995–2009

Judy Y. Tan, MA,
University of Connecticut

Tania B. Huedo-Medina, PhD,
University of Connecticut

Michelle R. Warren, BA,
University of Connecticut

Michael P. Carey, PhD, and
Brown University

Blair T. Johnson, PhD
University of Connecticut

Abstract

The HIV/AIDS epidemic continues to grow in pockets across Asia, despite early successes at curtailing its spread in countries like Thailand. Recent evidence documents dramatic increases in incidence among risk groups and, alarmingly, the general population. This meta-analysis summarizes the sexual risk-reduction interventions for the prevention of HIV-infection that have been evaluated in Asia. Sexual risk-reduction outcomes (condom use, number of sexual partners, incident sexually transmitted infections [STI], including HIV) from 46 behavioral intervention studies with a comparison condition and available by August 2010 were included. Overall, behavioral interventions in Asia consistently reduced sexual risk outcomes. Condom use improved when interventions sampled more women, included motivational content, or did not include STI testing and treatment. Incident HIV/STI efficacy improved most when interventions sampled more women, were conducted more recently, or when they included STI counseling and testing. Sexual frequency efficacy improved more in interventions that were conducted in countries with lower human development capacities, when younger individuals were sampled, or when condom-skills training was included. Behavioral interventions for reducing sexual risk in Asia are efficacious; yet, the magnitude of the effects co-varies with specific intervention and structural components. The impact of structural factors on HIV intervention efficacy must be considered when implementing and evaluating behavioral interventions. Implications and recommendations for HIV/AIDS interventions are discussed.

Keywords

Meta-analysis; East Asia; HIV/AIDS; intervention efficacy; sexual risk-reduction; review

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Corresponding Author: Judy Y. Tan, judy.tan@uconn.edu.

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Introduction

Asia is home to more than half of the world's population and five million people living with HIV (UNAIDS, 2008). Given the population in Asia, even a small increase in the incidence of HIV could reshape the pandemic worldwide (WHO, 2001). During the early 1990s, the HIV epidemic gained a foothold in East Asian countries like Thailand and India, and HIV-infections have steadily spread (Lu et al., 2008; Park et al., 2010; Ruxruntham et al., 2004). Drivers of the HIV/AIDS epidemic vary from region to region, with countries in East Asia carrying the burden of the disease. HIV typically commences among injection drug users and female sex workers; it spreads to male clients of sex workers and to the clients' female sexual partners (Ruxruntham et al., 2004). Sexual "bridging" between clients of sex workers and their steady partners constitutes a primary route through which HIV is spread from high- to low-risk groups (Gorbach et al., 2000; Hesketh et al., 2005). Recent epidemiological data indicate high rates of unprotected sex among men who have sex with multiple and concurrent male and female partners, and among men who have sex with men (Choi et al., 2003; Hernandez et al., 2006). HIV/AIDS prevalence in East Asia, coupled with a high burden of tuberculosis co-morbidity and increasing resistance to antiretroviral medication, necessitates the development and dissemination of effective HIV risk-reduction interventions (Lau et al., 2007; Narain & Lo, 2004).

Asia is as politically, culturally, and economically diverse regionally as its HIV/AIDS epidemic. East Asian nations have been especially influenced by globalization, with four of the world's fastest growing economies in the 80s and 90s (i.e., Hong Kong, Singapore, South Korea, and Taiwan) and India and China undergoing astonishing economic growth. Not only has such economic growth altered the course of labor migration patterns across Asia, it has fueled the development of several industrial sectors, one of the most prolific being the sex work industry (Lim & International Labour Office, 1998). Growth has left wide economic disparities between the rich and poor, with many Asian countries among the poorest worldwide. For example, 36% of China's population earns less than \$2 a day (OPHI, 2010). Each year, increasing numbers of women from dire economic circumstances enter sex trade, making female sex workers one of the largest migrant populations in Asia. Such rapid economic development has not been associated with comparable advancement in social and political developments. Therefore, while large-scale implementation of 100% condom use policies in Thailand and Cambodia have seen significant reductions in STI and HIV infections, women working in the sex trade industry continue to face gender-based discrimination and violations of their social, economic, and political rights.

Many prevention trials have been conducted in Asia. Yet, surprisingly little is known about best-practice intervention strategies for reducing sexual risk behavior in the context of unique historical and development patterns in Asia. It is conceivable that, given the lower status of women, particularly female sex workers, and their limited social, economic, and political rights, interventions that include more women in the sample and provide relevant resources should see greater intervention success. Similarly, interventions that incorporate socially and culturally relevant content in teaching safer sex skills should bode success in regions, especially where human development levels are low (Huedo-Medina et al., 2010). Because behavioral interventions have had varying efficacy in Asia, it is critical to review them to determine (a) when and where they have been most efficacious (Tan et al., 2010), (b) what study components, approaches, and delivery modes are most useful, (c) what population and sample characteristics are related to efficacy, (d) if structural-level factors such as women's rights and the human development index (HDI, an index of development based on life expectancy, educational attainment, and income) explain variations in intervention success, and (e) how patterns may differ in the risk outcomes assessed. This paper reports the results of the first meta-analysis of behavioral interventions implemented

to reduce HIV-risk in Asia. Moderator analyses were also conducted to identify and explain heterogeneity in study outcomes, focusing on study methods as well as structural features associated with the nations in which the trials were conducted.

