Interventions to Reduce Alcohol Use among HIV-Infected Individuals: A Review and Critique of the Literature

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Abstract

Alcohol use disorders are common among HIV-infected individuals and are associated with adverse physiological complications and increased engagement in other health risk behaviors. This paper provides a review and critique of interventions to reduce alcohol use among HIV-infected individuals, including a: (a) synthesis of core intervention components and trial designs; (b) summary of intervention efficacy to reduce alcohol use outcomes; and (c) methodological critique and guidance for future research. We reviewed 14 behavioral interventions that reported on alcohol use outcomes among HIV-infected individuals. Findings were mixed for intervention efficacy to reduce alcohol frequency and quantity. There was limited evidence that interventions reduced binge drinking frequency or alcohol abuse or dependence symptoms. Despite the prevalence of disordered alcohol use among HIV-infected individuals, there is lack of efficacious intervention approaches. Efficacious intervention approaches to reduce alcohol use among HIV-infected individuals are urgently needed.

Keywords

alcohol; alcohol interventions; behavioral aspects of HIV management; HIV; HIV-infected; HIV-positive

Introduction

Rates of new HIV infections remain relatively stable with an estimated 47,500 incident infections in the United States (US) in 2010 (1) and 2.5 million incident infections globally in 2011 (2). Currently there are more than 1 million individuals living with HIV in the US (3), with over 34 million individuals living with HIV globally (2). Substance abuse and dependence are common among HIV-infected individuals (4, 5), particularly disordered

alcohol use (5–7). In a US national probability sample of HIV-infected individuals, 8% were classified as heavy drinkers (i.e., consuming five or more alcoholic drinks on four or more days during the past month), a prevalence rate almost twice that of the general population (6). Furthermore, alcohol abuse and dependence are further elevated among HIV-infected individuals who use other substances (5, 6, 8) and frequently co-occur with other psychiatric illnesses (5, 9).

Disordered alcohol use may lead to a variety of deleterious health consequences for HIV-infected individuals. Alcohol dependence results in neurocognitive impairment, diminished cerebral cortex functioning, and increased prevalence of HIV-associated dementia (10, 11). Heavy alcohol use is also linked to malnutrition among HIV-infected individuals (12). In addition to health complications posed by alcohol directly, interactions between alcohol and antiretroviral (ARV) medications heighten the health risks posed to HIV-infected individuals who abuse alcohol. Alcohol and ARV medication interactions may contribute to hepatoxicity and liver disease (13–15), which may be accelerated by co-morbid Hepatitis C infection (16). Alcohol abuse also produces peripheral neuropathic pain, which may be further exacerbated by ARV medications (17).

In addition to the potential adverse physiological consequences of alcohol on HIV-related health outcomes, alcohol has been associated with decreased adherence to ARV medications (7, 18–22). ARV medications require high levels of adherence to maintain optimal viral suppression and prevent development of drug-resistant HIV strains (23–25). However, HIV-infected individuals are at risk for several categories of incomplete ARV adherence including delayed ARV initiation (26), treatment interruption (27), or treatment discontinuation (28). Alcohol use may negatively impact ARV adherence (18, 19, 29), in turn contributing to decreased viral suppression (7), lower CD4 count (30), and decreased ARV utilization (7, 31). In addition to poor ARV adherence, drinking is also associated with poor medical service utilization (31–33), which may also accelerate disease progression.

Alcohol consumption has also been associated with increased HIV-1 vaginal shedding (34, 35). Additionally, alcohol use has been linked to increased engagement in sexual risk behaviors, further heightening the potential for HIV transmission to uninfected partners and acquisition of other sexually transmitted infections (STIs). Indeed, there is a growing body of cross-sectional studies linking increased drinking to unprotected sexual activity (20, 36, 37), using substances prior to sex (38), and having multiple recent sexual partners (36, 39). Recent use of alcohol has also been associated with not disclosing one's HIV serostatus to partners (40). Thus, alcohol use may also be associated engagement in behaviors that increase the likelihood of HIV transmission or STI acquisition or among HIV-infected individuals.

Alcohol use disorders are common among HIV-infected individuals. Alcohol dependence, in particular, may lead to a number of adverse physical outcomes and is also associated with decreased adherence to HIV treatment and greater engagement in sexual risk behaviors. Thus, there is a clear need to develop, evaluate, and disseminate efficacious interventions to reduce alcohol use among HIV-infected individuals. In this paper we review studies that evaluate the efficacy of interventions to reduce alcohol use among HIV-infected individuals. Specifically, this review will: (a) overview study designs employed in intervention trials and synthesize core intervention components; (b) summarize intervention efficacy for impacting alcohol use outcomes; and (c) provide a methodological critique and guidance for future research.

