

Alcohol as a Correlate of Unprotected Sexual Behavior Among People Living with HIV/AIDS: Review and Meta-Analysis

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Abstract The present investigation attempted to quantify the relationship between alcohol consumption and unprotected sexual behavior among people living with HIV/AIDS (PLWHA). A comprehensive search of the literature was performed to identify key studies on alcohol and sexual risk behavior among PLWHA, and three separate meta-analyses were conducted to examine associations between unprotected sex and (1) any alcohol consumption, (2) problematic drinking, and (3) alcohol use in sexual contexts. Based on 27 relevant studies, meta-analyses demonstrated that any alcohol consumption (OR = 1.63, CI = 1.39–1.91), problematic drinking (OR = 1.69, CI = 1.45–1.97), and alcohol use in sexual contexts (OR = 1.98, CI = 1.63–2.39) were all found to be significantly associated with unprotected sex among PLWHA. Taken together, these results suggest that there is a significant link between PLWHA's use of alcohol and their engagement in high-risk sexual behavior. These findings have implications for the development of interventions to reduce HIV transmission risk behavior in this population.

Keywords Alcohol · Condoms · HIV · Meta-analysis · Sexual behavior

Introduction

Despite the implementation of a number of prevention-related programs aimed at reducing the spread of HIV, HIV incidence continues to remain at a high level throughout many parts of the world, with current estimates indicating 2.7 million new HIV infections in 2007 alone [1]. Fueling much of this ongoing HIV epidemic is the occurrence of unprotected sexual intercourse between HIV-infected and non-infected individuals. It has been reported that over 70% of people living with HIV/AIDS (PLWHA) remain sexually active after diagnosis [2], and that one-third of PLWHA engage in unprotected sexual behavior [3]. Some reports have even shown rates of unprotected sex among PLWHA to be as high as 84% [4]. Given the level of unprotected sex demonstrated by PLWHA, and recognizing that alcohol has not only been frequently implicated as a risk factor for unprotected sex, but also that heavy alcohol consumption tends to be more prevalent among PLWHA than among the general population [5, 6], the present investigation sought to statistically assess the association between alcohol consumption and unprotected sex in PLWHA populations through a meta-analysis.

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Alcohol and Unprotected Sex: Theory and Research

Among the numerous factors that have been associated with unprotected sex (e.g., [2, 7]), alcohol has received particular attention. Alcohol has been purported to have a relatively direct impact on unprotected sex, serving as a

disinhibitory mechanism [8], and resulting in “alcohol myopia [9],” in which a restricted cognitive capacity stemming from alcohol consumption causes one to focus only on impelling immediate cues (e.g., arousal) while ignoring inhibiting distant cues (e.g., risk of HIV or STI acquisition with potential consequences in the future) when making decisions about condom use (see also [10, 11]). Additionally, expectations about alcohol can be impactful on their own, affecting condom use attitudes and skills, risk perceptions, unsafe intentions, and risky sexual behavior [12–18]. Finally, “third variables” can also account for the alcohol-risky sex association [8, 19–21]. Having a “risky” personality type, or being high on the dimensions of sensation seeking [22–25] or sexual compulsivity (e.g., [26–29]) might dispose individuals to engage in both risky drinking and risky sex, and from a situational perspective, because alcohol is often consumed in the same venues where new and casual sexual partners are met, a link between alcohol use and unprotected sex may result from the sheer confluence of accessible alcohol and available sexual partners [8, 19].

Empirical Support for an Alcohol-Risky Sex Association

The association between alcohol and risky sex has been assessed with varying degrees of specificity, focusing on (1) *global-level associations* that examine the relationship between generalized measures of alcohol use and unprotected sex; (2) *situational-level associations* that examine the relationship between alcohol use in sexual contexts (e.g., alcohol before/during sex) and unprotected sex; and (3) *event-level associations* that examine the relationship between a specific sexual act (or set of acts) and alcohol use prior to each corresponding act [30]. Evidence from systematic reviews and meta-analyses regarding these associations is quite mixed. Although there appears to be evidence for a link at the global-level [30–32], the evidence for a link at the situational level is less pronounced [21, 30, 31, 33]. The association appears to be diminished even further at the event-level, with reviews tending not to support an overall event-level relationship, but instead suggesting that the relationship may be qualified by the nature of the encounter [30, 31, 34, 35] or the amount of alcohol consumed [21]. Taken as a whole, findings tend to provide inconsistent evidence for an overall alcohol-risky sex association.

The Present Investigation

Among the many studies that have investigated the association between alcohol and unprotected sex, only a small proportion has examined this association in samples of

PLWHA. Additionally, although systematic reviews and meta-analyses have examined the alcohol-risky sex association across diverse samples, including adolescents [36], men who have sex with men (MSM) [21], and African populations [19, 32], a comprehensive, macro-level assessment of the alcohol-risky sex association specifically among PLWHA remains absent from the literature. Given that (1) a significant portion of PLWHA continue to engage in unprotected sex [3]; (2) alcohol use and problematic drinking tend to be higher among PLWHA than among non-infected individuals [5, 6]; and (3) the evidence for a link between alcohol and unprotected sex is mixed, and for the most part based on HIV-negative samples; the present study involved a meta-analysis to statistically assess the extent to which alcohol is linked to unprotected sex in samples of PLWHA.