Method

Sample of Studies and Selection Criteria

We searched for studies in English through the simultaneous use of three main strategies: (a) We searched electronic reference databases (MEDLINE, PsycINFO, and AIDSearch) using terms related to HIV and other sexually transmitted diseases: HIV *OR* AIDS *OR* (human *AND* immu* *AND* virus) *OR* (acquired *AND* immu* *AND* deficien* *AND* syndrome) *OR* STD *OR* STI *OR* (sexually *AND* transmitted *AND* disease*) *OR* (sexually *AND* transmitted *AND* infection*) *OR* chlamydia *OR* gonorrhea, etc.), prevention (i.e., prevent* *OR* interven*), and sexual behavior (i.e., sex* *OR* condom* *OR* intercourse). These terms were joined with the names of Asian nations. Inclusion of Asian nations was based on the UNAIDS definition of Asia, which excludes nations in Central Asia/Eastern Europe. (b) We searched HIV-related listservs, the NIH database of grant awardees, and conference proceedings (e.g., the International AIDS Conference). (c) We searched the reference lists of obtained studies and reviews.

Studies available by August 2010 were eligible for inclusion if they (a) examined an HIV risk-reduction intervention in an Asian nation; (b) used a randomized controlled trial, a quasi-experimental design with a control group, or a pre-post intervention design; and (c) measured a behavioral and/or biological sexual risk-reduction marker following the intervention. Studies were excluded if they (a) included perinatal transmission contexts or behaviors; (b) did not use a behavioral intervention; (c) did not focus on HIV/AIDS, or (d) could not be located or authors could not be reached to complete missing study details. Consistent with meta-analytic convention (Cooper et al., 2009), when a study reported on the effectiveness of multiple interventions, each intervention was examined individually. Attempts were made to contact authors to procure information for analysis wherever lacking. Of 13 studies whose authors contacted, nine were excluded for lack of response. Matching selection criteria were 46 articles; six studies provided separate intervention statistics and were treated as individual interventions. Thus, 53 interventions from 46 articles qualified for the analysis, whose total sample size was 128,224 individuals (Figure 1).

Gauging Intervention Features

Two trained raters independently coded studies for (a) geographical location; (b) sample characteristics (e.g., *n* at baseline and first follow-up, mean age, proportion female, HIV and other sexually transmitted infection prevalence); (c) intervention characteristics (e.g., length of sessions, delivery method); (d) intervention content (e.g., skills training, condom distribution, trans-situational motivational strategies that tap personal life goals and core social values (Carey & Lewis, 1999); and (e) design and measurement characteristics (e.g., presence of a control group, assignment to conditions). Inter-coder reliability was high for categorical dimensions (average Kappa = 0.92) as well as for continuous variables (average Spearman-Brown correlation = 0.98).

Structural features were derived from the United Nations Development Programme's Human Development Reports (UNDP, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2006), the World Bank's World Development Indicators database (Bank, 2007), and the Cingranelli-Richards (CIRI) Human Rights Dataset (Cingranelli & Richards, 2008), matching indicators to the nation of each trial and the year when the trial commenced.

Specifically, HDI values were obtained for each country from the Human Development Reports; these HDI values approximate a nation's level of development based on longevity, GDP per capita, and level of education. Income equality was indicated by the Gini index, such that greater income equality is related to higher levels of development in wealthy nations. Gini values were obtained from the World Development Indicators database, and are an approximation of economic inequality within a nation based on a scale ranging from 0 (lowest) to 0.99 (highest). Last, measures depicting the extent to which women's political rights are protected by law were obtained from the CIRI Human Rights Dataset and coded based on the presence and active enforcement of laws ensuring the equality of women (0 = complete absence of protection to 2 = complete institution and enforcement of laws). This dataset coded women's political rights as characterized by a woman's right to participate in politics, such as having the right to vote, run for political office, and petition government officials. When a value for a year was missing, it was imputed by regression interpolating the function of the reported data in the earlier and more recent two years.

Gauging Efficacy and Assessing Effect Modifiers

We calculated individual effect sizes for nine outcomes: (a) condom use with an unspecified partner, (b) condom use with a steady partner, (c) condom use with a casual partner, (d) condom use with a client (for female sex workers), (e) sexual intercourse with female sex workers, (f) number of sexual occasions, (g) number of sexual partners, (h) incidence of sexually transmitted infections (STIs), and (i) HIV seroconversions. Summary indicators were generated for *condom use* (averaging the first four outcomes); *sexual frequency* (the next four outcomes); and *biological outcomes* (the last two outcomes).

For continuous outcomes, we calculated effect sizes in the form of the standardized mean difference, d , which is defined as the mean difference between the intervention and control group (or baseline) divided by the pooled standard deviation (or standard deviation of the pretest for paired comparisons) (Becker, 1988; Hedges & Olkin, 1985). Positive values implied risk-reduction (e.g., reduction in frequency of unprotected sex) and negative effect size risk elevation. When means and standard deviations were not available, other inferential statistics (e.g., t - or F -values) were used to calculate d (Johnson & Eagly, 2000; Lipsey & Wilson, 2001). Finally, for dichotomous variables, we calculated an odds ratio which we transformed to d using the Cox transformation (Sánchez-Meca et al., 2003). Effect sizes were corrected for sample size bias and, in the case of between-group designs, for baseline differences (Becker, 1988). Effect sizes were calculated for measures provided at the first follow-up (most interventions had only one such follow-up).

