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Behavioral Interventions Targeting Alcohol Use among People Living with HIV/AIDS: A Systematic Review and Meta-Analysis

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Abstract

Alcohol use is often reported among people living with HIV/AIDS (PLWHA) and is associated with increased sexual risk and poor medication adherence. This meta-analysis evaluated the efficacy of behavioral interventions addressing alcohol use among PLWHA. Twenty-one studies (N = 8,461 PLWHA) that evaluated an individual-level intervention addressing alcohol use alone or as part of a more comprehensive alcohol/HIV intervention, included a control condition, and were available through December 2016 were included. Independent raters coded study, sample, and intervention content. Weighted mean effect sizes, using random-effects models, were calculated. Results indicate that interventions *reduced* alcohol consumption, *increased* condom use, and *improved* medication adherence relative to controls (d_+s = 0.10–0.24). Plasma viral load was also reduced in intervention versus control participants (d_+ = 0.14, 95% CI = 0.02, 0.26; k= 7). These findings show that behavioral interventions addressing alcohol use can successfully reduce alcohol consumption and also improve HIV-related outcomes among PLWHA.

Keywords

people living with HIV; alcohol; intervention; meta-analysis

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Compliance with Ethical Standards

Conflict of Interest: All authors declare that they have no conflicts of interest.

Ethical Approval: This article does not contain any studies with human participants performed by any of the authors.

INTRODUCTION

Globally, more than 36-million people currently live with HIV/AIDS, with sub-Saharan Africa bearing the heaviest burden, accounting for nearly 70% of all people living with HIV/AIDS (PLWHA) (1). Alcohol consumption is common among PLWHA with more than one-third reporting recent alcohol use across multiple geographical regions (2). In a U.S. sample of PLWHA linked to care, 8% were heavy drinkers (defined as drinking ≥5 drinks on a single day for ≥5 or more days in the past 30 days); among those who reported drinking in the past month, 15% were heavy drinkers – more than double the prevalence of heavy drinking in the general population (3, 4). A meta-analysis of studies conducted in Africa that examined the alcohol-HIV association (5) found drinker status to be associated with HIV infection such that drinkers were 70% more likely to be HIV-infected than non-drinkers and the risk of HIV was notably higher among problem drinkers than among non-problem drinkers. Furthermore, harmful alcohol use by PLWHA is of concern given that alcohol use is associated with the transmission of HIV, poor HIV management, and poor HIV treatment outcomes (6). Therefore, reducing alcohol consumption among PLWHA can help to reduce the transmission of HIV and promote medical adherence and subsequent viral suppression.

Behavioral interventions for PLWHA have largely focused on reducing sexual risk behaviors or improving medication adherence. The limited attention to alcohol use interventions for PLWHA is a missed opportunity given the consistent findings that alcohol consumption, especially problematic alcohol use, weakens the immune system, thus worsening the disease course (7). In contrast, a small, but growing body of research evaluating interventions targeting alcohol use alone or in the context of a broader HIV intervention (e.g., reducing sexual risk behaviors by addressing situations in which alcohol is consumed) has emerged over the past decade. Prior narrative reviews of interventions focused on alcohol use among PLWHA have found mixed results likely due to the nature of the intervention (i.e., single vs. multiple health behavior change target) (6, 8, 9). Researchers have advocated for a multiple behavioral change approach when intervening on behaviors that are related to one another such as alcohol and risky sexual behavior but there is limited evidence showing that multiple health behavior change interventions are superior to interventions addressing a single health behavior (10, 11).

Therefore, the purposes of this systematic review and meta-analysis were (a) to evaluate the efficacy of behavioral interventions addressing alcohol use alone or as part of a more comprehensive alcohol/HIV intervention, (b) to determine whether single-focus (i.e., alcohol use alone) interventions or multiple-focus (i.e., multiple risk behaviors) interventions are more efficacious, and (c) to examine study, sample, and intervention characteristics as potential moderators of the observed intervention effect. We expected that intervention participants would report *greater* reductions in alcohol use, *fewer* sexual risk behaviors, and *improved* medication adherence relative to controls across all studies. We also expected that the magnitude of these effects to differ by intervention target. If the intervention targeted alcohol use alone, we expected the intervention would be successful in reducing alcohol use but the success of the intervention to reduce other behaviors (when assessed) would be weaker given that participants were not provided with any intervention content (e.g., education, goal setting/harm prevention planning, stress management) to assist with their

sexual risk reduction or medication adherence behaviors. We expected that participants exposed to a broader alcohol/HIV intervention would reduce their alcohol use, reduce their sexual risk behaviors, and increase their medication adherence relative to controls.

This meta-analysis differs from prior reviews of the literature (6, 8, 9) in four ways. First, we included interventions that explicitly addressed (and measured) alcohol use (not broad substance use) alone or as part of a more comprehensive intervention to determine the efficacy of interventions that include an alcohol component. Second, we included studies with a control or comparison condition (i.e., no single-group pretest-posttest designs) to determine the impact of alcohol-related interventions relative to controls. Third, we evaluated the impact of single-vs. multiple-focus alcohol-related HIV interventions to establish the potential benefit of multiple risk behaviors vs. single-focused alcohol interventions. Finally, we evaluated moderators of intervention efficacy to isolate for whom, where, and how interventions succeed at improving alcohol use, sexual risk behaviors, and medication adherence among PLWHA.

METHODS

The conduct and reporting of the current meta-analysis followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (12); the PRISMA checklist can be found in the Supplementary Materials (S1).

Eligibility Criteria

Studies were included if they: (a) sampled people living with HIV/AIDS, (b) examined an individual-level intervention addressing alcohol use alone or as part of a more comprehensive alcohol/HIV intervention, (c) used a randomized controlled trial (RCT) or a quasi-experimental design that included a control or comparison condition, (d) measured drinking outcomes (e.g., quantity of alcohol consumed per drinking day, heavy drinking), (e) provided data needed to calculate effect sizes, and (f) were available via print or electronic journals, interlibrary loan, or from the authors (including electronic publications and dissertations) and obtained by December 2016. Studies were excluded if the (a) studies evaluated a pharmacological, mass media, or structural-level alcohol/HIV intervention, (b) intervention did not address alcohol use, and (c) assessment plan did not include a measure of alcohol use at post-intervention.

