



# Efficacy of Psychological Interventions Towards the Reduction of High-Risk Sexual Behaviors Among People Living with HIV: A Systematic Review and Meta-analysis, 2010–2020

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## Abstract

People living with HIV/AIDS (PLWH) may be vulnerable to mental illness. As sexual transmission is the leading cause of HIV infection, evidence-based study for the effect of psychological interventions on the change of sexual is needed. To estimate the efficacy of psychological interventions towards reducing unprotected sex and increasing condom use among PLWH. We systematically searched PubMed, Web of Science, EMBASE (OVID), and PsycINFO (OVID) for studies reporting psychological intervention effects on the outcomes of condom use and/or unprotected sex from 2010 to 2020. This review is registered with PROSPERO, CRD42020193640. Of 949 studies, 17 studies were included in this systematic review. Overall, participants in the intervention group reduced sexual risk or condomless sex relative to control groups. The effect was higher for people having sex with HIV-positive partners comparing with those who had sex with HIV-negative or unknown status partners. Psychological interventions might positively affect the condom use of PLWH and should be prioritized and regularly.

**Keywords** HIV · Behavior · Condom use · Psychological interventions · PLWH · Meta-analysis

## Introduction

HIV has become a chronic illness instead of a disease that rapidly leads to severe sickness or death due to antiretroviral medication in recent years. Sexual transmission, via unprotected heterosexual or homosexual contact, is the leading cause of HIV infection. Thus, sexual risk behaviors increasing becomes an important reason for HIV transmission [1]. Simultaneously, people living with HIV/AIDS (PLWH) are those who suffer mental illness most [2]. Depression or stigmas occur commonly in HIV-positive individuals with limited the quality of life, and leading to poorly clinical outcomes [3]. A study focused on mental health problems among female sex workers has revealed that sexual assault was associated with current PTSD (post-traumatic stress

disorder) symptoms. Female sex workers who had experienced violence were five times more likely to be depressed than those who were not victims of violence [4], which may increase the spread of HIV or sexual transmitted diseases (STDs) [5]. HIV-related stigma might lead HIV-positive people to internalize negative messages about themselves and other HIV-positive individuals [6]. The internalized HIV-related stigma might lead to HIV transmission-related risk behaviors, including suboptimal antiretroviral adherence, condomless sex, avoidance of medical services, and HIV status disclosure [7].

In light of the above, several previous psychosocial interventions were conducted recent years to promote mental health among PLWH. Theoretical basis including cognitive-behavioral therapy (CBT), stress management interventions, information-motivation, and behavioral skills (IBM) have been developed for PLWH with mental disorders. These interventions effectively reduce symptoms of depression, anxiety and improving quality of life among PLWH [8, 9]. At the same time, previous systematic reviews and meta-analyses about behavioral intervention suggested that risk reduction interventions on people living with HIV/AIDS are efficacious in reducing 43% of self-reported unprotected sex [1, 10]. However, no meta-analysis was conducted to

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investigate the effects of psychological interventions on sexual behaviors.

Evidence showed that condom effectiveness against HIV found an average protective effect of 80% for consistent condom use, unadjusted for lack of correct use [11]. One study in New Zealand have emphasized evidence-based primary prevention by condom use, which was implemented in communities and supported by comprehensive public health action [12]. Condom use remains a staple prevention method though international attention has been recently devoted to biomedical prevention strategies such as pre-exposure prophylaxis (PrEP) [11, 13, 14].

In conclusion, the systematic review and meta-analysis on psychological interventions was conducted to evaluate the efficacy of HIV risk reduction, especially on condom use, among PLWH.

## Methods

This review complied with preferred reporting items for systematic review and meta-analysis (PRISMA) [15]. A systematic literature search was performed to identify trials that evaluated the impact of psychological interventions on self-reported condom use among PLWH. The literature searching strategy was decided after several rounds of discussion. Two authors performed the searching process independently. Articles with different opinions were discussed with one or more of the other authors to decide.

### Literature Search, Study Selection, and Data Extraction

We searched on PubMed, Web of Science, EMBASE (OVID), and PsycINFO (OVID) from May 4th to 12th, 2020. The search strategy can be found in the Appendix. And We selected studies carried out from January 1, 2010, to December 31, 2019. The articles were screened to determine by the following criteria: (1) The intervention target population was 14 years old or above HIV-positive subjects (including HIV discordant couples). (2) The study design should be intervention studies, including clinical trials, randomized controlled trials (RCT), a quasi-experimental design with a comparison condition, and pilot study. (3) Psychological intervention, which means the intervention primary aimed to change the mental disorders, thoughts, or emotions among PLWH. (4) Intervention outcomes included at least one behavior change technique or behavioral outcomes (condom use, sexual behavior times, number of sexual partners, commercial behavior, etc.) The flow diagram for the identification and selection of articles for inclusion was shown in Fig. 1.

Two trained coders independently coded each eligible intervention for the following study characteristics (e.g., study date, author, location, sample size, study design), intervention characteristics (e.g., components, delivery method, follow-up), outcomes, and risk of bias. If sexual behavior data for different types of partners were reported, the review summarized the results of sex with all partners or at-risk partners (i.e., HIV-negative or status-unknown partners). Besides, for studies that reported multiple measurements or follow-up assessments, we summarized all the results for interventions by different assessments in each eligible research (i.e., condom use frequencies/proportions, condomless sex frequencies/proportions, risk/odds ratio).