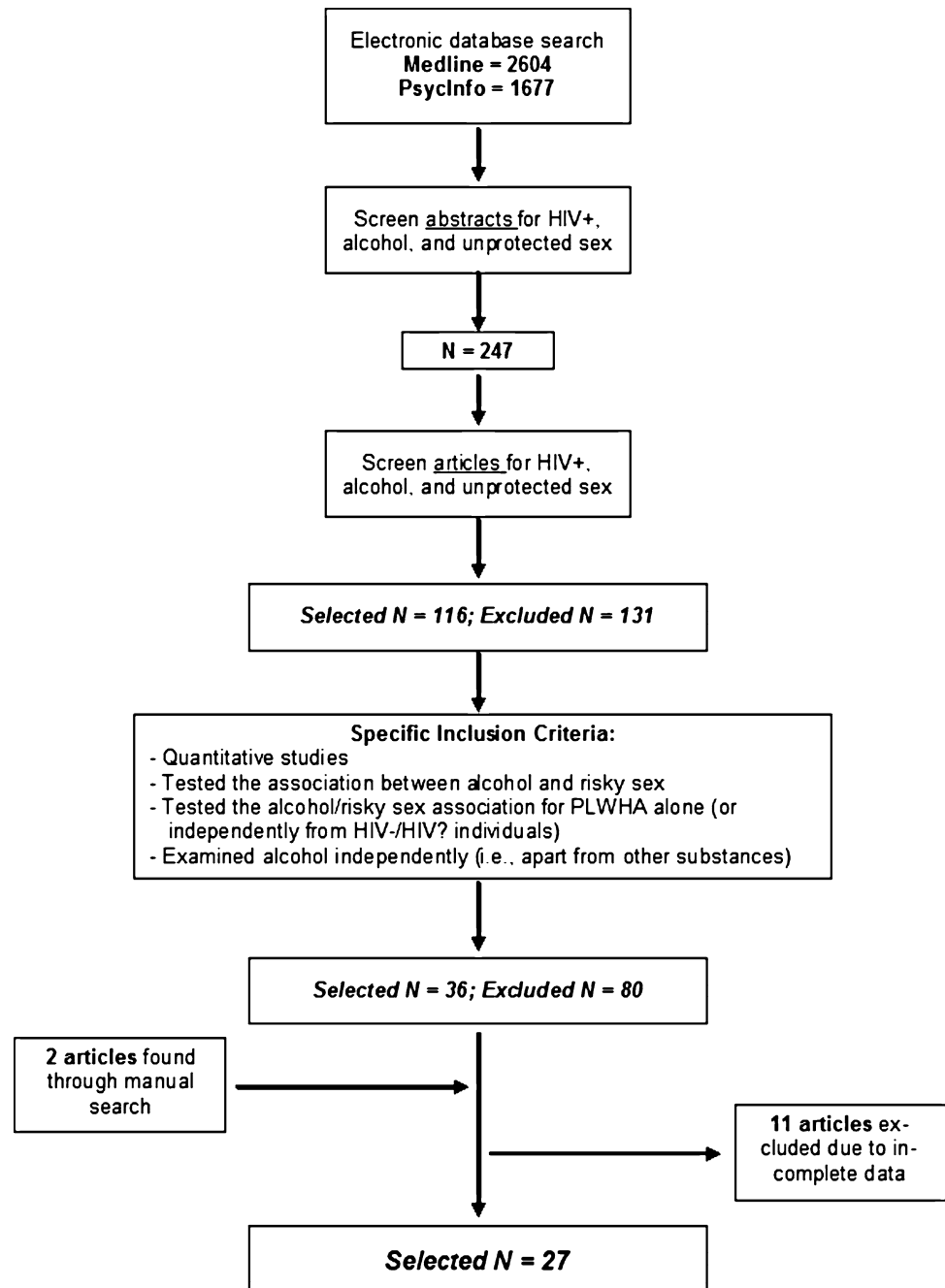
Method

Search Strategy and Study Selection

PsycInfo and Ovid Medline (including CINAHL—Nursing and Allied Health) databases were queried for articles that tested associations between alcohol and unprotected sex in samples of PLWHA. Comprehensive search terms were employed for each factor under investigation. Search terms for PLWHA included “HIV,” “AIDS,” “human immunodeficiency virus,” “acquired immune deficiency syndrome,” “plh,” “pla,” “plha,” and “plwha.” For risky sex, terms included “std,” “sexually transmitted disease,” “safe*,” “sex*,” “unsafe*,” “risk*,” “condom,” “protect*,” “unprotect*,” “sexually transmitted infection,” and “sti.” Finally, for alcohol, terms included “alcohol,” “drink*,” “drinking,” and “substance use.”

Figure 1 summarizes the search results that yielded 2,604 articles from Medline and 1,677 articles from PsycInfo. Titles and abstracts for all references were reviewed, and 247 articles were retained for full paper reviews. Articles were retained for further analysis if they met the following inclusion criteria: (1) consisted of original, quantitative research published in a peer reviewed journal; (2) reported a statistical association between alcohol and risky sex; (3) statistically tested the alcohol-risky sex association for PLWHA alone (or separately from HIV-negative/HIV status unknown samples); and (4) assessed alcohol consumption independently from the use of other substances. In total, 36 publications satisfied the above search criteria. Two additional studies that met the inclusion criteria were found through an examination of the reference sections from relevant studies and through a listserv reporting on recent HIV-related publications, bringing the total to 38 studies.

Fig. 1 Search strategy and inclusion criteria for meta-analysis



All 38 studies were examined for unadjusted and adjusted associations between alcohol consumption and unprotected sex. Because data pertaining to adjusted odds ratios (AORs) were not available for over 80% of the studies ($n = 31/38$), a focus was placed on unadjusted odds ratios (ORs) with corresponding 95% confidence intervals (CIs). ORs and CIs were taken directly from publications, and if not provided, were calculated based on available contingency tables. If neither ORs nor contingency tables were provided, attempts were made to contact authors to obtain relevant statistical

information. Taken together, these procedures yielded ORs and CIs for 27 studies which formed the basis of our meta-analysis. Key study characteristics and outcomes for all 27 relevant publications can be found in Table 1.

Definition of Alcohol Consumption and Risky Sex Constructs

Measurement of alcohol consumption and risky sexual behavior was highly variable across studies (see Table 1).