Information Sources and Search Strategy

Studies were identified using: (a) electronic bibliographic databases, (b) database and document repository held by The Meta-Analyses on Alcohol Use, Sexual Risk Behaviors, and HIV (MASH) Team at The Miriam Hospital (PI: Lori A. J. Scott-Sheldon, PhD), which has accumulated a database of published and unpublished research on alcohol and sexual/HIV risk behavior, (c) reference sections of relevant papers, (d) scientific journals, and (e) databases of funded research (i.e., NIH RePORTER, ClinicalTrials.gov). First, we searched multiple electronic reference databases (*PubMed*, *PsycINFO, ProQuest Dissertations and Theses Full Text, CINAHL, ERIC, Global Health*, *SocIndex, The Cochrane Library*, and *Web of Science* [social sciences and science citation indices]) using a

Boolean search strategy: (“people living with HIV/AIDS” OR “people living with HIV” OR “people living with AIDS” OR “HIV-positive” OR “HIV+” OR “HIV seropositive” OR “HIV-infected” OR “HIV patients”) AND ((bing* AND drinking) OR (binge AND drinkers) OR (heavy and drinking) OR (heavy and drinkers) OR “alcoholic beverages” OR “alcohol drinking” OR “alcohol abuse” OR alcoholic OR alcohol OR “alcohol-related disorders” OR alcoholism OR intoxicat* OR drunk* OR liquor) AND (intervention OR prevention). Our search statement was developed with the assistance of a medical sciences librarian in the Alpert Medical School of Brown University. Because many electronic databases have specific search methods (e.g., Medical Subject Heading [MeSH] terms used in PubMED are not available in other databases such as PsycINFO), our basic search strategy was modified based on the specific search parameters for each electronic bibliographic database. No language or other restrictions were applied. All electronic reference database searches were conducted in July 2016 and updated in December 2016.

Study Screening

All electronic bibliographic records (i.e., titles and abstracts) were initially screened for inclusion. Full-text manuscripts of potentially relevant records were retrieved and reviewed for final inclusion. Finally, reference sections of relevant manuscripts (including published reviews obtained through the electronic reference database searches) were also reviewed and included if they met the inclusion criteria. When authors reported details, ancillary information (e.g., results from the pilot study), and/or outcomes of a study in multiple manuscripts, the manuscripts were linked in the database and represented as a single unit (to avoid double-counting the same study). The manuscript reporting on the intervention outcomes was selected as the primary manuscript.

Data Collection and Reliability

Two independent coders extracted study information and setting (e.g., year, location), sample characteristics (e.g., gender, ethnicity), design and measurement specifics (e.g., recruitment strategy, method of assessment), risk characteristics (e.g., problem drinking) and intervention components (e.g., personalized alcohol feedback, condom communication skills-training). Methodological quality was assessed using 17 items (e.g., random assignment) from validated measures (13–15), with a maximum total quality score of 25. When multiple reports described the same study, relevant data were coded from both the primary and linked manuscripts. Inter-rater reliability was assessed for all study, sample, and methodological variables. There was a high degree of consistency. For the categorical variables, raters agreed on 88% of the judgments (mean Cohen’s $\kappa = .71$). Reliability for the continuous variables (e.g., proportion women) yielded an average intra-class correlation coefficient (ρ) of 0.85 across categories (median = 1.00). Disagreements between pairs of coders were resolved through discussion (e.g., coder identified manuscript page number where the information could be found) and the coding was revised. All revisions to the data were reviewed by the first author.

Study Outcomes

Intervention efficacy was determined from self-reports of alcohol use. Measures of alcohol use included (a) proportion of participants who consumed alcohol, (b) frequency of drinking

days, (c) quantity of alcohol consumed, and (d) heavy episodic drinking (i.e., defined as 5 [4] or more drinks per occasion for men [women] over a period of time (30–90 days) (16–18). We also determined the efficacy of each intervention to reduce sexual risk behaviors (i.e., number of sexual partners, condom use, and sexual risk composite). The sexual risk behaviors of condom use (e.g., proportion or number of protected sex events, consistent condom use) and sexual risk composite (e.g., total number of sexual risk behaviors) were assessed using multiple methods and collapsed across measures to obtain single item of condom use and sexual risk. Finally, the efficacy of the interventions to improve adherence were determined by plasma viral load as well as self-reports of medication adherence.

Risk of Bias across Studies

We examined the studies for potential publication bias by (a) inspecting funnel plots (19) and (b) assessing the degree asymmetry in the distribution of effect sizes using Begg's and Egger's techniques (20, 21). Trim and fill procedures (22, 23) are used to estimate and correct for the possibility of missing studies (based on a rank-based data augmentation procedure) when publication bias is detected using the aforementioned funnel plot asymmetry tests (20, 21). Consistent with meta-analytic procedures, we conducted these tests only for dependent variables with 10 or more studies (24).

Summary Measures

Effect sizes (*d*) were calculated as the mean difference between the intervention and the control or comparison group (between-group) divided by the pre-test standard deviation (25, 26). The effect sizes were controlled for baseline when baseline statistics were provided (26). Other statistical information (e.g., *t*-tests) were used when means and standard deviations were not provided (27, 28). If a study reported dichotomous outcomes (e.g., frequencies), we calculated an odds ratio and transformed it to *d* using the Cox transformation (29). If the statistical information was unavailable (and could not be obtained from the authors) and the study reported a non-significant or significant difference, we estimated that effect size to be zero or, when a report noted the effect was significant, calculated an effect size based on the minimum statistically significant *p*-value (i.e., $p = .05$), respectively (28). All effect sizes were corrected for sample size bias (30); positive effect sizes indicated that participants who received the intervention reported reductions in their alcohol use or sexual risk behaviors and improvements in their medication adherence compared to controls. Two independent coders calculated effect sizes for each study, and discrepancies were resolved through discussion.