For all outcomes, analyses followed random- and fixed-effects assumptions to estimate means. Homogeneity of the effect sizes (I^2) was also assessed (Higgins & Thompson, 2002; Huedo-Medina et al., 2006). Two strategies were used to evaluate asymmetries suggestive of publication bias: Begg's strategy (Begg & Mazumdar, 1994) and Egger's test (Egger et al., 1997). To test for possible dependence, sensitivity analyses were conducted where the same control group was used as the comparison group for multiple comparisons. We tested whether coded features modified the observed effects for each of the three composite outcomes. Statistically significant outliers (i.e., values that were more than three standard deviations from the average effect size) were winsorized to the values at 90th percentile to have more robust estimations reducing the influence of the outliers (Lipsey & Wilson, 2001). Study dimensions that related to the variability of each of the three outcomes were entered into a series of models that controlled for intercorrelations among the dimensions. These models determined the extent to which variation may be uniquely attributed to study dimensions adjusting for the effect of the other variables. Only study dimensions that retained statistical significance (Bonferroni $p < 0.001$) and exhibited stable coefficients across the series of models were retained. To determine the robustness of models, we re-

evaluated the surviving study dimensions using mixed-effects model (i.e., random-effects constant following maximum-likelihood assumptions, fixed-effects slopes), which is known to be more statistically conservative because it explains a portion of the variation in effect size through the unconditional variance (Hedges & Vevea, 1998).

Results

Description of Studies

Table 1 describes the interventions, samples, and the programmatic features. Of the 53 interventions from 46 studies conducted in Asia with 128,224 individuals, 16 were implemented in China, 11 in Thailand, 10 in India, 5 in Indonesia, 4 in the Philippines, 3 in Hong Kong, 2 in Singapore, and 1 each in Cambodia and Nepal. The mean HDI of these countries during the year of data collection was 0.71 ($SD = 0.13$; range: 0.35 to 0.94) (for comparison, the HDI for the U.S. in 2009 was 0.95). The majority of interventions (44 [83%]) took place in urban settings. Twenty-seven interventions (51%) included only women, 15 (29%) included only men, and the remainder included both genders (11 [20%]). The mean age of participants was 26.5 years ($SD = 5.47$). Thirty-five interventions (66%) used between-group comparisons whereas 18 (34%) used within-group comparisons. The initial follow-up assessment occurred at a mean of 235 days (range: 0 – 730 days) post-intervention, with four interventions that took measures immediately after intervention. Most ($k = 34$, 64%) devoted at least three hours to intervention delivery and the rest were shorter.

Efficacy of the Interventions

Condom use was assessed in 52 interventions (98%), HIV and/or STI incidence in 20 interventions (38%), and sexual frequency or partner type in 16 interventions (30%); 2 interventions (4%) assessed all three risk-reduction outcomes. As Table 2 shows, overall, interventions increased condom use, decreased sexual frequencies, and reduced the incidence of STIs, including HIV. There were no asymmetries suggestive of publication bias in condom use effect sizes, and some asymmetries suggestive of bias with overall sexual frequency and incident HIV/STIs effect sizes. Study findings lacked homogeneity, implying that a model based on the mean value is inadequate. Figure 1 portrays the distribution of condom use outcomes.

Effect Modifiers of Condom Use Efficacy

Four factors explained unique variation in condom use effect sizes: (a) STI/HIV counseling and testing, (b) use of motivational strategies, (3) proportion of women in the sample, and (d) methodological quality (Table 3). In the combined model, interventions were more successful at increasing condom use when they included higher proportions of women in the sample ($\beta = 0.33$), used motivational strategies ($\beta = 0.27$), had lower methodological quality ($\beta = -0.23$), and/or did not include STI/HIV counseling and testing ($\beta = -0.41$). Inspecting the estimates in Table 3, interventions evaluated with less rigorous methods appeared to be more efficacious with respect to condom use. Among the factors that related to condom use efficacy on a bivariate basis (Appendix 1 [INSERT LINK TO ONLINE FILE](#)) but that ceased being significant in the mixed model were HDI, interpersonal skills training, and HIV testing and counseling.

Effect Modifiers of Sexual Frequency Efficacy

Three factors explained the variation in effect sizes for sexual frequencies: (a) HDI, (b) age, and (c) condom skills training (Table 4). Reductions in sexual frequency were greater for older samples ($\beta = 0.24$), for interventions that included condom skills training ($\beta = 0.41$),

and/or are conducted in countries with low HDI ($\beta = -0.43$). Other factors (e.g., percentage of women in sample, risk-awareness or feedback, and study quality) were related to efficacy on a bivariate basis (Appendix 2 [INSERT LINK TO ONLINE FILE](#)) but ceased being significant in the combined model.

Effect Modifiers of Incident HIV/STI Efficacy

Three factors explained the variation in effect sizes for HIV/STI incidence: As Table 5 shows, interventions were most efficacious when (a) they included STI counseling and testing ($\beta = 0.41$) as an intervention component, (b) collected data more recently ($\beta = 0.60$) and (c) sampled more women ($\beta = 0.30$). Three other factors were related to HIV/STI prevalence reduction on a bivariate basis (Appendix 3 [INSERT LINK TO ONLINE FILE](#)) but ceased being significant in the combined model, protection of women's political rights, Gini index, and methodological quality.