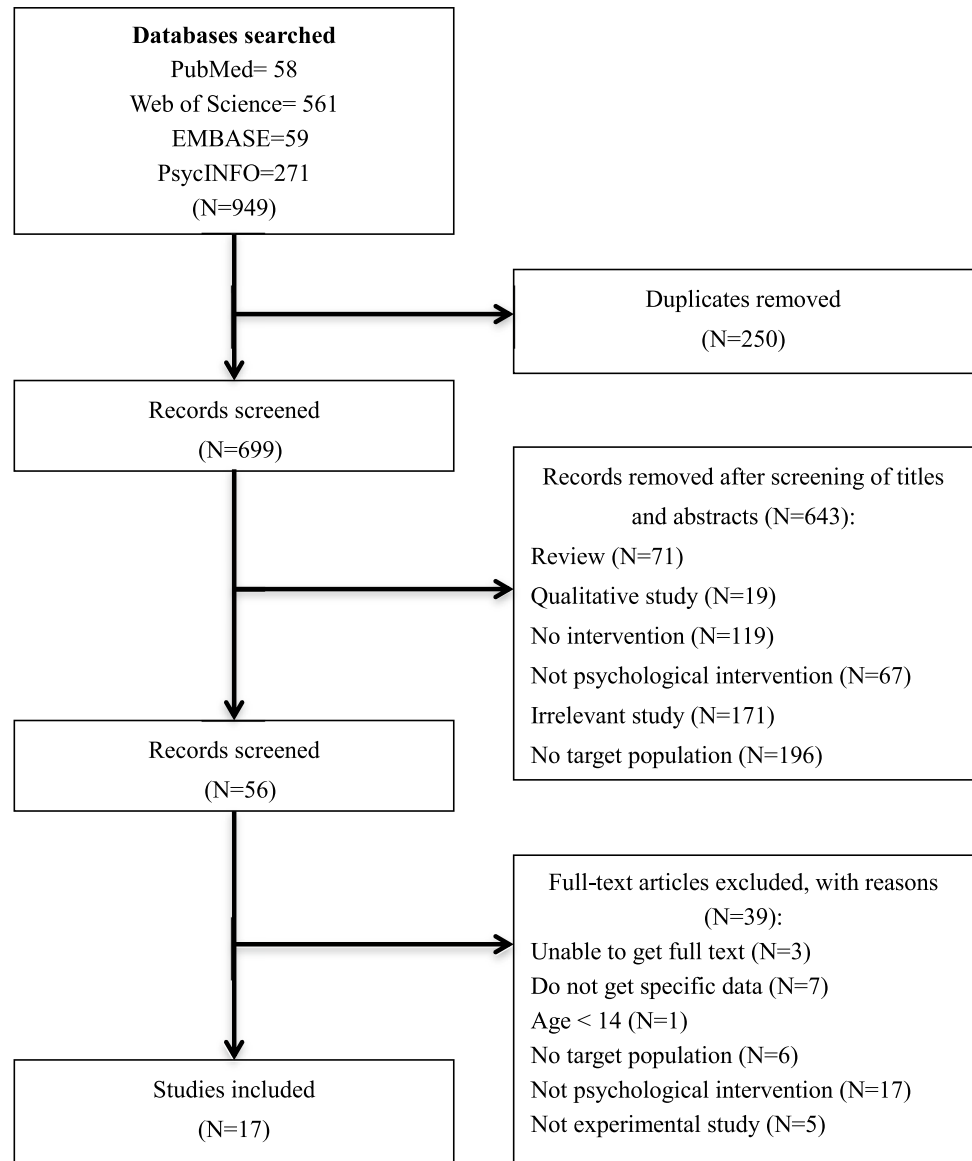
### Quality Assessment

Study quality was assessed using adapted Cochrane risk-of-bias variables [16]. Each intervention was evaluated for Sequence generation, Allocation concealment, Blinding (participants), Incomplete outcome data, Selective outcome reporting, Availability of treatment manual, and Use of training for therapy providers. Each item was scored as high (−1), or unclear (0) or low (1) risk of bias. Overall, study quality was scored from 0 to 7, with a higher score indicating a lower risk of bias [17]. ‘Low risk of bias’, means plausible bias unlikely to seriously alter the results (Score:  $\geq 4$ ). ‘Unclear risk of bias’, means plausible bias that raises some doubt about the results (Score:  $-4$  to  $4$ ). ‘High risk of bias’, means plausible bias that seriously weakens confidence in the results (Score:  $\leq -4$ ). Disagreements in quality assessment were resolved through discussion.

### Data Analysis

Meta-analysis was conducted among studies using the same measurement of condom use. For studies using various assessment were qualitatively summarized. However, we did not conduct meta-analysis for all included studies due to various intervention design and outcome assessments across sexual behaviors. We used standardized mean differences (SMD) for condom use proportion to calculate the effect size. The SMD was defined as the mean difference between treatment and control groups divided by the pooled standard deviation. Cohen’s D was calculated as a measure of effect size, and the evaluation criteria of Cohen’s D were as follows: small effects ( $\geq 0.2$  and  $< 0.5$ ); Moderate effect ( $\geq 0.5$  and  $< 0.8$ ); Big effect (0.8 or higher). Heterogeneities were assessed by  $I^2$  statistics,  $I^2 \leq 50\%$  was considered as no heterogeneity, and the fixed-effects model was adopted; otherwise, a random-effects model with restricted maximum likelihood variance estimation was used to obtain average condom use effect sizes. And the funnel plot, Egger’s test of the intercept, was employed to assess indications of

**Fig. 1** Flow chart showing the search and study selection process for literature



publication bias. All analyses were conducted in R studio 1.1.456 using a “meta” meta-analysis package.