Synthesis of Results

Data analyses were conducted with Stata/SE 12.1 (31) using published macros (28, 32). Weighted mean effect sizes were calculated using random-effects procedures (28). The 95% confidence intervals (CIs) surrounding the weighted mean effect size were calculated; CIs indicate the degree of precision as well as the significance of the mean effect size (28). Heterogeneity in effect sizes was identified by computing *Q* and the associated degrees of freedom; a significant *Q* indicates a lack of homogeneity and an inference of heterogeneity. To assess the extent to which outcomes were consistent across studies, the I^2 index and its

corresponding 95% CIs were calculated (33, 34). The I^2 values of 25%, 50%, and 75% are considered to be low, medium, and high heterogeneity (35).

Moderator tests were used to explain the variability in the effect size estimates. Moderator analyses were conducted using a modified weighted regression analysis or the meta-analytic analogue to the ANOVA (following random-effects assumptions) with weights equivalent to the inverse of the variance plus the random variance component for each effect size (28, 36). The proportion of between-study variation (T_2) and residual variation due to heterogeneity (I^2) were computed for the meta-regression analyses. The between-study heterogeneity (Q_B) for the meta-analytic analogue to the ANOVA was assessed. These analyses examined *a priori* determined moderators. That is, we expected that the study (i.e., geographical location, recruitment setting), sample (proportion women, proportion problematic alcohol use, and proportion currently on ART), or intervention length (total intervention dose) would be related to the variability in the between-group effect sizes.

RESULTS

Study Selection

Electronic database searches identified 4,060 records with relevant key terms (after removing duplicates). An additional 89 manuscripts were identified through other sources (e.g., reference sections of review papers). Of the 4,149 records reviewed, 3,176 records were excluded based on title and abstract review because those studies did not meet any of the inclusion criteria or were review papers. The full-text reports of the remaining 973 records were reviewed with an additional 856 records excluded because the study did not meet the inclusion criteria (e.g., no intervention, control group, or relevant outcomes). The final sample included **21** studies and **96** supplemental manuscripts that provided additional intervention details or data from the same sample reported in the primary paper (Figure 1) (16–18, 37–54).

Study Characteristics

Table I provides study, sample, and intervention details for the 21 studies ($k = 22$ interventions) included in the systematic review and meta-analysis. Included studies were published (or available) between 2003 and 2016 ($M = 2010$, $SD = 3.98$); data collection occurred an average of 6 years earlier ($M = 2004$, $SD = 4.85$; range = 1994 to 2013). Studies were conducted in four World Health Organization defined geographical regions (55): 71% Americas (14 United States, 1 Haiti), 19% Africa (2 Uganda, 1 Kenya, and 1 multiple countries: Namibia, Kenya, and Tanzania), 5% South-East Asia (1 Thailand), and 5% European (1 Russia). Recruitment took place most often in a clinic (67%); samples were also recruited from the community (5%), prison (5%), or multiple clinic and community sites (24%).

Sample Characteristics

In total, 8,461 PLWHA consented to participate in the studies ($M = 403$, $SD = 736$; range = 65 to 3,538); average retention was 82% ($SD = 0.16$). Samples included 43% women with a mean age of 36 ($SD = 9.22$; range = 15 to 46). Of the studies reporting race and/or ethnicity,

60% of the participants were Black (African or non-African), 19% were Asian, and 17% were White; 17% were Hispanic or Latino/a. Two studies exclusively sampled men who have sex with men (MSM).

Participants were diagnosed with HIV for an average of 8 years (*M* months = 97, *SD* = 54; range = 16 to 180; *k* = 10); 69% (*SD* = 0.25; range = 24% to 100%) reported currently taking antiretroviral medications. Baseline mean CD4 counts and plasma viral load was 417.61 (*SD* = 65.01; *k* = 8) and 3.17 (*SD* = 0.76; *k* = 4), respectively.

Most participants (*M*% = 66, *SD* = 0.33; range = 3% to 100%) reported recent alcohol use. Problematic drinking (see Table I for varying definitions) was assessed in 12 studies; in these studies, most participants (69%; *SD* = 0.40; range = 5% to 100%) were problem drinkers. When reported, alcohol use disorders were diagnosed in an average of 47% (SD = 0.25; range = 15% to 78%; *k* = 6) of the participants assessed. About half of the participants (51%; *SD* = 0.17; *k* = 11) reported using drugs other than alcohol. Of the five studies assessing intravenous drug use (IDU), an average of 30% of the participants (*SD* = 0.35) reported IDU. The use of alcohol or drugs concurrent with sex was reported by 48% (SD = 0.44; *k* = 3) and 36% (SD = 0.21; *k* = 2) of participants, respectively.

Intervention Characteristics

The intervention setting was most often a clinic (71%); some studies reported delivering the intervention at clinic and community sites (10%) or prison (5%). (The intervention setting was not identified in three studies.) Interventions were conducted over a median of 5 sessions (range = 1 to 16) of 60 minutes each (range = 16 to 143). The intervention was most often delivered in-person (91%; 9% facilitated or delivered entirely by computer/technology) using individual only (55%), group only (23%), or both individual and group sessions (23%). Facilitators delivered group-based interventions to a median of 12 participants. The intervention was typically led by a single facilitator (range = 1 to 2); facilitators were most often paraprofessionals (41%; e.g., counselors).

Most interventions were theory-based (77%); intervention content was based on the transtheoretical model (32%), information-motivation-behavioral skills model (14%), or social cognitive/social learning theory (14%). Study authors also reported using motivational interviewing (32%) or motivational enhancement therapy (18%) techniques to deliver the intervention. The intervention content varied widely but often provided education (73%; 68% HIV, 45% alcohol, 36% sex, 27% medication adherence), personalized alcohol feedback (59%), and skills training (55%; 45% self-management skills; 41% communication skills, 14% condom skills, and 9% alcohol skills); encouraged the identification of risky situations (55%; e.g., drinking before sex); and assisted participants with goal setting (e.g., plans to reduce drinking; 86%).