Interactive Effects of HDI and Intervention Components

Because intervention efficacy may differ depending on the development level of the country, we conducted further analyses to explore the interactions between economic development and intervention components. We examined the interactive effects of HDI with intervention components at both the multivariate and bivariate levels. As Appendix 4 ([INSERT LINK TO ONLINE FILE](#)) shows, with regard to condom use efficacy, we found significant interactions between HDI and (a) inclusion of trans-situational motivation strategies ($\beta = 0.44$, $p < .001$), and (b) inclusion of relevant socially and culturally relevant content ($\beta = -0.37$, $p < .001$). Due to the small number of studies and lack of statistical power, these analyses were not conducted for the HIV/STI and sexual frequency outcomes.

Moderator Model Specification and Stability of Outcomes

Because studies with higher proportions of women in the sample were related to greater condom use, we explored whether this pattern was due to interventions focusing on female sex workers. When we included this variable in the model (100% female sex workers sample vs. not), proportion of women remained a significant predictor, which suggests that this effect is not an artifact of the female sex workers group *per se*. All the models were also tested under mixed-effects assumptions and the patterns were robust.

Discussion

The current meta-analysis provides the first comprehensive quantitative synthesis of behavioral interventions for HIV prevention across East Asia. Overall, the meta-analysis clearly supports the conclusion that behavioral risk-reduction interventions have been successful (Bingenheimer & Geronimus, 2009), consistent with past work on the efficacy of behavioral interventions for increasing condom use (Albarracín et al., 2005; Crepaz et al., 2006; Johnson et al., 2011). These behavioral interventions have improved condom use, decreased the frequency of sexual-risk behavior, and reduced incidence of HIV and other STIs. Importantly, the efficacy of behavioral interventions varied widely not only across studies but also measured outcomes (Table 2). For example, provision of STI testing and treatment was efficacious at reducing incident infections but not at improving condom use. Indeed, provision of STI testing and treatment was associated with worse condom use efficacy, suggesting that testing and treatment alone may be effective at reducing incidence, but not via changes in condom use. Alternatively, while STI testing and treatment has been shown to be effective at reducing STI incidence (Grosskurth et al., 1995), other research shows effectiveness only in conjunction with risk-reduction counseling (Kamb et al., 1998).

Our synthesis supports a link between structural factors and individual behavioral risk for HIV, consistent with research in this area (Coates et al., 2008; DiClemente et al., 2007; Gupta et al., 2008; Holtgrave & Crosby, 2003; Latkin & Knowlton, 2005; Sumartojo, 2000). Results suggest that the interplay of sociostructural factors may indirectly impact intervention success across regions with varying resources, policies and laws, and levels of economic and social equality in at least four ways.

1. The efficacy of interventions that teach and develop individual skills was greatest in countries with the lowest human development levels, a pattern that is consistent with a prior meta-analysis focusing on Latin American and Caribbean nations (Huedo-Medina et al., 2010). The burden of disease (morbidity and mortality resulting from HIV/AIDS) translates to immeasurable loss in human productivity and capital (Piot et al., 2007). That even relatively small doses of risk-reduction programming can succeed is encouraging given resource deficits across regions in Asia.
2. Results emphasize the importance of understanding the particular socio-ecological structures of the target site in order to determine the “key ingredients” of intervention success. At the local level, communal activities are most common in Asia, and community-wide interventions incorporating peer-to-peer delivery and utilizing existing social structures were most efficacious. Additionally, HDI factored into the efficacy of particular intervention emphases and components. As Appendix 4 (**INSERT LINK TO ONLINE FILE**) illustrates, socio-culturally relevant interventions and/or those that included motivational components were most efficacious in low-development countries. That is, in countries with lower development levels (e.g., HDI below 0.75), theory-based motivational components that tap life goals and values were more efficacious at improving condom use. This improvement in efficacy, however, declined as human development levels increase, and interventions that did not include motivational components showed almost no differences in condom use efficacy by HDI of the country of the intervention. Similarly, socio-culturally relevant messages improved condom use much more in low-development countries.
3. Highly controlled interventions were *least* efficacious at improving condom use, whereas the low-quality studies were *most* efficacious. An aspect of high-quality trials is their use of active controls, which have been shown to contribute to smaller between-group effects because both the treatment and control groups may exhibit risk-reduction (de Bruin et al., 2009). Indeed, even high-quality interventions delivered later may be less efficacious than low-quality interventions delivered earlier due to prior intervention efforts for populations in a given location. Finally, the methodological scoring scheme used in the current analysis was derived for randomized control trial behavioral interventions, which may well be inappropriate for evaluating important aspects of structural interventions in developing nations (see **Limitations** for further discussion).
4. Intervention efficacy varied depending on the gender composition of the sample. Interventions were most successful at increasing condom use and reducing sexual risk to the extent that more women (or fewer men) were included in the study sample. Several explanations are plausible. First, this finding may be partially due to women assuming a social role as gatekeepers of the health and well-being of their families and communities. Second, interventions with more women in the samples may be attuned to the particular issues they face (e.g., in negotiating condom use with sexual partners) given structural-level forces such as gender inequality that contribute to women’s vulnerability to HIV/AIDS. By focusing on

particular issues that women face, interventions have a better chance at increasing women's efficacy for behavioral change. Third, the largest target group in our meta-analysis was female sex workers. In many parts of Asia, many interventions have targeted sex work establishments, and repeated exposure to risk-reduction messages from sources aside from the intervention is common (Poudel, 2011). Further, many female sex worker samples were in locales where 100% condom use policy was implemented (e.g., Thailand, Cambodia, parts of China). Intervention efficacy may be improved given sex workers' exposure to institutionalized risk-reduction strategies and messages. Finally, health promotion trials generally succeed better among women relative to men (Johnson et al., 2010).