**Results**

Database searching produced a total of 949 citations (Fig. 1). After the initial screening of duplicates, 699 citations were dependently reviewed by two authors, of which 643 were excluded for not meeting the inclusion criteria (e.g., review, qualitative studies, irrelevant studies, or studies without psychological intervention). Fifty-six articles were pulled for full-text review, and 39 were excluded for different reasons (unable to access the full text or specific data, or no target population, et al. See details in Fig. 1). Ultimately, 17 studies

were included in the review (Table 1). The review registration number was PROSPERO CRD42020193640.

**Study Descriptions**

As Table 1 showed, included studies were published between 2010 and 2020. In total, 2885 participants reported in 17 unique publications [18–34] were included in the current review. Interventions focused on HIV-positive men who have sex with men (MSM) (n=6), HIV discordant couples (n=2), HIV-positive women (n=2), or other HIV-positive participants (n=7). The majority of the interventions were conducted in the United States (n=8), while others were conducted in South Africa (n=1), Nepal (n=1), Canada (n=1), Malawi (n=1), Europe (n=1), and four unclear study fields.

**Table 1** Descriptions of included studies

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Klein CH et al. 2013 [18]	USA	HIV-positive African-American women		<p>Session 1: Change what you think, change what you do;</p> <p>Session 2: Risk reduction, condoms and relationships;</p> <p>Session 3: Risk reduction and condom management;</p> <p>Session 4: Building healthy relationships, and it's your turn, in which participants practice being peer educators</p>	3-month	<p>Behavioral outcomes:</p> <p>(1) Percentage of condom protected vaginal and anal intercourse,</p> <p>(2) 100% condom use for vaginal and anal sex</p> <p>Condom use frequencies were calculated based on self-reported sexual behavior in the past 30 days</p>
Cruess DG et al. 2018 [21]	Unclear	HIV-positive Gay or bisexual	IMB model	<p>Session1: Group facilitators and group members introduced themselves;</p> <p>Session2: The facilitators reviewed the assignment on deception from the previous session, and introduced the topic of HIV status disclosure with partners met online</p> <p>Session3: Discussion began with the assignment on sero status disclosure from the previous session</p> <p>Session4: Discussed their experiences with the condom negotiation assignment from the previous session</p>	6-month	<p>Self-reported total number of male sex partners during the past 6 months: including partner sero status (HIV-positive vs. HIV-negative/unknown) and the number of times they had CAS with partners in each sero status category</p>

**Table 1** (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Parsons JT et al. 2017 [29]	Unclear	HIV-positive Gay and bisexual men		<p>Unified Protocol for Trans diagnostic Treatment of Emotional Disorders (UP), consisted of the following 5 core treatment modules:</p> <p>(1) Mindful emotion awareness, (2) cognitive flexibility, (3) identifying and preventing patterns of emotion avoidance, (4) increasing awareness and tolerance of emotion-related physical sensations, and (5) interoceptive and situational emotion-focused exposures</p> <p>The 5 core modules are preceded by a module focused on enhancing motivation as well as an introductory module on the adaptive nature of emotions that provides a framework for understanding emotional experiences</p>	3-month	Emotion regulation; Symptoms of Sexual Compulsivity; HIV transmission risk behavior

**Table 1** (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Poudel KC et al. 2015 [31]	Kathmandu Valley, Nepal	HIV-positive	Protection Motivation Theory, Social Cognitive Theory	<p>Session 1: emphasized skill development to cope with HIV-related stressors</p> <p>Session 2: focused on participants' knowledge of HIV; the possibility of HIV co-infection and super infection; and the consequences of having HIV co-infection, super infection, or other STIs among HIV-positive individuals</p> <p>Session 3: designed to enhance participants' knowledge of HIV transmission risk behaviors and addressed common myths about HIV/STI prevention among HIV-positive persons</p> <p>Session 4: focused on the importance of condom use in preventing pregnancy and transmission of HIV and other STIs</p> <p>Session 5: reinforced the benefits of consistent condom use among HIV-positive persons and the participants conducted role-play to improve safer sex negotiation skills with various partners</p>	Post-intervention	Condom use intention

**Table 1** (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Jones DL et al. 2017 [24]	Urban South Florida	Perinatally infected or behaviorally infected with HIV	MI	<p>Session 1: expressing empathy, identifying positive elements of target behaviors, discussing discrepancies between current behavior and goals, supporting positive behavior, promoting decision making, goal setting, exploring ambivalence and using change talk and reflecting</p> <p>Session 2: focused on fertility desires, a plan for safer conception or selection of an appropriate contraceptive based on their own plan, and initiation of pre-conception communication with their provider</p>	Post-intervention, 6-month	Condom use proportion