Control Conditions

The control conditions included active comparisons (55%; e.g., education, time-match alternative intervention) or an assessment-only control (45%). Active comparisons were delivered over a median of 4 sessions (range = 1 to 15) with each session lasting a median of 60 minutes (range = 20 to 135).

Methodological Quality

The studies satisfied an average of 66% (*SD* = 11%) of the methodological quality (MQ) criteria; total MQ scores ranged from 7 to 20 out of a possible 25 points (*M* = 16.43, *SD* = 2.87). All of the study authors described the nature and purpose of the study and used a study design appropriate to test the stated hypotheses. Few studies reported that the participants were representative of the population from which they were recruited (5%) or that they randomly sampled potential participants (24%). Random assignment of individuals or groups to an intervention or control group was most often reported (90%); few studies (10%) reported that participants were blind to their assigned group. Control groups were typically compared (or matched) with the intervention group to determine (or ensure) equivalency (95%). Standardized treatment by using a manual and/or providing specific training to facilitators was reported in 90% of the studies. All of the studies reported the use of valid and reliable measures to assess the main outcomes; only 10 studies reported including an objective outcomes (e.g., blood; 48%). Only 14% reported blinding those measuring the intervention outcomes. Most studies (76%) used an assessment that occurred six months or later post-intervention. Intervention compliance was reported in most studies (76%). Retention was high with 90% of the studies reporting that at least 70% of the sample completed the study. Withdrawals or dropped outs were described in most studies (62%). Few studies (33%) considered missing data in their outcome reporting (e.g., intent-to-treat, compared with non-attrition cases at baseline); 52% of the studies used statistical methods that controlled for baseline and/or other characteristics. There were no differences for any of the outcomes based on the proportion of MQ criteria satisfied [results not shown].

Impact of the Interventions Compared with Controls

The weighted mean effect sizes and homogeneity statistics for the between-group analyses at the last assessment are presented in Table II. These analyses are presented separately by type of outcome: alcohol use, sexual risk behaviors, and antiretroviral adherence. (Only 10% of the effect sizes calculated were estimated; analyses excluding the estimated effect sizes [results not shown] revealed the same pattern of results for all outcomes and thus, the estimated effect sizes were retained in the analyses.) All studies provided at least one assessment of alcohol use; assessments of sexual risk behaviors and adherence were provided by 13 and 7 studies, respectively.

Alcohol use—Intervention participants *reduced* their quantity of alcohol consumed ($d_{+\ \text{random}}$ = 0.11, 95% CI = 0.03, 0.20; k = 11) and reported *less* heavy drinking ($d_{+\ \text{random}}$ = 0.24, 95% CI = 0.07, 0.41; k = 3) relative to control conditions. The hypothesis of homogeneity was supported for both the quantity of alcohol consumed (p = .558) and heavy drinking (p =.877), but the uncertainty limits were wide and exceeded the 50% threshold. There were no significant differences between the intervention and control participants on alcohol use or the frequency of drinking days. The hypothesis of homogeneity for alcohol consumption (p < .001) or the frequency of drinking days (p = .005) was not supported.

Sexual risk behaviors—Intervention participants increased their condom use compared to controls ($d_{+\ \text{random}}$ = 0.24, 95% CI = 0.07, 0.40; k = 11). The hypothesis of homogeneity was not supported (Q [12] = 48.76, p <.001; I^2 = 79, 95% CI = 64, 88). There were no

significant differences between the intervention and control groups with respect to the number of sexual partners or composite indices of sexual risk.

Antiretroviral adherence—Intervention participants had significant reductions in their plasma viral load relative to controls ($d_{+\ \text{random}} = 0.14$, 95% CI = 0.02, 0.26; $k = 7$). The hypothesis of homogeneity was supported ($p = .448$) but the uncertainty limits of the I^2 were wide (range = 0 to 56) and exceeded the 50% threshold. Medication adherence increased among intervention participants relative to controls ($d_{+\ \text{random}} = 0.14$, 95% CI = 0.07, 0.21; $k = 6$). The hypothesis of homogeneity was supported ($Q[5] = 0.98$, $p = .964$; $I^2 = 0$, 95% CI = 0, 31).

Comparison of Single-Behavior vs. Multiple-Behavior Interventions

Interventions were more successful at reducing the frequency of drinking days when the intervention targeted alcohol use alone ($d_{+\ \text{random}} = 0.56$, 95% CI = 0.28, 0.83; $k = 2$) vs. alcohol use and other HIV-related behaviors ($d_{+\ \text{random}} = -0.06$, 95% CI = −0.26, −0.14; $k = 3$), $Q_B(1) = 12.57$, $p < .001$. No significant differences were found for the proportion of participants who drank alcohol or the quantity of alcohol consumed. (The impact of the type of intervention could not be assessed for heavy drinking, sexual risk behaviors, and adherence as only a single study for each outcome evaluated an alcohol-only intervention.)

Moderators

Moderator tests were conducted to examine whether hypothesized moderators of intervention efficacy including study (geographical region, recruitment setting), sample (proportion women, proportion problematic alcohol use, and proportion currently on ART), or intervention length (total intervention dose) related to the variability in the between-group effect sizes. Due to insufficient sample size ($k \leq 5$), moderator tests were conducted only for the following outcomes: *alcohol use*, *frequency of drinking days, quantity consumed*, *condom use*, *plasma viral load*, and *medication adherence*.

Only a few moderators of intervention efficacy were identified for two outcomes—percent using alcohol and condom use (see Table III). Compared to controls, interventions were more successful in reducing the proportion of participants who consumed alcohol if the study recruited patients from a clinic setting (vs. other/mixed settings) ($Q_B[1] = 10.25$, $p < .001$). Interventions (vs. controls) were less successful in increasing condom use if the intervention was delivered for longer durations (B = −.00, SE = .00, $p = .019$). There were no significant differences on any other test for moderation.