Implications for Future Intervention Research

The current meta-analysis of behavioral interventions clearly demonstrated that behavioral interventions are efficacious in reducing HIV-risk behavior and incident STI/HIV in Asia. Taken together, behavioral interventions were *most* efficacious at improving condom use when they targeted more women, incorporated trans-situational motivational strategies that tap personal life goals and core social values (Carey & Lewis, 1999), and/or excluded STI testing and treatment without risk-reduction counseling. The Sonagachi Projects (Basu et al., 2004) and Project Saheli (Gilada, 2000) are examples of such interventions. Behavioral intervention efficacy, at least in terms of condom use improvement, did not appear to be related to particular methods commonly used to evaluate clinical trials. However, whether methodological quality is related to intervention efficacy in Asia should be a focus of future research.

Limitations

As with any meta-analysis, we were limited by the studies available in three ways. First, there is a relative dearth of interventions for major risk populations. We were able to include only three interventions for men who have sex with men and five interventions for injection drug users, limiting our ability to investigate differences in intervention efficacy between different risk groups. Second, from the included studies, we were limited to the populations they targeted and the risk-reduction outcomes measured. For example, condom use outcome was the most widely assessed risk-reduction marker, with sexual frequency and incident HIV/STI measured in far fewer studies, limiting our ability to compare efficacy of particular study features across all three moderator models. Further, studies that measured sexual frequency outcomes tended to target majority-male, heterosexual samples. Therefore, the finding that interventions were more efficacious at reducing sexual frequency among younger than older samples, or when condom skills training was provided, may be *apropos* for men. Meta-analytic undertakings such as this one depend on the availability of studies, and implications from these results must be considered with this caveat in mind.

Structural-level indices such as HDI and the Gini index are imperfect indicators (Sagar & Najam, 1998). For example, if such indicators were available within the nations included, the observed relations would logically have been more marked. Nevertheless, they provided information for modeling the effects of structural factors on HIV outcomes. Third, we included structural-level interventions, which are difficult to evaluate. It was also the case that lower study-quality scores tended to be associated with structurally based interventions (e.g., peer- or community-based). Development of new and better methods will be necessary if we are to better evaluate structural-level interventions (Swendeman et al., 2009). Last, although we considered whether socially and culturally relevant dimensions were included in interventions, we did not include other potentially important cultural factors such as religion, which includes Buddhism, Hinduism, and Islam. Confucianism is both a religion and a pervasive relational norm (Lee & Tan, 2011). Future meta-analyses should consider

the role of religion in various parts of the world where people follow a variety of different religious and cultural traditions.

Conclusion

In East Asia, particularly in countries with fewer resources, curtailing the HIV epidemic will require efficacious prevention programs. It is essential that such programs benefit from the knowledge generated by amassing extant evidence. Meta-analyses such as this one can help to accrue knowledge so that prevention resources can be deployed more effectively to avert a wider epidemic in East Asia.

Highlights

- the first, rigorous quantitative synthesis of HIV/AIDS intervention efficacy in Asian nations
- HIV is spreading rapidly in pockets across Asia; such a state of affairs calls for swift evidence-based measures
- Results are based on 53 HIV interventions examining dimensions of the interventions and of the nations in which they were conducted
- Results have the potential to advance HIV prevention scholarship and inform changes at the policy level

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Selection Process for Study Inclusion.

Figure 2.
 Forest Plot of Condom Use Effect Sizes Ordered from Smallest to Largest in Magnitude.

Table 1

Descriptive features of 54 interventions from 46 studies in the sample.

Authors	Year Published	Study Design ¹	Intervention Type ²	Sample	Intervention Features ³
Abdullah et al.	2003	Quasi	School-based	840 children from four intermediate schools in Hong Kong	Classroom-based sex & HIV/AIDS education program promoting condom use
Basu et al.	2004	Community RCT	Empowerment, Structural	200 FSW in Cooch Behar, Dinahata, India	SONAGACHI Project: community-level, peer-led skills training; HIV/AIDS education, community-wide awareness & local stakeholder involvement, condom promotion, STI treatment
Bentley et al.	1998	Pre-Post	Behavioral change with heterosexual men	1,628 seronegative men attending STI clinics in Pune, India	HIV, STI testing, counseling, & treatment; HIV/AIDS education, condom promotion & distribution
Bhatia et al.	2005	Pre-Post	Behavioral change with heterosexual men	Men aged 18–45 in impoverished community, Chandigarh, India	HIV/AIDS education; condom promotion & distribution; skills training
Bhave et al.	1995	Quasi	Behavioral change for FSW	Establishment-based FSW & madams in Mumbai (Bombay), India	HIV/AIDS education; condom promotion & distribution; STI treatment; education for brothel managers (madams)
Busza & Baker	2004	Pre-Post	Empowerment, Structural	Young, establishment-based migrant Vietnamese FSW in Phnom Penh, Cambodia	Introduction of female condoms; activity-based skills training; STI treatment; condom promotion; community-wide awareness & local government agencies involvement
Celentano et al.	2000	Quasi	Behavioral change with heterosexual men	Male conscripts in Royal Thai Army in northern provinces, Thailand	HIV/AIDS education; condom promotion & distribution; testing & counseling; STI treatment; activity-based skills training
Chen & Liao	2005	Pre-Post	IDU risk-reduction	Female IDUs aged 19–48, Guangxi Province, China	Harm reduction (no needle exchange) using culture-based relational model (including family members or friends); HIV/AIDS education; condom promotion
Comman et al.	2007	Group RCT	Behavioral change with heterosexual men	Long-distance truck drivers in Tamil Nadu, India	Information-Motivation-Behavioral (IMB) model intervention
Feng et al.	2009	Pre-Post	Behavioral change with MSM	1,772 young MSM aged 20–29 in Chongqing, southwest China	HIV/AIDS education; condom promotion & distribution; counseling & testing
Fontanet et al.	1998	Group RCT	Empowerment	FSW from 71 establishments in four cities in Thailand	Introduction of and skills training on female condoms use
Ford & Koetsawang	1999	Quasi	Behavioral change with FSW	475 high- & low-income FSW in Nakhon Pathom, central Thailand	HIV/AIDS education; condom promotion; STI treatment; skills training; involvement of sex establishment staff to institute condom use policy
Ford, Wirawan, Fajans et al.	1996	Quasi	Behavioral change with FSW	1,586 establishment-based FSW in Denpasar, Bali, Indonesia	INTERVENTION 1 (CARIK): Condom promotion & distribution to sex workers; STI treatment; skills training INTERVENTION 2 (SANUR): Condom promotion & sales to clients; STI treatment; skills training