Table 1 (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Williams M et al. 2012 [33]	Unclear	Heterosexual African American crack cocaine users living with HIV infection	Social cognitive theory	<p>The (positive choice intervention) PCI was composed of six, 60 mins mixed gender group sessions</p> <p>Session 1: Effects of antiretroviral medications, the risks and consequences of HIV/STD infection/reinfection, HIV transmission to sex partners, and risks when both sex partners are HIV-positive</p> <p>Session 2: explored ways to make sex with a condom pleasurable and fun, and strategies for negotiating condom use with a reluctant partner</p> <p>Session 3: examined discussing HIV status to all sex partners and how to talk with partners about HIV and condom use</p> <p>Session 4: devoted to assessing personal sexual rights, sexual diversity, the need for intimacy, and positive sexual choices</p> <p>Session 5: A forum for examining gender role and relationship expectations, sexual scripts, and achieving sexual pleasure without vaginal sex</p> <p>Session 6: reviewed intervention topics and invited participants to discuss any intervention topic interesting to them</p>	3, 9-month	Frequency of sex, number of sex partners, and consistent condom use in the past 30 days



**Table 1** (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Lovejoy TI et al. 2014 [26]	Eastern and Midwestern United States	HIV-positive late middle-age and older adults	Trans theoretical model and IMB	<p>The 4-Session Tele-MI: Session 1 focused on ascertaining the client's current relationship and sexual dynamics</p> <p>Session 2, therapists discussed the client's concurrent sexual relationships</p> <p>If not addressed in an earlier session, Session 3 focused on the identification of barriers to engaging in protected sex and the development of a client-generated sexual behavior change plan</p> <p>Session 4, the client and therapist discussed the client's progress toward implementing the change plan and made plan modifications as needed</p> <p>The 1-Session Tele-MI: therapists focused on the most high-risk behavior for clients who had multiple risky behaviors and/or sexual partnerships and only discussed secondary behaviors and concurrent sexual partnerships</p>	3, 6-month	Sexual behaviors, depression symptoms

Table 1 (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Hart TA et al. 2016 [34]	Toronto	HIV-positive MSM	IMB, motivational interviewing, self-directed behavioral skills practice	(a) Basics of HIV transmission and pathogenesis; HIV-status disclosure skills; (b) Negotiation of safer sex practices; (c) Exploration of non-penetrative sex alternatives; (d) Experimentation with a variety of condoms to enhance the condom-wearing experience	Post-intervention, 3-month	Sexual behavior. Participants reported the total number of male sexual partners
El-Bassel N et al. 2010 [22]	Atlanta; Los Angeles; New York; Philadelphia	African American HIV discordant couples	Social cognitive theory, relationship-oriented ecological framework	Session 1: provide information about STDs, HIV, and safer sex practices; Session 2: Enhancing Couple Communication Session 3: Safer sex methods; Session 4: Discussed other issues (e.g., use of alcohol or drugs) in their relationship that may have affected their sexual risk-taking behaviors; Session 5: Practicing the FENCE techniques to problem solve barriers to safer sex and learning to identify and build social networks that promote safer sex	Post intervention, 6, 12-month	Couple's reported proportion of condom-protected intercourse acts in the past 90 days

**Table 1** (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Mashaphu S et al. 2020 [27]	Durban, South Africa	HIV discordant couples	Social cognitive theory, relationship-oriented ecological framework	<p>Session 1: Provide information about STDs, HIV, and safer sex practices;</p> <p>Session 2: Enhancing couple communication</p> <p>Session 3: Safer sex methods;</p> <p>Session 4: Discussed other issues in their relationship that may have affected their sexual risk-taking behaviors;</p> <p>Session 5: Practicing the FENCE techniques to problem solve barriers to safer sex; and learning to identify and build social networks that promote safer sex</p>	3, 6-month	Condom use; concurrent partners. Biological outcomes

**Table 1** (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Hightow-Weidman LB et al. 2019 [23]	Unclear	Young black HIV-positive MSM	Integrated behavioral model (IBM)	The mobile phone and internet-based HIV intervention features within the intervention include: Forums for discussion of relevant topics, such as HIV prevention and treatment, dealing with stigma, safer sex behaviors and relationships; A space to upload and share personal videos, audio, pictures or prose (Getting Real); the availability of an online doctor who would respond to questions within 72-h; Decision support tools (e.g. brief surveys, with feedback and referral to prevention services based on results, HIV testing and care locators) for assessing and addressing risk behaviors	3, 6, 12-month	Sexual risk behaviors; Detectable viral load; Psychosocial variables

**Table 1** (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Kalichman SC et al. 2018 [25]	Atlanta, GA	HIV-positive	Social cognitive theory of behavior change	<p>The one-on-one coaching sessions included a brief personalized assessment of recent experiences gaining access to health care, addressing barriers to staying in care, challenges to taking cART, sexual decisions, emotions, and relationships</p> <p>Each session included content directed at addressing the links between mood, situational contexts, social relations and substance use in relation to HIV health care, cART adherence, and sexual behaviors</p> <p>Decisional balance exercises and problem-solving activities focused on treatment adherence and sexual risks for STI in the context of viral load</p> <p>In each session, sexual decision-making was placed within scenarios of individually tailored challenges such as substance use, mood/depression, relationship status, viral load, and HIV disclosure. Effective decisions regarding medication management and sexual health strategies were the focus of each session</p>	3,6,9,12-month	HIV viral load; Antiretroviral adherence and HIV care visits; Sexual behavior