Assessment of Risk of Bias

Risk of bias was assessed for the three outcomes (alcohol use, quantity of alcohol consumed, and condom use) with 10 or more effect sizes. Funnel plots and results of the statistical tests appear in the Supplementary Materials (S2). The graphical and statistical tests revealed no asymmetries that might be interpreted as small-study effects for alcohol use, quantity of alcohol consumed, or condom use.

DISCUSSION

Our meta-analysis of 21 studies evaluating interventions targeting alcohol use for 8,461 PLWHA found that interventions were successful in reducing alcohol consumption. Importantly, interventions with a significant alcohol focus also increased condom use and medication adherence among PLWHA. Furthermore, improvements in medication adherence among intervention participants were corroborated by parallel changes in plasma viral load. Improvements in adherence and plasma viral load observed in this meta-analysis are similar in magnitude and direction to those found in a prior meta-analysis directly evaluating single-targeted medication adherence interventions (adherence: odds ratio [OR] = 1.50, d = 0.26 vs. d_+ = 0.14; viral load: OR = 1.25, d = 0.14 vs. d_+ = 0.14) (56). Thus, adding alcohol content does not appear to decrease the efficacy of adherence interventions and may have the added benefit of reducing risky drinking. Therefore, alcohol interventions for PLWHA also improve behaviors that are critical for reducing HIV transmission and improving HIV care.

Overall, very few interventions have targeted alcohol use among PLWHA (2, 6, 57). Only four studies in this meta-analysis focused exclusively on alcohol use (16, 38, 42, 52), whereas the majority of the studies addressed alcohol use as part of a multiple HIV behavior change intervention. The standard of care for HIV often involves addressing all risky health behaviors (58) but it has been unclear whether focused interventions (i.e., those targeting a single behavioral target such as alcohol use) are more effective than those targeting multiple behaviors (e.g., alcohol use and risky sex) simultaneously (10). The results of this meta-analysis suggest that interventions targeting alcohol use alone were more successful in reducing the frequency of drinking days relative to interventions addressing multiple HIV-related behaviors, but there were no difference between the type of intervention used (i.e., single vs. multiple) when we assessed the quantity of alcohol use. Thus, a single health behavior change approach may be more effective in reducing alcohol use among PLWHA but additional comparative efficacy research is needed.

Overall, the tests for moderation identified few moderators of intervention efficacy despite the substantial heterogeneity found in some of the study outcomes (e.g., condom use, see Table II). Two exceptions to this overall pattern were observed: (a) Interventions recruiting patients from a clinic setting (vs. other/mixed settings) tended to be more successful in reducing the proportion of participants who drank alcohol at follow-up. This finding is consistent with the evidence that alcohol screening and brief interventions among clinic patients can reduce alcohol consumption and avert adverse health consequences associated with alcohol use among PLWHA as well as the broader population in primary care (59, 60); and (b) Interventions delivered over longer durations were less effective in increasing condom use. Many of the interventions included in this meta-analysis were lengthy (median = 8 hours), which could have increased fatigue in a population already coping with a number of HIV-related problems. Although somewhat counter-intuitive, this finding is consistent with the broader literature showing that brief interventions can be more effective than interventions of longer durations in some contexts (61).

Limitations

The findings should be interpreted in light of the limitations of the meta-analysis. First, study inclusion criteria restricted the set of studies to only those that addressed alcohol use as part of the intervention *and* assessed (or reported) an alcohol use outcome. Second, most outcomes involve self-reports, which are vulnerable to measurement, cognitive (e.g., memory), and social (e.g., self-presentation) biases (62). Third, there were too few studies of single and multiple behavior targets to identify the efficacy of each in terms of sexual risk behavior and medication adherence. Future research should compare single versus multiple target interventions on a range of outcomes for PLWHA. Fourth, moderator tests were limited to the data available in the primary-level studies and, therefore, some moderator tests could not be completed due to the low number of cases (e.g., recruitment setting among studies assessing the frequency of drinking days) or incomplete information (e.g., proportion of time spent addressing alcohol). Furthermore, we could not assess whether the efficacy of the interventions was based on the type, technique, or content given the variability of the interventions (e.g., motivational interviewing for alcohol use, secondary HIV prevention, cognitive behavioral stress management to increase medication adherence, family-based intervention for mothers living with HIV). Future research should identify the specific intervention types, techniques, and components that increase the efficacy of the intervention to lower alcohol consumption, reduce sexual risk behaviors, and improve medication adherence. Finally, inconsistencies in the measuring of problematic alcohol use as well as the reporting of clinical and immunological markers (e.g., baseline CD4 counts, viral load) prevented us from fully exploring potential moderators that may explain these findings.