Table 1 Summary of PLWHA alcohol-risky sex studies included in the meta-analysis

Author [Ref. no.]	Sample	Alcohol consumption category and definition; ^a time frame Y/N = Any alcohol use vs. no alcohol use PD = Problematic drinking SC = Alcohol use in sexual contexts	Sexual risk indicator used for data analysis; time frame	Associations between alcohol category and sexual risk indicator OR (95% CI)	Comments
Benotsch et al. [27]	N = 91 f, 203 m; USA	Y/N: any alcohol use vs. none—past 3 months	Unprotected sex—past 3 months	Y/N: 1.29 (0.78–2.13)	OR/CIs obtained from first author
Bouhnik et al. [54]	N = 272 f, 391 m; heterosexuals with HIV—/HIV? main partner for 12 months; France	PD: binge: ≥ 6 drinks/time at least once/month vs. ≥ 6 drinks never or less than once/month—past 12 months PD: binge: ≥ 6 drinks/time at least once/month vs. ≥ 6 drinks/time never or less than once/month—past 12 months	Inconsistent condom use with HIV—/? main partner—past 12 months Inconsistent condom use with regular partner—past 12 months	PD: Overall = 1.98 (0.80–5.00) f = 1.4 (0.4–4.8) m = 2.8 (1.6–5.2) PD: 2.08 (1.33–3.28)	Overall OR/CIs calculated by pooling female and male ORs/CIs Contingency table used to calculate overall OR/CIs (across partner serostatus)
Brewer et al. [56]	N = 61 f; smoked crack or snorted/injected cocaine or heroin; USA	PD: ≥ 1 time/day vs. < 1 time/day—past 30 days	Using condom less than always or being diagnosed with gonorrhea or primary syphilis—past 60 days Not using condom during all sexual encounters—past 6 months	PD: 1.02 (0.36–2.85)	
Chuang et al. [53]	N = 73 f, 276 m; lifetime history of alcohol problems; USA	Y/N: NIAAA, hazardous and moderate drinking vs. no drinking—past 30 days PD: NIAAA, hazardous drinking vs. abstinent and moderate drinking—past 30 days		Y/N: 1.82 (1.17–2.82) PD: 1.84 (1.16–2.91)	Y/N: contingency table used to calculate ORs and CIs for hazardous and moderate vs. abstinent. PD: contingency table used to calculate OR/CIs for hazardous vs. moderate and abstinent
Cook et al. [57]	N = 1,009 m; veterans; USA	PD: AUDIT, hazardous or binge drinking vs. no binge drinking—past 12 months PD: ≥ 3 drinks/day vs. < 3 drinks/day—past year	Inconsistent condom use and ≥ 2 sexual partners—past 12 months UIAI—past year	PD: 1.24 (0.71–2.14)	Contingency table used to calculate OR/CIs
Darrow et al. [58]	N = 51 m; MSM; USA			PD: 1.61 (0.50–5.17)	Contingency table used to calculate OR/CIs

Table 1 continued

Author [Ref. no.]	Sample	Alcohol consumption category and definition; ^a time frame Y/N = Any alcohol use vs. no alcohol use PD = Problematic drinking SC = Alcohol use in sexual contexts	Sexual risk indicator used for data analysis; time frame	Associations between alcohol category and sexual risk indicator OR (95% CI)	Comments
Ehrenstein et al. [52]	N = 72 f, 273 m; history of alcohol problems; USA	Y/N: NIAAA, moderate and at-risk drinking vs. no drinking—past 30 days PD: NIAAA, at-risk drinking vs. no drinking and moderate drinking—past 30 days SC: drinking 1 h before intercourse vs. no drinking before intercourse—past 3 months	Using a condom less than 100% of the time—past 6 months	Y/N: 1.76 (1.13–2.73) PD: 1.99 (1.16–3.43)	Y/N: contingency table used to calculate OR/CIs for at-risk and moderate vs. abstinent PD: contingency table used to calculate OR/CIs for at-risk vs. moderate and abstinent OR/CIs obtained from first author
Godin et al. [69]	N = 96 m; MSM; Canada	SC: drinking 1 h before intercourse vs. no drinking before intercourse—past 3 months	Condom non-use during anal intercourse—past 3 months	SC: 1.31 (0.31–5.59)	
Kalichman [51]	N = 129 f, 203 m; USA	Y/N: any alcohol use vs. none—past 6 months SC: alcohol before sex vs. no alcohol before sex—past 6 months	At least one occasion of unprotected vaginal/anal intercourse—past 6 months	Y/N: Overall = 1.90 (1.20–3.03) f = 1.95 (0.94–4.02), m = 1.88 (1.02–3.47) SC: Overall = 2.85 (1.71–4.73) f = 1.66 (0.69–4.00), m = 3.79 (2.01–7.16)	Y/N: contingency table used to calculate OR/CIs SC: contingency table used to calculate OR/CIs
Kalichman et al. [41]	N = 112 f, 223 m, 5 transsexual; USA	Y/N: weekly and monthly use vs. none—past 3 months	STI diagnosis—past 3 months	Y/N: Overall = 1.01 (0.59–1.71) f = 2.18 (0.89–5.35), m = 0.90 (0.44–1.84)	Sexually active with STI were compared to sexually active with no STI (non-sexually active excluded). Contingency table used to calculate OR/CIs

Table 1 continued

Author [Ref. no.]	Sample	Alcohol consumption category and definition; ^a time frame Y/N = Any alcohol use vs. no alcohol use PD = Problematic drinking SC = Alcohol use in sexual contexts	Sexual risk indicator used for data analysis; time frame	Associations between alcohol category and sexual risk indicator OR (95% CI)	Comments
Kalichman et al. [23]	N = 197 m; USA	SC: alcohol use before vaginal/anal sex vs. no alcohol use before vaginal/anal sex—most recent vaginal/anal intercourse	No condom use—most recent vaginal/anal intercourse	SC: 1.93 (0.87–4.29)	Contingency table used to calculate OR/CIs for participant used alcohol/participant and partner used alcohol vs. neither person used alcohol/only the partner used alcohol OR/CIs obtained from first author
Kiene et al. [68]	N = 83 f, 69 m; clinical care sample receiving ARVs; South Africa	SC: alcohol use during sex vs. no alcohol use during sex—past 3 months	Inconsistent condom use—past 3 months	SC: 2.37 (0.71–7.94)	OR/CIs obtained from first author
Kiene et al. [40]	N = 58 f, 24 m; South Africa	SC: alcohol use before sex vs. no alcohol use before sex, daily diary—42 days	No use of condom during anal/vaginal sex, daily diary—past 5 weeks	SC: 1.75(1.22–2.49)	OR/CIs obtained from first author
Krupitsky et al. [59]	N = 76 f, 125 m; Russia	PD: DSM-IV, ASI and MAST—alcohol abuse or dependence vs. no alcohol abuse or dependence—lifetime	Using a condom less than always—past 6 months	PD: 1.69 (0.93–3.05)	Contingency table used to calculate OR/CIs for any alcohol dependence (i.e., alcohol + drug dependence vs. no dependence/drug only dependence)
Milam et al. [60]	N = 121 m; heterosexuals; USA	PD: binge: ≥ 5 drinks/time for at least 12 days (vs. not meeting this criterion)—past 3 months	Any unprotected vaginal sex—past 3 months	PD: 1.29 (0.24–7.03)	
Moatti et al. [61]	N = 348 f, 363 m; Ivory Coast	PD: “high alcohol consumption” (vs. no “high alcohol consumption”)—past 6 months	At least one episode of unprotected intercourse—past 6 months	PD: 1.77 (0.98–3.18)	