Authors	Year Published	Study Design ¹	Intervention Type ²	Sample	Intervention Features ³
Ford, Wirawan, Reed et al.	2002	Pre-Post	Behavioral change with FSW	Low-income, establishment-based FSW, brothel managers, and clients in Bali, Indonesia	LOW IMPACT (one session every 6 months): HIV/AIDS education; condom promotion & distribution; skills training; counseling & testing; client & brothel manager education HIGH IMPACT (three sessions every 6 months): HIV/AIDS education; condom promotion & distribution; skills training; counseling & testing; client & brothel manager education Peer-led HIV/AIDS education & skills training; condom promotion; STI treatment; counseling & testing Peer-led HIV/AIDS education; condom promotion & distribution
Ford, Wirawan, Suastina et al.	2000	Quasi	Peer-education	FSW aged 15-42 in Bali, Indonesia	
Gangopadhyay et al.	2005	Quasi	Empowerment, Structural	Establishment-based FSW in Sonagachi red light district, Calcutta (Kolkata), India	
Gilada	1999	Pre-Post	Empowerment, Structural	5,500 FSW in Bombay, 3,500 in Pune, India	Project SAHEL1: Peer-led HIV/AIDS education & skills training; sex work legitimacy (photo-identity cards provided to sex workers; newsletter); STI treatment; condom promotion & distribution
Jana & Singh	1995	Pre-Post	Empowerment, Structural	Establishment-based FSW in Sonagachi red light district, Calcutta, India	SONAGACHI Project: Peer-led education & skills training; legitimacy of sex work; community-wide awareness & local stakeholder involvement; microloans
Kawichai et al.	2004	Pre-Post	Behavioral change with heterosexual adults	2,251 young adults aged 19-35 living in Chiang Mai, northern Thailand	HIV counseling & testing; condom use education
Kumar et al.	1998	Quasi	IDU risk-reduction	Street-recruited male IDUs in Madras (Chennai), India	Community-based outreach; HIV/AIDS education; bleach & condom distribution; health care referral
Latkin et al.	2009	RCT	IDU risk-reduction	427 male IDUs and risk partners in Chiang Mai, Thailand	Peer-led HIV/AIDS education & skills training based on network model (recruiting social network index as peer educators); HIV counseling & testing
Lau, Lau, Cheung et al.	2008	RCT	Behavioral change with MSM	Young, internet-recruited MSM in Hong Kong	E-mail-based intervention using individualized feedback for risk-reduction
Lau, Tsui, Cheng et al.	2010	RCT	Behavioral change with heterosexual men	301 male cross-border truck drivers in Hong Kong	Counseling & testing; HIV/AIDS education; condom promotion
Li, Stanton, Wang et al.	2008	Group RCT	School-based	380 college students from four universities in Nanjing, China	Culturally-adapted HIV/AIDS education and condom use promotion
Li, Wang, Fang et al.	2006	Quasi	Behavioral change with FSW	Young female sex workers in southern China	Culturally-adapted intervention: Counseling & testing, condom promotion, HIV/AIDS education
Ma et al.	2002	Pre-Post	Behavioral change with FSW	966 FSW in Guangzhou, China	HIV/AIDS education; condom promotion; skills training; STI testing & treatment
Morisky, Ang, Coby et al.	2004	Quasi	Peer-education; structural	3,389 male clients of FSW in southern Philippines	Peer-led HIV/AIDS education, condom promotion, skills training; community-wide awareness & focal stakeholder involvement
Morisky, Chiao, Stein et al.	2005	Quasi	Peer-education; structural	369 FSW in four cities south of Manila, Philippines	WORKERS only: Peer-led HIV/AIDS education, condom promotion, skills training