Table 1 (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Nöstlinger C et al. 2016 [28]	European	HIV-positive MSM	SCT, IMB, and dual process approaches in health risk decision making	<p>Session 1: focused on exploring participants' emotional response to individual problems with safer sex, using the filmed role models;</p> <p>Session 2: focused on developing personal solutions for the identified problems that would fit participants' context and lifestyles;</p> <p>Session 3: counseling interaction and resulted in a personalized risk reduction plan</p>	Post intervention, 3, 6-month	Condom use; Relevant Socio-demographic; Health-related variables
Teti M et al. 2010 [32]	Philadelphia, PA	Women Living with HIV/AIDS	Trans theoretical Model, the Modified AIDS Risk Reduction Model, and the Theory of Gender and Power	<p>Brief HIV prevention messages delivered by clinicians in the context of routine medical visits</p> <ul style="list-style-type: none"> <li>• A group-level intervention (GLI) delivered by a Health Educator</li> <li>• A Peer-led support group</li> </ul>	6, 12, 18-month	Partner Disclosure; Condom use
Brown JL et al. 2019 [19]	Northeastern US city	HIV-positive MSM	Motivational interviewing	<p>Session 1: Program overview, focus on healthy living, coping effectiveness training, and stress management;</p> <p>Session 2: Healthy relationships</p> <p>The two group sessions that addressed motivational, behavioral skills, and HIV transmission information tailored to HIV-infected MSM coupled with stress management training</p>	Post intervention, 3-month	HIV Transmission Knowledge; Condom Attitudes; Unprotected Sexual Behaviors

**Table 1** (continued)

Authors, publication year	Location	Participants	Theoretical basis	Intervention	Follow-up time	Outcomes
Caballero-Suárez NP et al. 2019 [20]	Mexico City	HIV-positive	CBT	<p>Module1: Emotional regulation</p> <p>Module2: Sero status disclosure</p> <p>Module3: Quality of sexual life</p> <p>Module4: Triggers of sexual risk behaviors</p> <p>Module5: Correct and consistent condom use</p> <p>Module6: Negotiation of sex</p>	1,3-month	<p>Depression symptoms;</p> <p>Anxiety symptoms;</p> <p>Sero-status disclosure;</p> <p>Quality of sexual life;</p> <p>Consistent condom use;</p> <p>Correct condom use skills</p>
Pettifor A et al. 2015 [30]	Lilongwe, Malawi	Acute HIV Infection	IMB, Motivational interviewing	<p>This and all subsequent sessions will begin with a review of the participant's emotional status, understanding of HIV, behavioral experiences relating to sex or abstinence, and barriers to the chosen behavioral goals</p> <p>Learning condom-use skills and negotiation, disclosure-communication skills, and social support</p> <p>Reviewing the participant's emotional status, HIV understanding, behavioral experiences relating to sex or abstinence and barriers to the chosen behavioral goals, and the status of partner notification/closure and referral</p>	Weeks 2, 4, 8, 12, 16, 20 and 24	Sexual behaviors

The studies differed substantially in their design. Eleven studies of them were randomized controlled trials (RCTs) with randomization at either the individual or group (facility/community) level [18, 21–28, 32, 33], while six studies employed non-randomized trials (pilot study/quasi-experimental study) or a randomized trial with no control [19, 20, 29–31, 34]. Studies varied in the number of interventions adopted, with fourteen reported a two-armed design, one reported a three-armed design, and two reported no control design.

Almost all studies had one or more underlying theoretical basis. Information, motivation and behavior skills model (IMB) [21, 26, 28, 30, 34], protection motivation theory/social Cognitive theory [22, 25, 27, 28, 31, 33] were the first two theories that founded the basis of intervention, others including Motivational interviewing [19, 24, 30, 34], Transtheoretical Model [32], self-directed behavioral skills practice [34], relationship-oriented ecological framework [22, 27], Integrated Behavioral Model (IBM) [23], cognitive-behavior therapy (CBT) [20], Modified AIDS Risk Reduction Model [32], and the Theory of Gender and Power [32].

### Summary of Intervention Characteristics

Interventions of seventeen studies showed in Table 1. Most interventions adopted face to face, but some interventions used multiple adaptations such as mobile phones or internet-based methods [23]. The online-intervention built forums for

discussion on relevant topics, such as HIV prevention and treatment, dealing with stigma and relationships, safer sex behaviors, or provided space to upload and share personal videos, etc. Some interventions combined multiple intervention components, many of which based on IMB and MI model.

Almost all of these interventions involve changing behavior by changing thoughts, mainly focused on motivation activation and skill training, such as communicated risk awareness, thinking changes, status exposure, and condom use skills training. Some interventions also included counseling and strengthened/promoted the relationship between partners to improve condom use.

### Study Quality

Table 2 presented information on quality assessment. More than half of all the studies were classified as low (9/17) quality regarding the overall quality classification. One study was classified as high quality. None of the studies met all quality criteria.