Table 1 continued

Author [Ref. no.]	Sample	Alcohol consumption category and definition; ^a time frame Y/N = Any alcohol use vs. no alcohol use PD = Problematic drinking SC = Alcohol use in sexual contexts	Sexual risk indicator used for data analysis; time frame	Associations between alcohol category and sexual risk indicator OR (95% CI)	Comments
Morin et al. [50]	N = 1,910 m; MSM; USA	Y/N: daily use and some use vs. none—past 3 months	Any insertive/receptive anal/vaginal intercourse without a condom with HIV—/? casual or steady partners—past 3 months	Y/N: 1.81 (0.85–3.85)	ORs/CIs pooled across steady and casual partners for some and daily use vs. no use
Niklowitz and Eich-Höchli [67]	N = 64 m; MSM; Germany	SC: sex under influence of alcohol vs. no sex under the influence of alcohol—past 6 months	Condom non-use during insertive/receptive anal intercourse with casual/steady partner—past 6 months	SC: 0.96 (0.18–5.13)	Contingency table used to calculate OR/CIs
Olley et al. [62]	N = 105 f, 44 m; recently (<1 year) diagnosed HIV; South Africa	PD: MINI, alcohol dependence vs. no alcohol dependence—past month	No condom use at last sex	PD: 2.33 (0.68–8.01)	Contingency table used to calculate OR/CIs
Palepu et al. [63]	N = 73 f, 276 m; history of alcohol problems; USA	PD: NIAAA, at-risk alcohol consumption vs. non-at risk alcohol consumption—past 6 months	Using condom less than 100% of the time—past 6 months	PD: 1.42 (0.99–2.02)	OR/CIs obtained from first author
Purcell et al. [48]	N = 456 m; MSM; USA	Y/N: consumed alcohol almost never to everyday vs. never—past 3 months SC: alcohol use before/during sex vs. no alcohol use before/during sex—past 3 months	Any UIAI/URAI with main/casual HIV—/? Partner—past 3 months	Y/N: 1.76 (1.16–2.68) SC: 2.98 (1.52–5.82)	Contingency table obtained from first author. OR/CIs calculated accordingly

Table 1 continued

Author [Ref. no.]	Sample	Alcohol consumption category and definition; ^a time frame Y/N = Any alcohol use vs. no alcohol use PD = Problematic drinking SC = Alcohol use in sexual contexts	Sexual risk indicator used for data analysis; time frame	Associations between alcohol category and sexual risk indicator OR (95% CI)	Comments
Purcell et al. [49]	N = 1,168 m; MSM; USA	Y/N: any alcohol use vs. none—past 3 months SC: alcohol use before/during sex vs. no alcohol use before/during sex—past 3 months	Any UIAI/UIRAI with HIV±/? casual partners—past 3 months	Y/N: 1.49 (1.00–2.21) SC: 1.84 (1.32–2.58)	Y/N: overall OR/CIs for any alcohol use calculated by pooling ORs/CIs for UIAI/UIRAI for HIV+/-HIV-HIV? partners SC: overall OR/CIs for alcohol use before/during sex calculated by pooling ORs/CIs for UIAI/UIRAI for HIV+/-HIV-HIV? partners
Reilly and Woo [66]	N = 68 f, 292 m; USA	SC: alcohol use before sex vs. no alcohol use before sex—past 6 months	At least one occasion of unprotected vaginal/anal intercourse—past 6 months	SC: 1.51 (0.64–3.55)	Contingency table used to calculate OR/CIs for regular partners and OR/CIs for casual partners. OR/CIs for regular and casual partners then pooled to obtain overall OR/CIs
Stein et al. [47]	N = 109 f, 153 m; USA	Y/N: any alcohol use vs. none—past 6 months PD: NIAAA, hazardous drinking vs. no hazardous drinking—past 6 months PD: binge: ≥4 drinks/occasion at least once a week vs. drinking ≥4 drinks/occasion less than once a week or never—past 3 months	Any vaginal/anal intercourse without a condom—past 6 months Using a condom less than 100% for vaginal sex—past 3 months	Y/N: 2.30 (1.22–4.33) PD: 2.66 (1.32–5.35)	Y/N: contingency table used to calculate CIs PD: contingency table used to calculate CIs
Theall et al. [64]	N = 187 f; USA			PD: 1.64 (1.02–2.63)	

Table 1 continued

Author [Ref. no.]	Sample	Alcohol consumption category and definition; ^a time frame Y/N = Any alcohol use vs. no alcohol use PD = Problematic drinking SC = Alcohol use in sexual contexts	Sexual risk indicator used for data analysis; time frame	Associations between alcohol category and sexual risk indicator OR (95% CI)	Comments
Tucker et al. [65]	N = 26 f, 128 m; seriously mentally ill; USA	PD: diagnostic interview schedule—engaging in problem drinking vs. not engaging in problem drinking—past year	Any vaginal/anal sex without a condom—past 6 months	PD: 1.25 (0.50–3.15)	

HIV? HIV serostatus unknown, STI sexually transmitted infection, UIAI unprotected insertive anal intercourse, URAI unprotected receptive anal intercourse

^a Alcohol measures AUDIT: alcohol use disorder identification test, hazardous drinking: AUDIT score ≥ 8 , binge: ≥ 6 drinks/time at least once a month, NIAAA definitions for at-risk drinking: men: >14 drinks per week or >4 drinks per day or >3 drinks per time; women: >7 drinks per week or >3 drinks per day or >2 drinks per time, NIAAA definitions for moderate drinking among drinkers: men: ≤ 14 drinks per week; women: ≤ 7 drinks per week. DSM-IV diagnosis and statistical manual of mental disorders fourth edition, MAST Michigan alcohol screening test, ASI addition severity index, MINI mini international neuropsychiatric interview

Alcohol consumption was frequently assessed using standardized measures for problematic consumption or abuse, including the AUDIT [37], the Addiction Severity Index (ASI) [38], and classifications of the National Institute on Alcohol Abuse and Alcoholism [39]. In other instances, a variety of non-standardized items were used to assess frequency and patterns of alcohol consumption. Across studies, there was a tendency for analyses to be based on dichotomous consumption categories, comparing either any alcohol consumption with abstinence, or comparing “binge drinking,” “problem drinking,” “at-risk drinking,” “hazardous drinking,” or “dependence,” with moderate and no drinking.