CONCLUSION

Few studies have targeted alcohol use among PLWHA despite the potential benefits. This may be due, in part, to the prioritization of other challenges (e.g., medication adherence, HIV-related stigma, mental health concerns), limited clinic time, competing life stressors, or other barriers. Nonetheless, interventions targeting alcohol use among PLWHA are efficacious in reducing high-risk alcohol, sexual, and nonadherent behaviors that are known to be associated with secondary HIV transmission and poor clinical outcomes. Continued development, testing, and refinement of interventions to reduce alcohol use among PLWHA is needed, as are strategies to integrate alcohol interventions into clinical care and the stressful life circumstances of PLWHA.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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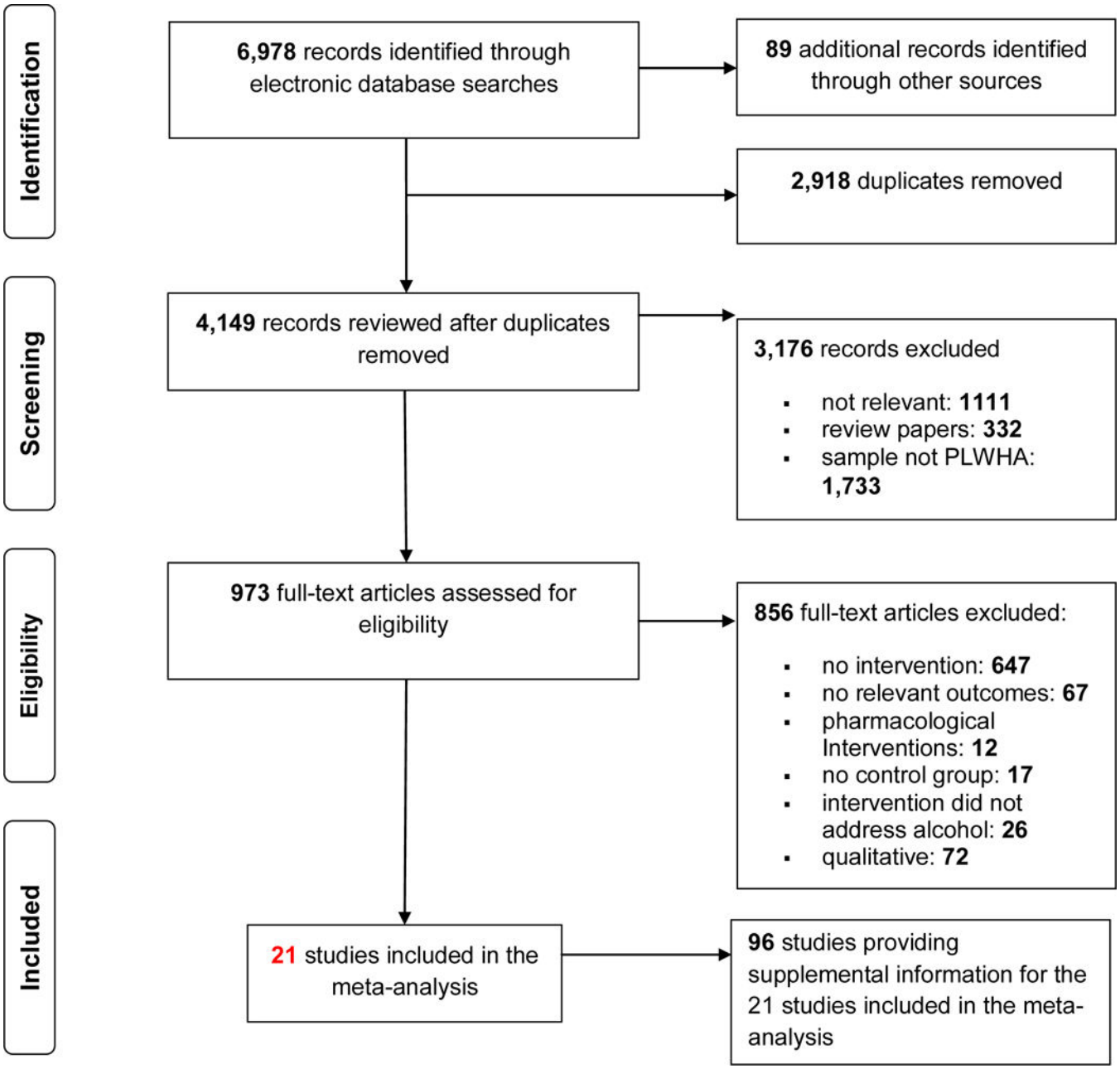

Figure 1.
Screening and Selection Procedures

Table I

Study, sample, and intervention details for the 21 studies (22 interventions) included in the meta-analysis

Citation	Sample	Setting and Location	Baseline Alcohol	Control	Intervention					Outcomes
					Theory/ Technique	Target	Level	Session (no.)	Dose (mins)	
Bachanas et al. (37); *Linked studies* (63–68)	N = 3,538; 58% F; Mage = 37; 70% diagnosed with HIV ≤36 months; 64% ART	HIV clinics; Kenya; Namibia; Tanzania, Africa	20% CD 5% PD[a]	WL/NT/AO	MF	Multiple (ALC; SEX; ADH)	IND/GRP	NR	NR	ALC; SEX; ADH
Chander et al. (16)	N = 148; 100% F; 86% Black; 70% ART	HIV clinic; Baltimore, MD, USA	100% CD 100% PD[b] 55% AUD[i]	WL/NT/AO	NR	ALC	IND	2	40	ALC; SEX; PVL; ADH
Gilbert et al. (17); *Linked studies* (69, 70)	N = 471; 21% F; 50% Black; M_{age} = 44	HIV clinics; San Francisco, CA, USA	39% CD 39% PD[c]	WL/NT/AO	TTM; MI	Multiple (ALC; SEX)	IND	1	24	ALC; SEX
Hasin et al. (38); *Linked studies* (71–81)	N = 258; 22% F; 49% Black; M_{age} = 46; $M_{months\ living\ with\ HIV}$ = 154; 77% ART	HIV clinic; New York, USA	100% CD 100% PD[d] 48% AUD	INFO	*Motivational Interviewing + HealthCall*					ALC
					TTM; MI	ALC	IND	3+	47.5	
					Motivational Interviewing					
Jean (39)	N = 116; 100% F; 95% Black; M_{age} = 36; 100% ART	Medical clinics; Port-au-Prince, Haiti	100% CD 83% PD[a]	WL/NT/AO	IMB	Multiple (ALC; ADH)	GRP	8	960	ALC; ADH
Naar-King et al. (40); *Linked studies* (71, 82–88)	N = 186; 47% F; 83% Black; M_{age} = 21; 34% ART	Adolescent HIV clinics; Los Angeles, CA; Philadelphia, PA; Baltimore, MD; Fort Lauderdale, FL; Detroit, MI, USA	53% CD 13% PD[e]	WL/NT/AO	TTM; MET	Multiple (ALC; SEX; ADH)	IND	4	240	ALC; PVL
Naar-King et al. (41); *Linked studies* (89–92)	N = 77; 48% F; 88% Black; M_{age} = 21	Adolescent HIV clinic; USA	77% CD	WL/NT/AO	TTM; MI	Multiple (ALC; SEX; ADH)	IND	4	240	ALC; SEX; PVL
Papas et al. (42); *Linked studies* (93–95)	N = 75; M_{age} = 37; 99% Black; $M_{months\ living\ with\ HIV}$ = 16; 61% ART	HIV clinic; Eldoret, Kenya	100% CD	WL/NT/AO	SCT	ALC	GRP	6	540	ALC
Parsons et al. (43); *Linked studies* (96–101)	N = 359; 21% F; 66% Black; M_{age} = 44; $M_{months\ living\ with\ HIV}$ = 127; 100% ART	Behavioral research center; New York, NY, USA	100% CD 100% PD[f]	INFO	IMB; MI	Multiple (ALC; ADH)	IND	8	480	ALC; ADH; CD4; PVL
Rongkavilit et al. (44); *Linked studies* (102)	N = 110; 19% F; 99% Asian; M_{age} = 22; 79% diagnosed with HIV in ≤24 months; 36% ART	AIDS research center clinics; Bangkok, Thailand	36% CD	ICM	MI	Multiple (ALC; SEX; ADH)	IND	4	240	ALC; SEX; ADH; PVL
Rotheram-Borus et al. (45); *Linked studies* (96, 103–112)	N = 339; 100% F; 68% Latino/a; M_{age} = 40; $M_{months\ living\ with\ HIV}$ = 109; 76% ART	Clinic and community sites; Los Angles, California, USA	62% CD	WL/NT/AO	SCT	Multiple (ALC; SEX; ADH)	GRP	16	1680	ALC; SEX
Samet et al. (46); *Linked studies* (113–125)	N = 151; 19% F; 47% Black; M_{age} = 43; 100% ART	Clinics; Boston, MA, USA	48% CD 100% PD[g]	WL/NT/AO	HBM; MET	Multiple (ALC; ADH)	IND	4	570	ALC; CD4; PVL; ADH
Samet et al. (47); *Linked studies* (126–138)	N = 700; 41% F; $M_{months\ living\ with\ HIV}$ = 53; 24% ART	Infectious disease hospital; St. Petersburg, Russia	100% CD 100% PDh 64% AUD	ICM	SCT; MET	Multiple (ALC; SEX)	IND/GRP	5	NR	ALC; SEX; STIs