Authors	Year Published	Study Design ¹	Intervention Type ²	Sample	Intervention Features ³
		Quasi			MANAGERS only: HIV/AIDS education, manager-led condom promotion
Morisky, Nguyen, Ang et al.	2005	Quasi	Peer-education	Young male taxi & tricycle drivers in southern Philippines	COMBINED (managers & workers) Condom use promotion; skills training; peer-led HIV/AIDS education
Morisky, Stein, Chiao et al.	2006	Community RCT	Peer-education	897 FSW in four cities south of Manila, Philippines	PEER + MANAGER: Multilevel intervention using manager- & peer-led condom promotion
		Community RCT			PEER only: Peer-led condom promotion
Muller et al.	1995	Quasi	Behavioral change with heterosexual adults	Young, seropositive adults in Bangkok, Thailand	Counseling & testing
Peak et al.	1995	Pre-Post	IDU risk-reduction	507 IDUs in Kathmandu, Nepal	Clean needles exchange; STI treatment; condom promotion & distribution
Sherman et al.	2009	RCT	Peer-education	1,189 young methamphetamine users ages 18–25 in Chiang Mai, Thailand	Peer network intervention using peer-led HIV/AIDS education, skills training, condom promotion
Tripitboon	2001	Community RCT	Community-wide intervention	607 married women aged 18–49 in rural northern Thailand	Community-wide awareness & local stakeholder involvement; HIV/AIDS education; skills training
Ubaidullah	2004	Pre-Post	Behavioral change with heterosexual men	300 male truck drivers aged 25–45 in Andhra Pradesh, India	HIV/AIDS education; condom promotion
van Griensven et al.	1998	Quasi	Behavioral change with FSW	Establishment-based FSW in Sungai Kolok, Betong, Thailand	Voluntary counseling & testing; HIV/AIDS education; peer-led condom promotion & distribution
Visrutaratna et al.	1995	Pre-Post	Community-wide intervention	FSW from 43 establishments in Chiang Mai, Thailand	“Superstar” & “Model brothel” programs: Peer-led HIV/AIDS education; peer- and manager-led condom promotion
Wang & Keats	2005	Quasi	Behavioral change with heterosexual men	450 men aged 17–39 from three ethnic groups in Sichuan province, China	DIRECT: HIV/AIDS education; involvement of peer educators to develop risk-reduction intervention materials
		Quasi			INDIRECT: Peer-led HIV/AIDS education, skills training, and condom promotion
Wong, Chan, & Koh	2004	Quasi	Behavioral change with FSW	1,259 young establishment-based migrant (Malaysian Chinese) FSW in Singapore	Condom use promotion; mandatory STI testing; skills training; HIV/AIDS education
Wong, Chan, Lee et al.	1996	Quasi	Behavioral change with FSW	253 establishment-based FSW from two locales in Singapore	HIV/AIDS education; condom promotion; skills training
Wu et al.	2007	Pre-Post	Behavioral change with FSW	Establishment-based FSW from three towns in Yunnan province, China	HIV/AIDS education & condom promotion with workers and managers/establishment owners; discounted condoms
Xiaoming, et al.	2000	Community RCT	Community-wide intervention	Young adults aged 18–30 in Kunshan county, China	HIV/AIDS education integrated into existing family planning program; condom promotion & distribution
Xu, Kilmarx, Supawitkul et al.	2002	Pre-Post	Behavioral change with heterosexual adults	648 STI-clinic patients in Shanghai, China	Clinic-based counseling & testing; skills training; condom promotion

Authors	Year Published	Study Design ¹	Intervention Type ²	Sample	Intervention Features ³
Xu, Wang, Zhao et al.	2002	RCT	Behavioral change with heterosexual adults	779 young, married, seronegative women in Chiang Rai, Thailand	Video-based HIV/AIDS education
Ye et al.	2009	RCT			Video-based HIV/AIDS education + risk-reduction discussion with medical doctor during clinic visit
		Quasi	School-based	893 high school students in Hong Kong	Peer-educators training; teacher-led HIV/AIDS education
Zhu et al.	2008	Pre-Post	Behavioral change with MSM	218 young MSM in three cities in Anhui province, China	Peer-led HIV/AIDS education

Note. Abbreviations: *MSM*, men who have sex with men; *FSW*, female sex workers; *IDUs*, injection-drug users; *STIs*, sexually transmitted infections.

¹ *Pre-Post*, within-subjects design with no comparison, *Quasi*, quasi-experimental design, *RCT*, randomized controlled trial with individuals as units of randomization, *Group RCT*, randomized controlled trial with groups as units of randomization, *Community RCT*, randomized controlled trial with communities as units of randomization.

² *Empowerment*, Intervention strategies aimed to increase behavioral efficacy and in effecting intended and actual change, *Structural*, Intervention strategies focused on changing brothel- or community-based policies and gamer community support and awareness.

³ Information-Motivation-Behavioral model guide intervention design to target increasing knowledge, motivation, and behavioral skills to change behavior.

Table 2

Weighted mean effect sizes of HIV-risk-reduction outcomes.

Outcome	k	Weighted mean d_+ (95% CI)		Homogeneity of effect sizes		Deviation from normality	
		Fixed Effects	Random Effects	I^2 (95% CI) ^a	Begg's z	Egger's t	
Overall condom use	52	0.57 (0.55, 0.59)	0.73 (0.54, 0.93)	98.99 (98.88, 99.09)	2.68 ($p=0.56$)	0.58 ($p=0.13$)	
With steady sex partner	7	0.25 (0.20, 0.31)	0.48 (0.13, 0.83)	96 (94.26, 97.62)			
With casual sex partner	14	0.70 (0.66, 0.74)	0.41 (0.09, 0.73)	98 (97.13, 98.28)			
Overall sexual frequency	16	0.05 (0.01, 0.09)	0.17 (−0.037, 0.38)	95 (93.25, 96.35)	0.63 ($p=0.01$)	1.61 ($p=0.57$)	
Number of sex partners	11	0.12(0.05, 0.18)	0.18 (−0.11, 0.48)	96 (93.72, 96.94)			
STI and HIV incidence	20	0.28 (0.25, 0.30)	0.35 (0.10, 0.60)	99.18 (99.05, 99.30)	0.22 ($p=0.23$)	0.85 ($p=0.85$)	
HIV incidence	6	0.89 (0.84, 0.94)	1.19 (−0.11, 2.48)	99.86 (99.84, 99.88)			
Other STI incidence	15	0.26 (0.22, 0.29)	0.37 (0.07, 0.67)	99.14 (98.97, 99.28)			

Note. Weighted mean effect sizes (d_+) are larger than 0 for differences that favour the intervention group (lower HIV incidence) relative to the comparison (a control group or a pretest baseline assessment).