In a subset of studies, alcohol consumption was examined specifically in the context of sexual activity, with assessments focusing on alcohol use that preceded sexual acts. Although single-item measures were typically used to assess overall alcohol use prior to sex over specified time periods (e.g., past 6 months), daily diary entries were also employed to assess event-specific alcohol consumption [40]. As with the global alcohol measures, there was a tendency for alcohol use in sexual contexts to be dichotomized, comparing those who consumed alcohol prior to sex versus those who did not.

For the present meta-analysis, measures of alcohol consumption from all 27 studies were classified into one of three categories. The first category involved any alcohol use; comparing PLWHA who did versus did not consume any amount of alcohol. The second category focused on “problematic drinking,” comparing PLWHA who engaged in “binge,” “at-risk,” “problem,” or “hazardous” drinking versus those who did not. The last category focused on alcohol use in sexual contexts, comparing PLWHA who had versus had not consumed alcohol prior to sex (see Table 1).

For risky sexual behavior, 26 out of 27 studies included an outcome that was based on engaging in sex without a condom, and in one study [41], the outcome focused on sexually transmitted infections (STIs) (see Table 1). Despite the substantial degree of consistency in terms of studies’ focus on condom use, measurement varied based on sexual act, relationship type, and partner serostatus. However, condom use measures were dichotomized in essentially all cases, leading to outcomes based on PLWHA who did versus did not engage in unprotected sex. In the present meta-analysis, this method of classification was employed. For the one study with STIs as the outcome [41], because STIs are indicative of condom non-use, the absence versus the occurrence of STIs were classified in terms of not engaging versus engaging in unprotected sex, respectively, and data were analyzed accordingly.

Statistical Analysis

Three separate meta-analyses were performed to assess associations between unprotected sex and (1) *any* alcohol use (vs. no use); (2) problematic drinking (vs. no drinking/moderate drinking); and (3) alcohol use in sexual contexts (vs. no alcohol use in sexual contexts). Note that whereas the first two categories were aimed at assessing global-level associations, the third category assessed alcohol-risky sex associations at the situational- and event-levels [30].

Meta-analyses examined univariate ORs using DerSimonian and Laird's [42] random effects model. For studies with multiple estimates for a given association (e.g., separate ORs for casual and steady partners), estimates were pooled prior to analysis (see Table 1 for details). Overall ORs and 95% CIs were based on weighted pooled measures. Forest plots were used to visually assess the individual and pooled OR and CI values, and heterogeneity was assessed using both the Cochrane Q-test and the I^2 statistic [43]. Publication bias was assessed using tests proposed by Begg and Mazumdar [44] and by Egger et al. [45]. Subgroup analyses were also performed when sufficient data were available. All statistical analyses were conducted using Stata Version 10.1 [46].

Results

Of the 27 relevant studies, nine examined the association between drinking any alcohol and unprotected sex [27, 41, 47–53], 15 examined the association between problematic drinking and unprotected sex [47, 52–65], and nine examined the association between alcohol consumption in sexual contexts and unprotected sex [23, 40, 48, 49, 51, 66–69]. Six studies examined the association between alcohol and unprotected sex using more than one alcohol consumption category.

Primary Analyses

Random effect analyses revealed significant associations between the occurrence of unprotected sex and all three alcohol consumption categories. As seen in Fig. 2, PLWHA who consumed any amount of alcohol had a significantly increased likelihood of engaging in unprotected sex compared to PLWHA who did not consume any alcohol (pooled OR = 1.63, CI = 1.39–1.91). Similarly, PLWHA who engaged in problematic drinking demonstrated a significantly increased likelihood of unprotected sex compared to those who had not engaged in problematic drinking (pooled OR = 1.69, CI = 1.45–1.97) (see Fig. 3), and as shown in Fig. 4, there was a significantly increased

Fig. 2 The association between drinking *any* alcohol (vs. none) and unprotected sex