Citation	Sample	Setting and Location	Baseline Alcohol	Control	Intervention					Outcomes
					Theory/ Technique	Target	Level	Session (no.)	Dose (mins)	
Senyoni et al. (48); *Linked studies* (111, 139)	N = 186; 53% F; 100% Black; M_{age} = 15; $M_{months\ living\ with\ HIV}$ = 180; 100% ART	HIV clinic, Kampala, Uganda	3% CD	INFO	SCT	Multiple (ALC; SEX)	GRP	8	640	ALC; SEX
Sikkema et al. (49)	N = 65; 0% F; 51% White; M_{age} = 32; $M_{months\ living\ with\ HIV}$ = 30	HIV primary care clinic; New York, NY, USA	NR	INFO	IMB	Multiple (ALC; SEX)	IND	3	180	ALC; SEX
Sikkema et al. (50); *Linked studies* (140–148)	N = 247; 52% F; 68% Black; M_{age} = 42; $M_{months\ living\ with\ HIV}$ = 120; 69% ART	AIDS services organization and community health care clinics; New York, NY, USA	42% CD 13% PD 21% AUD	RCM	Stress and Coping Theory	Multiple (ALC; SEX)	GRP	15	1350	ALC; SEX
Sorensen et al. (51); *Linked studies* (149, 150)	N = 190; 27% F; 43% Black; M_{age} = 38	San Francisco General Hospital; San Francisco, CA, USA	61% CD	INFO	NR	Multiple (ALC; SEX; ADH)	IND	NR	NR	ALC; SEX
Velasquez et al. (18); *Linked studies* (63, 151–153)	N = 279; 0% F; 54% Black; M_{age} = 39; $M_{months\ living\ with\ HIV}$ = 120	Multiple community venues; New York, NY, USA	100% CD 100% PD[a] 78% AUD	INFO	TTM; MI	Multiple (ALC; SEX)	IND/GRP	8	NR	ALC;SEX
Wandera et al. (52)	N = 337; 34% F; 32–46 years of age; 77% ART	Infectious disease clinic; Kampala, Uganda	100% CD 69% PD[a]	RCNM	MI	ALC	IND	1	25	ALC
Weiss et al. (53); *Linked studies* (102, 154–156)	N = 482; 100% F; 42% Black; M_{age} = 42; 47% ART	Clinics and community sites; Miami, FL; New York, NY; NJ, USA	11% CD 15% AUD	RCM	CBSM	Multiple (ALC; SEX; ADH)	IND/GRP	16	2250	ALC; PVL; ADH
Zack et al. (54); *Linked studies* (112, 157)	N = 147; 0% F; 55% Black; M_{age} = 38; $M_{months\ living\ with\ HIV}$ = 60	Prison; Marin County, CA, USA	66% CD	WL/NT/AO	NR	Multiple (ALC; SEX)	GRP	8	1080	ALC; SEX

Note. N, number of consenting participants; F, proportion female; CD, current drinker; PB, problematic drinking; WL/NT/AO, wait-list/no treatment/assessment only; INFO, informational/educational content only; ICM, irrelevant content, matched for time; RCM, relevant content, matched for time; RCNM, relevant content, not matched for time; MF, message framing (158); MI, Motivational Interviewing (159); TTM, Transtheoretical Model (160); Information-Motivation-Behavioral Skills (IMB) Model (161); SCT, Social Cognitive/Learning Theory (162); HBM, Health Belief Model (163); MET, Motivational Enhancement Theory (164); CBSM, Cognitive-Behavioral Stress Management (165); ALC, alcohol; SEX, sexual risk behaviors; ADH, adherence; IND, individual; GRP, group; CPLS, couples; PVL, plasma viral load; NA, not applicable; NR, not reported.

[a]Problematic drinking defined as scoring 8 or more on the Alcohol Use Disorders Identification Test (AUDIT) (166).