^aValues significantly higher than 0 imply the rejection of the hypothesis of homogeneity (i.e., there is more variability in effect sizes than expected by sampling error alone).

Table 3Moderators of Condom Use Effect Sizes ($k = 52$)^a.

Study dimension and level ^b	All comparisons	
	Adjusted ^c d_+ (95% <i>CI</i>)	β value
Percentage of women in sample		0.33 **
	0% 0.43 (0.05, 0.82)	
	100% 0.97 (0.71, 1.24)	
Methodological quality		-0.23 *
	Low quality 1.08 (0.63, 1.54)	
	High quality 0.25 (-0.40, 0.90)	
Trans-situational motivational strategies		0.27 *
	Absent 0.55 (0.32, 0.78)	
	Present 0.98 (0.61, 1.36)	
Provided testing and treatment for STIs		-0.41 *
	Absent 0.96 (0.70, 1.22)	
	Present 0.63 (0.30, 0.96)	

Note. Abbreviations: *CI*, confidence interval; d_+ , weighted mean effect size; *STI*, sexually transmitted infection; significance of the standardized regression coefficient is denote as

* $p < .05$;

** $p < .01$

*** $p < .001$.

^aCondom use effect sizes for 52 studies were modeled as the dependent variable in weighted least-squares multiple regression, with four study dimensions simultaneously entered as independent variables and the inverse variance as the weights following mixed-effects assumptions. Positive effect sizes imply better condom use efficacy for the intervention group relative to the comparison group adjusted for the other variables in the model. High and low values for moderator category reflect maximum and minimum values in sample. The model explains 40% of the variance in effect sizes.

^bHigh and low values for moderator category reflect maximum and minimum values in sample.

^cThe trans-situational motivational strategies and provide STI testing and treatment were contrast coded and the other two variables were zero-centered. High quality is reflective of high methodological quality score.

Table 4Moderators of Sexual Frequency Effect Sizes ($k = 16$).

Study dimension and level ^a	All comparisons	
	Adjusted ^b d_+ (95% <i>CI</i>)	β
Human Development Index		−0.34***
Low 0.35	0.45 (0.27, 0.62)	
Medium 0.71	0.02 (−0.03, 0.07)	
High 0.94	−0.25 (−0.34, −0.16)	
Mean age		−0.28***
15 years	0.25 (−0.16, 0.34)	
42 years	−0.22 (−0.37, −0.06)	
Condom skills training		0.34***
Absent	−0.10 (−0.16, −0.04)	
Present	0.14 (0.07, 0.21)	

Note. Abbreviations: *CI*, confidence interval; d_+ , weighted mean effect size; significance of the standardized regression coefficient is denote as

* $p < .05$;

** $p < .01$

*** $p < .001$.

The model was a weighted least-squares multiple regression, with study dimensions simultaneously entered as independent variables and the inverse variance as the weights, following fixed-effects assumptions. Positive effect sizes imply less sexual frequency efficacy for the intervention group relative to the comparison group adjusted for the other variables in the model. The model explains 38% of the variance, $R^2(3,12)=94.16$ (95% *CI*=91.50, 95.99).

^aHigh and low values for moderator category reflect maximum and minimum values in sample.

^bHolding continuous factors constant at their mean, or, in the case of condom skills training, holding this factor constant through use of contrast coding.

Table 5Moderators of the Effect Sizes for Incident HIV and STI ($k = 20$).

Study dimension and level ^a	All comparisons	
	Adjusted ^b d_+ (95% CI)	β
Percentage of women in sample		0.30 ***
	0% 0.10 (0.06, 0.14)	
	100% 0.50 (0.46, 0.54)	
Data collection year		0.60 ***
	1991 -0.90 (-1.01, -0.80)	
	2008 1.58 (1.48, 1.68)	
Provided testing and treatment for STIs		0.41 ***
	Absent 0.38 (0.33, 0.43)	
	Present 0.42 (0.39, 0.45)	

Note. Abbreviations: *CI*, confidence interval; d_+ , weighted mean effect size; *STIs*, sexually transmitted infections; significance of the standardized regression coefficient is denote as

*
 $p < .05$;

**
 $p < .01$

 $p < .001$.

The model was a weighted least-squares multiple regression, with study dimensions simultaneously entered as independent variables and the inverse variance as the weights, following fixed-effects assumptions. Positive effect sizes imply less incident HIV/STI efficacy for the intervention group relative to the comparison group adjusted for the other variables in the model. The model explains 33% of the variance, $\hat{P}(3,16)=98.68$ (95% CI=98.39, 98.92).

^a High and low values for moderator category reflect maximum and minimum values in sample.

^b Holding continuous factors constant at their mean, or, in the case of provided STI testing and treatment holding this factor constant through use of contrast coding.