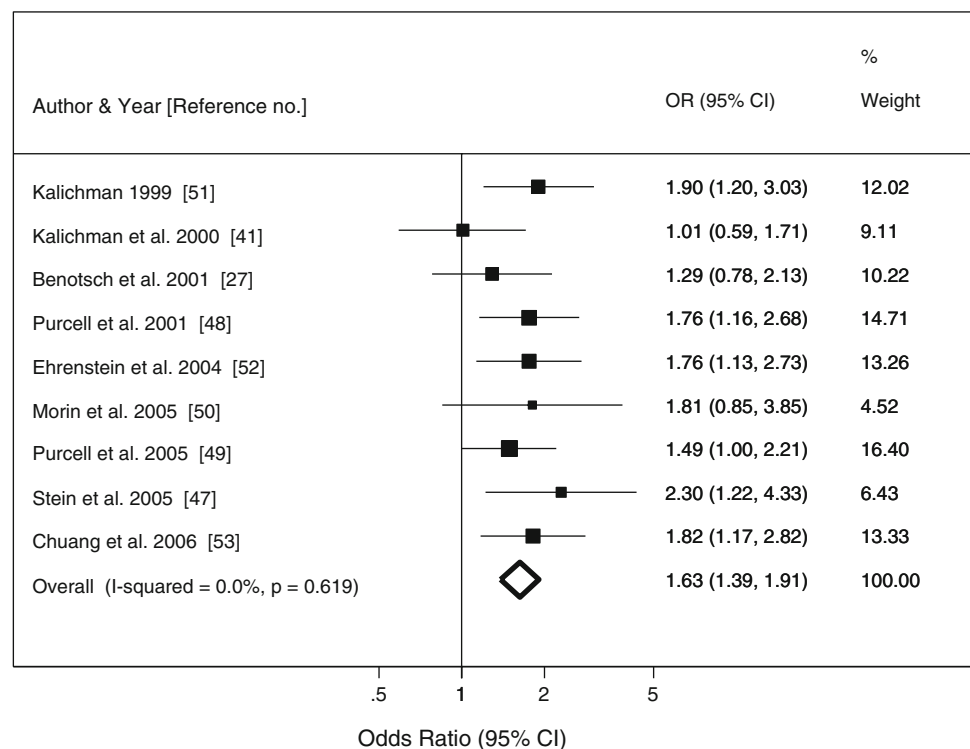


Fig. 3 The association between problematic drinking and unprotected sex

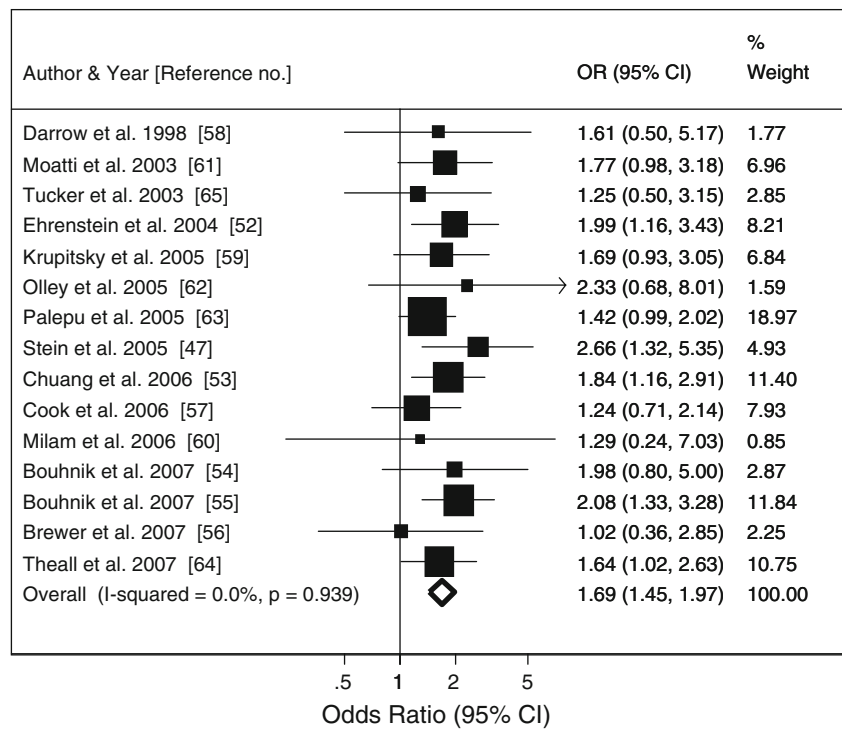
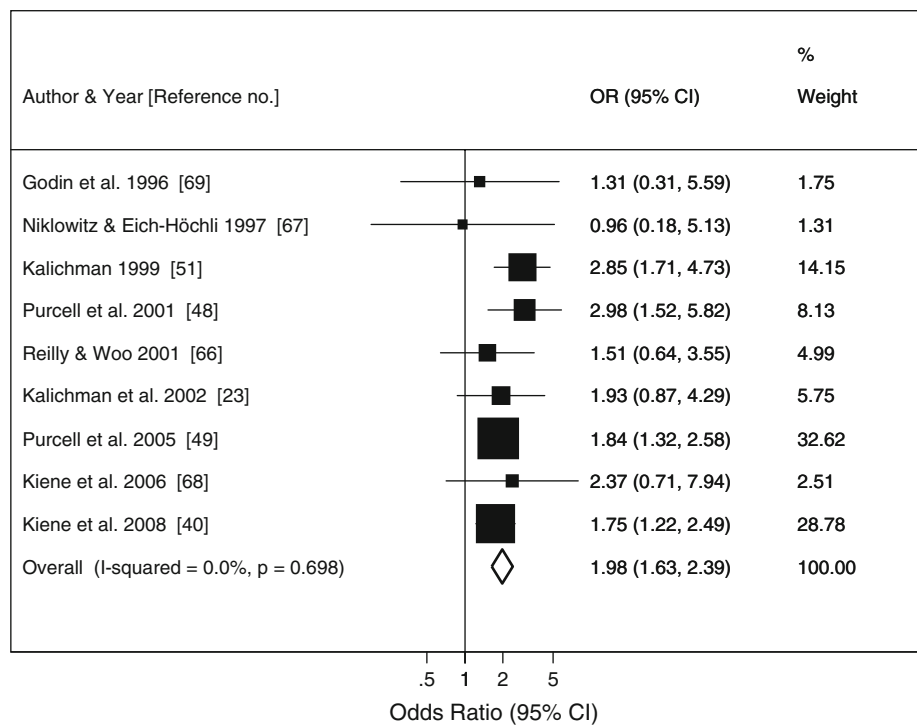


Fig. 4 The association between alcohol consumption in sexual contexts and unprotected sex



likelihood of engaging in unprotected sex among PLWHA who drank alcohol in sexual contexts versus those who did not (pooled OR = 1.98, CI = 1.63–2.39).

Tests of heterogeneity and publication bias (see Fig. 5 for Begg’s funnel plots) demonstrated that for any alcohol consumption, heterogeneity ($Q(8) = 6.26, p = 0.62;$

$I^2 = 0%$, CI = 0–65%) and publication bias ($p = 1.00$ and 0.87 by Begg and Mazumdar’s and Egger et al.’s tests, respectively) were not significant. These non-significant patterns were also evident for problematic drinking (heterogeneity: $Q(14) = 6.88, p = 0.94; I^2 = 0%$, CI = 0–54%; publication bias: $p = 0.69$ and 1.00 by Begg and