### Intervention Effects on Condom Use or Unprotected Sex Outcomes

Table 3 showed detailed intervention effects on sexual behaviors. Included studies used different measures. Six studies provided proportions of condom use [18, 22, 24, 27,

**Table 2** Quality assessment of included studies

Author	Sequence generation	Allocation concealment	Blinding of participants	Incomplete outcome data	Selective outcome reporting	Availability of treatment manual	Use of training for therapy providers	Quality classification
Charles H. Klein	Low	Low	Low	Low	Unclear	Low	Low	Low
Dean G. Cruess	Low	Unclear	Low	Low	Unclear	Unclear	Low	Low
Jeffrey T. Parsons	NA	NA	High	Unclear	Unclear	Low	Low	Unclear
Krishna C. Poudel	Unclear	Low	Unclear	Unclear	Unclear	Unclear	Low	Unclear
Deborah L. Jones	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
Mark Williams	Low	Low	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
Travis I. Lovejoy	Unclear	Low	Unclear	Unclear	Unclear	Low	Low	Low
Trevor A. Hart	NA	NA	High	Unclear	Unclear	Low	Low	Unclear
Nabila El-Bassel	Low	Low	Low	Low	Unclear	Low	Low	Low
Lisa B. Hightow-Weidman	Unclear	Unclear	Unclear	Unclear	Unclear	Low	Low	Unclear
Sibongile Mashaphu	Low	Low	Low	Low	Unclear	Low	Low	Low
Seth C. Kalichman	Low	Low	Low	Low	Unclear	Unclear	Low	Low
Christiana Nöstlinger	Low	Low	High	High	Unclear	Unclear	High	High
Michelle Teti	Low	Low	Unclear	Unclear	Unclear	Low	Low	Low
Jennifer L. Brown	Unclear	Unclear	Unclear	Low	Unclear	Low	Low	Unclear
Nancy Patricia Caballero-Suárez	NA	NA	High	Unclear	Unclear	Low	Low	Low
Audrey Pettifor	Low	Low	High	Unclear	Unclear	Low	Low	Low



**Table 3** Sexual behaviors findings from included studies

Variables	Author	Findings	
Proportions of condom use	Charles H. Klein	3-month: Sex with All partners: mean difference = 0.33, $P = 0.002$ HIV negative partners: mean difference = 0.31, $P = 0.04$ HIV positive partners: mean difference = 0.48, $P = 0.003$	
	Deborah L Jones	Means: Control: baseline: 0.72, post intervention: 0.70, 6-month: 0.63 Intervention: baseline: 0.60, post intervention: 0.73, 6-month: 0.57	
	Nabila El-Bassel	Intervention: Control: Baseline: 0.44 (0.38) Baseline: 0.44 (0.40) Post-intervention: 0.82 (0.28) Post intervention: 0.55 (0.43) 6-month: 0.75 (0.36) 6-month: 0.56 (0.43) 12-month: 0.72 (0.38) 12-month: 0.56 (0.43)	
	Sibongile Mashaphu	3-month: Intervention: 73.68% Control: 37.50% 6-month: Intervention: 77.78% Control: 71.42%	
	Nancy Patricia Caballero-Suárez	Baseline Mdn = 100, IQR: 88.88–100 F (One week after intervention) Mdn = 95.83%, IQR: 80.35–95.83 Correct condom use skills: Before Mdn = 57.14%, IQR: 42.85–64.28 After Mdn = 100% Effect size ( $d = 2.75$ ) F (One week after intervention) Mdn = 100% IQR: 85.71–100 F versus FU1 (1-month) Mdn = 92.85% IQR: 85.7–92.85, $P = 0.039$ ; F versus FU2 (3-month) Mdn = 92.85%, IQR 85.71–92.85, $P = 0.013$	
	Mark Williams	Intervention: Control: Intake: 23% Intake: 22% 3-month: 55% 3-month: 39% 9-month: 48% 9-month: 44%	
	CAS* frequencies	Jeffrey T. Parsons	3-month: Means $\pm$ d: 9.50 $\pm$ 1.66
		Trevor A. Hart	Sex with Casual HIV-positive partners: Baseline: 61.5%, post-intervention: 46.2% 3-month: 42.3% Sex with Casual HIV-negative partners: Baseline: 17.3%, post-intervention: 21.2%, 3-month: 17.3%; Casual partners of unknown HIV-status: Baseline: 42.3%, post-intervention: 26.9% 3-month: 21.1% Sex with Regular HIV-positive partner: Baseline: 32.8%, post-intervention: 28.9% 3-month: 25.0% Sex with Regular HIV-negative partner: Baseline: 1.9%, post-intervention: 1.9% 3-month: 0.0%
	Proportion of CAS*	Seth C. Kalichman	Intervention (N = 250) M (Se) Comparison Condition (N = 250) 2-month: 0.69 (0.05) 0.54 (0.04) 4-month: 0.43 (0.04) 0.62 (0.05) 5-month: 0.45 (0.04) 0.52 (0.04) 6-month: 0.34 (0.03) 0.39 (0.04) 7-month: 0.44 (0.04) 0.46 (0.04) 9-month: 0.50 (0.04) 0.37 (0.03) 10-month: 0.46 (0.04) 0.41 (0.04) 12-month: 0.50 (0.04) 0.36 (0.04)
		Jennifer L. Brown	3 months: Intervention: M (se) 0.18 (.05) Control: M (se) 0.27 (.05), Effect size = 0.02