[b]Problematic drinking defined as 8 or more drinks per week OR 2 or more heavy drinking episodes (i.e., 4 or more drinks per drinking day) in the past 6 months.

[c]Problematic drinking defined as ≥14 [7] drinks per week for men [women] per week OR 3 or more heavy drinking episodes (i.e., 5 [4] or more drinks per drinking day) in the past 3 months.

[d]Problematic drinking defined as 4 or more drinks on at least one occasion in the past 30 days.

[e]Problematic drinking defined as drinking 8 or more times in the past week.

[f]Problematic drinking defined as ≥16 [12] drinks per week for men [women].

[g]Problematic drinking defined as scoring 2 or more on the CAGE Questionnaire (167).

[h]Problematic drinking defined as ≥14 [7] drinks per week for men [women] per week OR 3 or more heavy drinking episodes (i.e., 5 [4] or more drinks per drinking day) in the past 30 days.

[i] Alcohol use disorders were clinically assessed in a subset (10%) of participants.

Table II

Weighted mean effect sizes and homogeneity statistics for between-groups analyses at the last assessment.

Outcome	*k*	$d+_{random}$(95% CI)	*Q*	*p*	I^2 (95% CI)
Alcohol Use					
Alcohol use (% participants)	10	0.04 (−0.15, 0.23)	66.90	<.001	87 (77, 92)
Frequency of drinking days	5	0.18 (−0.16, 0.51)	14.76	.005	73 (32, 89)
Quantity of alcohol consumed[a]	11	**0.11 (0.03, 0.20)**	8.73	.558	0 (0, 74)
Heavy drinking	3	**0.24 (0.07, 0.41)**	0.26	.877	0 (0, 85)
Sexual Risk Behaviors					
Sexual partners	4	0.09 (−0.10, 0.23)	4.91	.427	0 (0, 87)
Condom use	11	**0.24 (0.07, 0.40)**	48.76	<.001	79 (64, 88)
Sexual risk composite	3	0.11 (−0.10, 0.33)	1.81	.405	0
Antiretroviral Adherence					
Plasma viral load	7	**0.14 (0.02, 0.26)**	5.78	.448	0 (0, 56)
Medication adherence[a]	6	**0.14 (0.07, 0.21)**	0.98	.964	0 (0, 31)

Note. Weighted mean effect sizes ($d+$) are positive for differences that favor the intervention group relative to the control group. *K*, number of interventions; CI, confidence interval; *Q*, homogeneity statistic; *p*, probability value for the homogeneity statistic; I^2, consistency of effect sizes.

[a]Two outliers were detected for the quantity of alcohol consumed (44, 46) and a single outlier was detected for self-reports of medication adherence (44). The magnitude and direction of the weighted mean effect sizes that included the outlier(s) was generally consistent with the above outcomes (quantity of alcohol consumed: $d+ = -0.08$, 95% CI = −0.35, 0.19, $k = 13$; medication adherence: $d+ = 0.18$, 95% CI = 0.08, 0.27, $k = 7$).

Table III

Moderator analyses for behavioral outcomes stratified by study, sample, or intervention characteristics

	% Alcohol Use		Frequency of Drinking Days		Quantity of Alcohol Consumed		Condom Use		Medication Adherence	
CONTINUOUS VARIABLES										
	k	B (SE)	*k*	B (SE)	*k*	B (SE)	*k*	B (SE)	*k*	B (SE)
Women (%)	10	−0.17 (0.25)	4	0.58 (0.31)	10	−0.21 (0.20)	11	−0.02 (0.25)	7	−0.14 (0.19)
Tau-squared		.0485		.0334		.0000		.0559		.0070
I^2		80%		44%		0%		81%		31%
Problem drinkers (%)	6	−0.17 (0.16)	0	–	9	−0.08 (0.17)	6	−0.25 (0.24)	6	0.06 (0.11)
Tau-squared		.0115		.0485		.0000		.0344		.0000
I^2		44%		80%		0%		72%		0%
Antiretroviral therapy (%)	9	−0.29 (0.46)	3	2.63 (0.88)	8	0.25 (0.18)	6	0.38 (0.58)	7	−0.22 (0.29)
Tau-squared		.0647		.0086		.0000		.0571		.0048
I^2		87%		14%		0%		83%		26%
Intervention dose	9	−0.00 (0.00)	4	0.00 (0.00)	9	−0.00 (0.00)	8	**−0.00 (0.00)**	6	−0.00 (0.00)
Tau-squared		.0198		.2782		.0000		.0000		.0086
I^2		49%		84%		0%		0%		19%
CATEGORICAL VARIABLES										
	k	d^+_{random} (95% CI)	*k*	d^+_{random} (95% CI)	*k*	d^+_{random} (95% CI)	*k*	d^+_{random} (95% CI)	*k*	d^+_{random} (95% CI)
Geographical Location										
Americas	7	−0.01 (−0.18, 0.17)	3	0.21 (−0.27, 0.70)	8	0.15 (0.03, 0.27)	8	0.24 (0.02, 0.46)	6	0.13 (−0.00, 0.27)
Other locations	3	0.12 (−0.15, 0.39)	2	0.12 (−0.50, 0.74)	3	0.07 (−0.06, 0.19)	3	0.24 (−0.10, 0.57)	1	0.00 (−0.66, 0.66)
Q_B (1)		0.56		0.05		0.99		0.00		0.05
p		.454		.817		.319		.974		.816
Recruitment setting										
Clinic only	6	**0.17 (0.04, 0.31)**	4	0.23 (−0.21, 0.68)	8	0.10 (0.01, 0.20)	7	0.31 (0.11, 0.51)	4	0.19 (0.04, 0.34)
Other settings	4	−0.15 (−.30, −.00)	1	0 (−0.81, 0.81)	3	0.13 (−0.04, 0.31)	4	0.10 (−0.16, 0.36)	3	0.19 (0.01, 0.39)
Q_B (1)		10.25		–		0.11		1.64		0.00
p		.001				.743		.200		.989