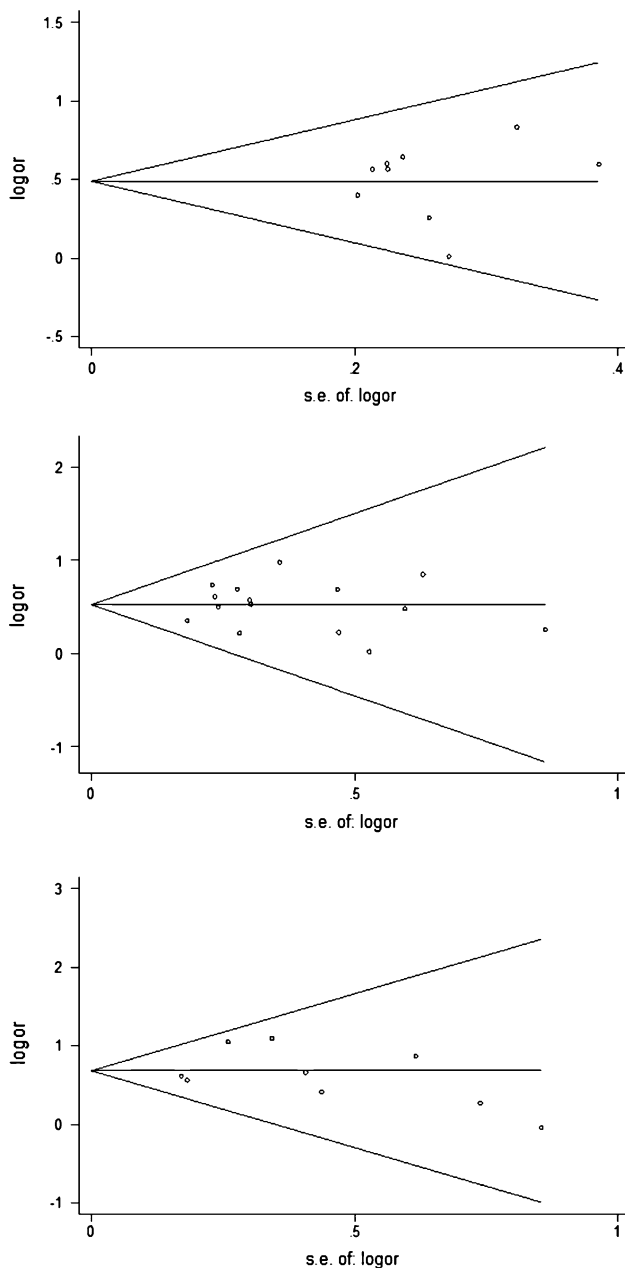


Fig. 5 Begg's funnel plots with pseudo 95% confidence limits for studies testing the association between unprotected sex and any alcohol use (*top*), problematic drinking (*middle*), and alcohol use in sexual contexts (*bottom*)

Mazumdar's and Egger et al.'s tests, respectively) and for alcohol consumption in sexual contexts (heterogeneity: $Q(8) = 5.54$, $p = 0.70$; $I^2 = 0\%$, $CI = 0\text{--}65\%$; publication bias: $p = 0.35$ and 0.84 by Begg and Mazumdar's and Egger et al.'s tests, respectively).

Subgroup Analyses

Available data were not sufficient to perform subgroup analyses based on partner type (e.g., casual/steady partners)

or risk category (e.g., MSM, Heterosexual). Sufficient data for subgroup analyses were available for a gender-based comparison, but only for problematic drinking, demonstrating the strongest association for male samples ($n = 5$ studies; pooled $OR = 1.88$, $CI = 1.38\text{--}2.56$), followed by combined male-female samples ($n = 8$ studies; pooled $OR = 1.72$, $CI = 1.41\text{--}2.10$), and female samples ($n = 3$ studies; pooled $OR = 1.50$, $CI = 1.00\text{--}2.25$).

Discussion

The present investigation involved a series of meta-analyses to statistically assess the association between alcohol and unprotected sex in samples of PLWHA. Results demonstrated that any alcohol consumption, problematic drinking, and alcohol use in sexual contexts, were all significantly associated with the occurrence of unprotected sex among PLWHA. These findings, which are based on relatively diverse indicators of alcohol consumption, and which involve global-, situational-, and event-level associations, provide consistent support for the involvement of alcohol in PLWHA's engagement in unsafe sex.

Drinking any alcohol and engaging in problematic drinking were both associated with PLWHA's sexual risk behavior, and taken together, these results demonstrated that PLWHA who drank were approximately 60–70% more likely to have engaged in unprotected sex than PLWHA who did not consume alcohol. Although these global-level associations cannot definitively establish a causal or even a temporal link between alcohol and risky sex [30], their statistical significance precludes one from ruling out entirely the possibility that such links may potentially exist. It is also possible that these significant global-level associations are indicative of underlying personality characteristics or situational factors that may in and of themselves be associated with both a tendency to consume alcohol and an inclination to engage in sex without condoms.

Interestingly, the overall effect sizes for any alcohol use and for problematic drinking were highly similar ($OR = 1.63$ and 1.69 , respectively). Using this simple comparison as the basis for a very crude dose-response analysis, it appears that among PLWHA, consuming alcohol in larger quantities or with greater frequency may not necessarily be associated with a proportional increase in risk behavior. Rather, the alcohol-risky sex association at the global-level for PLWHA appears to be bifurcated based on abstinence from alcohol versus the consumption of alcohol at any level. Although this finding is somewhat contrary to data from Fisher et al. [19], unlike Fisher et al.'s meta-analysis, the present study focused solely on PLWHA, who have been shown to engage in higher levels of alcohol consumption and problematic drinking than non-

infected individuals [5, 6]. With this increased incidence of heavy alcohol consumption, a relatively larger proportion of PLWHA who consume alcohol may be classified as “problematic drinkers,” and this may therefore have led to a situation in the present meta-analysis in which there would have been considerable overlap between those in the “any drinking” category and those in the “problematic drinking” category. Alternatively, due to factors such as HIV treatment-related issues and co-morbidities, PLWHA might be susceptible to the effects of alcohol at lower levels of consumption compared to non-infected individuals [70]. Therefore, because alcohol *intoxication* may occur for some PLWHA after consuming even relatively small amounts of alcohol, a meaningful difference in alcohol-risky sex associations demonstrated by PLWHA who consume alcohol at lower levels versus PLWHA who consume alcohol at higher levels may be difficult to discern. Although these explanations may account for the similarity in effect sizes found in the present investigation, additional research is necessary to more empirically assess the possibility of a dose-response relationship.