**Table 3** (continued)

Variables	Author	Findings
	Audrey Pettifor	Intervention: Baseline: 36% Week 12: 0% Week 24: 0%
		Control: 54% 8% 0%
RR or OR		
Condom use RR	Dean G. Cruess	6-month: Intervention vs. Control Sex with All partners: incident rate ratios (IRR)=0.91(0.63–1.30) Sex with HIV-negative/unknown: (IRR)=0.33(0.20–0.53)
	Travis I. Lovejoy	3-month follow-up, 4-session MI participants vs. Controls: OR = 3.15 [1.02–9.72]; 4-session vs. 1-session MI conditions: OR = 1.17 [0.48–2.86]; 1-session MI vs. Control conditions: OR = 2.69 [0.88–8.27] 6-month: 4-session MI participants vs. Controls: OR = 2.23 [0.78–6.40] 4-session vs. 1-session MI conditions: OR = 1.19 [0.48–2.99]; 1-session MI vs. Control conditions: OR = 1.87 [0.66–5.30]
CAS* RR	Lisa B Hightow-Weidman	3-months post-intervention: HIV-positive partners: Incidence ratio 0.18, 95% CI: 0.04, 0.32 Either HIV-positive with undetectable viral loads or HIV-negative/unknown: Incidence ratio 0.88, 95% CI: 0.51, 1.26
		HIV-positive partners: Incidence ratio 0.50, 95% CI: 0.12, 0.89 Either HIV-positive with undetectable viral loads or HIV-negative/unknown: Incidence ratio 0.87, 95% CI: 0.51, 1.23
Condom use OR	Christiana Nöstlinger	3 month vs. baseline: Intervention: OR = 6.77, 95%CI: 2.48–18.52 Control: OR = 1.77, 95%CI: 0.72–4.32 $P=0.03$ 6-month vs. baseline: Intervention: OR = 5.46, 95%CI: 2.16–13.79 Control: OR = 2.53, 95%CI: 0.98–6.52 $P=0.19$
Proportion of condom use difference OR	Michelle Teti	Baseline difference: OR: 4.58 (0.85, 24.74) 6-Month difference: OR: 17.13 (2.96, 99.10) 12-Month difference: OR: 1.52 (0.25, 9.24) 18-Month difference: OR: 270.04 (24.53, 2971.94)
Condom use intention net difference	Krishna C. Poudel	Post intervention: Regular partners: 0.60, $P < 0.001$ ; HIV positive: 0.36, $P = 0.005$ ; HIV negative: 0.11, $P = 0.34$ ; HIV status unknown: 0.05, $P = 0.65$

CAS Condom less Anal sex

IRR Incidence risk ratio

30, 32], five studies used RR or OR as the intervention effect size [21, 23, 26, 28, 32], and others provided proportions of condomless anal sex (CAS) [19, 25, 30], frequencies of CAS [29, 34], and condom use intention [31]. These studies' follow-up time points were generally post-intervention, three and six months after completing the intervention. And one study used 'Treatment as Prevention' intervention and follow up almost every month after the intervention [25].

We did meta-analysis with three interventions, which had the same measure for proportions of condom use, with means (standard variations) provided in both arms [18,

22, 24]. Heterogeneity was present in these three studies ( $I^2 = 56%$ ), so the random effect model was used (Fig. 2). The pooled results showed that the condom use proportion increased in the experimental group after intervention compared with the control group (Random SMD (Standard Mean Difference): 0.36; 95% CI: 0.06, 0.65). The intervention mainly contained emotional regulation, increasing communication with sexual partners, and teaching condom use skills.

There were also trials with more than one intervention arm, Travis I. Lovejoy's study used 4-session intervention and

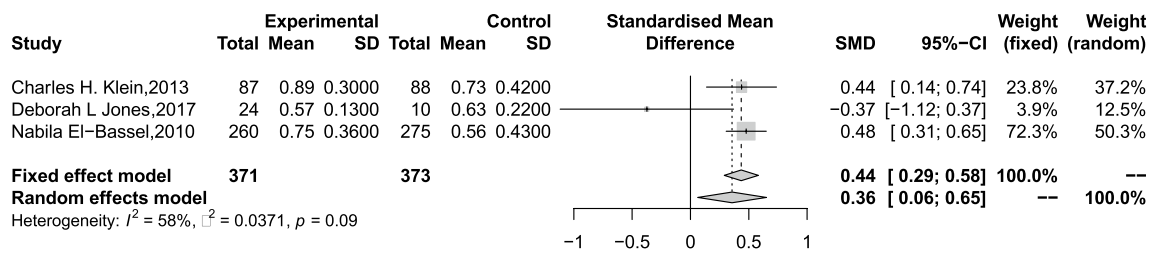


Fig. 2 Forest plot of effect size: impact of prevention interventions on proportions of condom uses

1-session MI to intervene with the participants. They found significant effects in 4-session group versus the control group for condom use in 3-month ( $OR = 3.15$ ,  $95\% CI: 1.02–9.72$ ) but not significant in 6-month follow-up ( $OR = 2.23$ ,  $95\% CI: 0.78–6.40$ ). In addition, no differences were observed between participants in the 1-session and control conditions or the 4-session and 1-session MI conditions at 3-month ( $OR = 2.69$ ,  $95\% CI: 0.88–8.27$  and  $OR = 1.17$ ,  $95\% CI: 0.48–2.86$ , respectively) or 6-month follow-up ( $OR = 1.87$ ,  $95\% CI: 0.66–5.30$  and  $OR = 1.19$ ,  $95\% CI: 0.48–2.99$ , respectively). It was noteworthy that the intervention effect decreased over time after the intervention [26].