The relationship between alcohol use in sexual contexts and unprotected sex, which addressed both situational- and event-level associations, was also found to be significant. PLWHA who reported drinking in sexual contexts were almost twice as likely to engage in unprotected sex compared to those who did not drink in such contexts. Although still not capable of providing evidence for a causal relationship between alcohol and unprotected sex, this significant association offers support for a temporal link. This link is further bolstered by our inclusion of two studies that assessed event-level associations in PLWHA samples [23, 40], one of which yielded significant outcomes through daily diary measurements [40].¹

This significant result appears to run contrary to findings from previous work involving HIV-negative populations, which tend not to provide overall support for situational- and event-level associations [21, 30, 31, 34, 35], suggesting the possibility that this association differs based on HIV serostatus. This difference may in part be due to the disparity in condom-related motivations experienced by PLWHA versus HIV-negative individuals. For PLWHA, the motivation to use condoms may derive from social or cultural norms that stress the need to prevent the

transmission of HIV to one’s partner, whereas for non-infected individuals, the motivation might be based on a desire to protect oneself from *possible* HIV infection [23, 35, 72, 73]. Although the suppressive effect of the former motivation may be stronger than that of the latter motivation when sober, under conditions of intoxication, alcohol myopia [9] may equally suppress these motivations, and the resultant increase in risk behavior would therefore be larger for PLWHA than for HIV-negative individuals. Alternatively, the difference may stem from issues of disclosure that are unique to PLWHA, whereby alcohol may impact PLWHA’s ability or motivation to disclose their HIV status to their partners, which in turn could result in condom non-use [23]. Alcohol may therefore provide an escape from these powerful constraints that typically govern PLWHA’s condom use decisions.

Limitations

Results from the present meta-analysis should be viewed in terms of possible limitations. First, most studies involved US samples, and given existing cultural differences in stigma, norms, and alcohol use, it may be difficult to generalize the current findings to other populations. Second, virtually all studies relied on self-reports of alcohol and risky sex. Because individuals may use alcohol as an excuse to justify unprotected sex after the fact, the strength of the alcohol-risky sex associations deriving from self-reports may have been overestimated. Third, very few studies examined partners’ alcohol consumption. Condom use decisions may be based on one or both partners, and in some cases, these decisions may be more affected by the intoxication of one partner versus the other [32]. Fourth, all studies involved correlational designs, thus making it impossible to draw causal conclusions from the present results. Fifth, because usable and complete AOR and corresponding CI data were available only for seven studies, it was necessary to base meta-analyses on unadjusted ORs rather than on AORs. Among the 20 studies without usable AOR data, AORs were not available for the following reasons: (1) in six studies, AORs were not calculated as a result of alcohol failing to reach significance in unadjusted analyses; (2) in four studies, AORs were not reported as a result of alcohol failing to reach significance in multivariable analyses; (3) in seven studies, only partial AOR and CI data were available, and this included AORs being presented only for groups yielding significant unadjusted effects (e.g., casual but not steady partners), as well as CI values not being reported; and (4) in three studies, there was no indication that any adjusted analyses (either with or without alcohol) had been performed. Even when complete AOR and CI data were available, the number of AORs available for each specific alcohol consumption category (any alcohol use = 2;

¹ In addition to the event-level investigation by Kiene et al. [40], a study by Barta et al. [71] employed telephone-based daily diary assessments and found a significant event-level association between PLWHA’s alcohol consumption prior to sex and the occurrence of unprotected sexual intercourse. Problematic drinking (i.e., alcohol dependence) was negatively related to unprotected sex. Due to the nature of the data analytic procedures and statistical outcomes presented by Barta et al. results from the study were not included in our meta-analyses.

problematic drinking = 4; alcohol use in sexual contexts = 2) was not sufficient to reliably perform meta-analytic procedures. Furthermore, a qualitative review of the studies with available AOR data did not appear to reveal any factor groupings (e.g., demographic, behavioral, etc.) that could potentially account for significant versus non-significant multivariable results. Taking this into account, our results, which are derived from *unadjusted* associations, potentially misestimate the strength of the alcohol-risky sex relationship and do not adequately take into account the influence of possible mediating factors. Sixth, alcohol and unprotected sex variables in the meta-analysis were constructed on the basis of diverse sets of measures (see Table 1). Employing better specified classifications for both variables could have perhaps led to more accurate representations of the alcohol-risky sex relationship. Seventh, given the nature of the available data, our comparison groups for all three alcohol consumption categories included PLWHA who had not consumed alcohol. Because factors such as poor health may be associated with abstinence from both alcohol and sexual behavior [74], it is possible that including those who did not drink alcohol in the comparison groups could have artificially inflated our alcohol-risky sex effect sizes. Although it would have been beneficial to conduct additional analyses that excluded non-drinkers and instead specifically compared the risk behavior of PLWHA who consumed alcohol at moderate levels versus PLWHA who consumed alcohol at hazardous levels, only two of 15 studies within the problematic drinking category contained the details necessary to make this comparison, and meta-analytic procedures using this classification were therefore not possible. More accurate estimates of the alcohol-risky sex relationship among PLWHA could potentially be determined through additional research that examines the role of alcohol in a more clearly-defined dose-response manner.

Summary and Conclusions

The present investigation is to our knowledge the first meta-analytic review that has assessed the association between alcohol use and unprotected sex specifically among PLWHA. Our significant findings provide support for an overall association between PLWHA's alcohol consumption and their engagement in high-risk sexual behavior, and in particular, the significant effect demonstrated for alcohol use in the context of sexual activity is further suggestive of alcohol's possible role in PLWHA's condom use decisions. However, given the limitations discussed above, we cannot make unequivocal claims regarding the independent role of alcohol in PLWHA's risky sex decisions, primarily because the present findings cannot rule out the possible impact of third variables that may mediate the alcohol-risky sex

association. It is therefore essential that future research more directly addresses the role of these third variables, and through such investigations, a clearer picture of the relationships among alcohol use, personality characteristics, health-related factors, situational factors, and unprotected sex can be determined.

Taking all of this into account, regardless of whether alcohol itself is independently related to PLWHA's unsafe behavior, or whether alcohol is a marker for underlying factors that lead PLWHA to engage in unprotected sex, prevention efforts aimed at PLWHA could significantly benefit by addressing alcohol-related issues. From one perspective, HIV prevention interventions could include modules aimed at informing PLWHA about the effects of alcohol, as well as providing them with the necessary skills to use condoms when intoxicated. In fact, a recent South African investigation found some support for an intervention that included both risky sex and alcohol components [75]. From another perspective, interventions could be targeted specifically toward PLWHA who report alcohol use, particularly within sexual contexts. By focusing on this subgroup of PLWHA, prevention efforts may have their greatest impact. Based on both of these perspectives, recognizing the association between alcohol and unprotected sex among PLWHA could assist in both the tailoring and targeting of prevention-related interventions. Such interventions could significantly impact PLWHA's levels of sexual risk behavior, potentially leading to decreases in HIV transmission over time.

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