Some studies compared condom use between different sex partners, including HIV-positive, HIV-negative, or unknown status. It showed that there were differences when had sex with HIV-positive partners compared with HIV-negative or unknown status partners [18, 21, 23, 34]. In Trevor A. Hart et al. study, they aimed to use IMB, MI to enhance condom use among HIV-positive MSM. The results showed that the condomless anal sex decreased at post-intervention and 3-month follow-up with any type of sexual partners. Besides, during the sex with casual partners who were HIV-negative or unknown, the condomless anal sex decreased largely [34]. Both HIV-positive couples might not use condoms during sex, so interventions targeting multiple HIV infections or drug resistance might be an effective intervention in helping increase condom use for both HIV-positive couples. Results also showed that condomless sex frequencies reduced for HIV-negative or unknown infection status partners, which were the significant factor for HIV transmission decreasing [35, 36]. Mark Williams’s study included the risks and consequences of HIV/STD infection/reinfection, HIV transmission to sex partners, and risks when both sex partners were HIV-positive [33]. In summary, our finding provided additional evidence for psychological intervention was helpful for HIV risk behaviors reduction, which was significant for public health implications and HIV reduction.

### Discussion

This systematic review and meta-analysis provided support for conducting psychological interventions on risky sexual behaviors among people living with HIV/AIDS. For the theory basis, most studies used the IMB model and MI. The IMB model combined with HIV prevention information, motivation, and behavioral skills to change sexual risk behaviors. The IMB model was an empirically supported model for sexual risk reduction and mental health problem reduction. The intervention content involved in this paper was almost combined with HIV-related knowledge, mental health management, behavioral skills, and communication or how to disclose with sexual partners.

Overall, these interventions had positive effects on reducing sexual risk, for example, psychological interventions significantly improved the proportion of condom use. However, in most studies, effects on condom use increased post-intervention, then the effect declined with time. Effect of psychological or behavioral intervention was peak immediately after the completion of the intervention, then decreased over time, which indicated that the intervention needs to be permanent and normalized to benefit PLWH consistently.

One study combined psychological interventions into a mobile phone and internet-based platform. This study also showed a positive effect on condom use: for HIV-positive partners, the RR for CAS was 0.50 ( $95\% CI: 0.12, 0.89$ ) compared with the control group, and the RR for CAS was 0.87 ( $95\% CI: 0.51, 1.23$ ) for either HIV-positive with undetectable viral loads or HIV-negative/unknown partners [23]. Mobile health intervention studies had shown feasibility and efficacy to improve mental health in different populations in recent years [37–41]. There were trends that mobile health (mHealth) intervention on improving

mental health because of its convenience and accessibility. Moreover, it may be imperative to develop effective interventions to improve mental health and quality of life for PLWH considering the current COVID-19 epidemic.

Considering the decrease of the intervention effects as time passed by, it was important to investigate whether these interventions could be administered easily, such as conducted at a community level, as one part of normal care for PLWH, or intervened by mHealth. One study used a mutual recovery method based on CBT among community-dwelling adults with depressive symptoms in China in 2012, and the decrease in depressive symptoms was observed immediately after the intervention [42]. This study reminded us to explore the non-personal intervention methods to change mental health or behaviors.

### Limitations

The sexually related behaviors were not merely condom use; also included commercial sex, more than one sex partner, etc. This review set condom use as the outcome of the psychological interventions, which may not be able to conclude the comprehensive effects of the intervention. Secondly, data used in this review was only derived from literature published in English, with non-English databases excluded consciously. Thirdly, although this review showed the efficacy of psychological health interventions on behavior change, we did not further compare the effectiveness of the different psychosocial interventions to find the most effective one. Thus, more research was needed to better understand these findings.

### Conclusion

This systematic review and meta-analysis found that psychological interventions might positively affect the condom use of PLWH. Based on this meta-analysis results, it is essential to incorporate psychosocial therapies into the routine care of PLWH to avoid the transient effects of the concerned intervention.

### Appendix

[Search terms included (hiv [mesh] or hiv infection [mesh] or hiv [tiab] or aids [tiab] or acquired human immunodeficiency syndrome[tiab] or human immunodeficiency virus[tiab]) AND (psychotherapy [mesh] or mental health services [mesh] or self-care [mesh] or self-help groups [mesh] or telemedicine [mesh] or therapy, computer assisted [mesh] or psychotherap\* [tiab] or psychological therap\* [tiab] or psychological treatment\* [tiab] or psychological

intervention\* [tiab] or counsel\* [tiab] or cbt [tiab] or behavior therap\* [tiab] or behaviour therap\*[tiab] or interpersonal therap\* [tiab] or coping [tiab] or peer support [tiab] or social support [tiab] or problem solving [tiab] or stress manage\* [tiab] or self-help [tiab] or internet therap\* [tiab] or online therap\* [tiab] or psychoed\* [tiab] or training [tiab] or exposure therap\* [tiab]relaxation [tiab] or mindfulness [tiab] or reinforcement [tiab] or commitment therap\* [tiab] or case manage\* [tiab] OR depression [mesh] OR depress\* [tiab] OR anxiety [mesh] OR anxi\* [tiab] OR fear [tiab] OR quality of life [mesh] OR quality-of-life [tiab] OR well-being [tiab] OR stress, psychological [mesh] OR stress\* [tiab] OR distress [tiab] OR mental health [tiab]) AND (condom use[tiab] or safe sex[tiab] or condom\*[tiab]) AND ((clinicaltrial[Filter] OR randomizedcontrolledtrial[Filter]) AND (y\_10[Filter]) AND (humans[Filter]) AND (english[Filter])).]

### Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Research Involving Human Participants and/or Animals** This article does not contain any studies with human participants or animals performed by any of the authors.

**Informed Consent** Informed consent did not apply to our study, as it contained no studies with human participants performed by any of the authors.

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