Literature Search Method and Criteria for Inclusion

A previous review conducted by Samet and colleagues reviewed health promotion interventions for HIV-infected alcohol users, defined as: (a) studies with HIV-infected individuals with past or current unhealthy alcohol use; or (b) studies with samples comprised of 10% or more currently using alcohol (41). In addition, this paper also reviewed HIV prevention interventions for alcohol drinkers at elevated HIV risk (41). Their review summarized each individual study's efficacy to affect a range of health outcomes including HIV disease progression, ARV medication adherence, receipt of ARV medications, HIV risk behaviors, STI acquisition, and alcohol use (41). For each study, the authors briefly described the intervention and individual study outcomes.

The current review expands upon Samet and colleagues' previous paper in several ways. First, the current review includes behavioral interventions not specifically targeted to HIV-infected individuals with alcohol problems or studies including a subset of current drinkers. Second, we focus upon alcohol consumption as the sole intervention outcome of interest. Thus, our review encompasses a broader array of interventions that enrolled HIV-infected individuals with and without current risky drinking. Third, we synthesize core intervention approaches and study design features across the reviewed studies. Fourth, we review the alcohol outcomes across studies by the type of measure (e.g., frequency measure, quantity measure). Fifth, we provide a methodological critique of reviewed interventions and identify potential future research directions.

Database searches of PsycINFO, PsycARTICLES, Medline, and PubMed were conducted to identify published articles in peer-reviewed journals that evaluated the impact of a behavioral intervention on alcohol use among individuals living with HIV. Combinations of the following search terms were used to identify relevant articles: *alcohol, alcohol intervention, behavioral intervention, HIV, HIV-positive, HIV-infected, AIDS*. A search of references cited in relevant studies was conducted to identify additional articles. English language articles published in peer-reviewed journals were screened for inclusion. Studies were included if they met all of the following criteria: (a) the study included at least one alcohol outcome measure; (b) the intervention targeted HIV-infected individuals with alcohol problems or the intervention included content to reduce alcohol use; (c) the study's sample was composed of only HIV-infected individuals; and (d) the intervention did not focus exclusively on reduction of another substance(s) (e.g., methamphetamines). According to these criteria, 16 papers were included in the review (see Table 1). It should be noted that there were multiple papers that reported subgroup analyses from larger trials or that reported on distinct outcomes from the same sample. Thus, among the 16 papers meeting the inclusion criteria, there were 14 unique interventions reviewed.

Overview of Intervention Approaches and Study Designs

This section describes key intervention features across the 14 reviewed interventions. First, a brief description of the guiding theoretical frameworks for the interventions' design and intervention components is provided. Second, the research methodologies implemented to evaluate the interventions are summarized. The treatments' duration and length of the follow-up assessments is then described. Next, a discussion of study sample characteristics is provided. Table 1 provides an overview of features of the reviewed interventions. Lastly, the alcohol measures employed by the reviewed studies are discussed. Table 2 provides additional detail regarding the alcohol measures used across studies.

Intervention Components and Theoretical Foundations

Table 1 provides information regarding the core intervention components and theoretical frameworks guiding the interventions' content and approach. Half of the interventions employed Motivational Interviewing (MI) as the primary guiding framework for the interventions (42–49). Coupled with an MI approach, two interventions utilized Stages of Change to assess participants' readiness to change target behavior(s) (45, 46). Cognitive behavioral therapeutic (CBT) approaches were employed in four of the interventions (44, 47, 48, 50, 51), with two of these interventions utilizing a combined MI and CBT approach (44, 47, 48). Interventions often incorporated a broader focus on HIV risk reduction using health behavior change theories (43, 45, 52–56). However, the specific theoretical framework(s) employed to guide the intervention content were typically not cited nor described in the study methods. Stress management training was included in two interventions (50, 53, 56). Participants were provided with case management in two of the reviewed interventions (53, 56, 57). Collectively, the majority of interventions employed either an MI or CBT approach. Interventions also sought to reduce HIV risk behaviors using health behavior change theory.

While all of the reviewed interventions sought to improve the health of HIV-infected individuals, a minority had an exclusive focus on alcohol reduction. Indeed, only two studies (14%) had an exclusive focus on reducing alcohol use (42, 51). Instead, reducing alcohol use was a focus within interventions to reduce HIV transmission behaviors more broadly (e.g., sexual risk behaviors; 43, 45–48, 52–57) or reducing alcohol in conjunction with other substances (43, 46, 49, 53–57). Additionally, four interventions included content to improve HIV-infected individuals' adherence to ARV medications (44, 47–49, 53, 56). Two stress management interventions sought to improve individuals' overall coping skills with decreased use of alcohol as a coping strategy (50, 53, 56). In sum, interventions typically sought to address multiple behaviors rather than an exclusive focus on reducing HIV-infected individuals' alcohol use.

Delivery Format

The majority of studies tested an individually delivered intervention approach (*n* = 9; 42–44, 46–49, 53, 55–57). Additionally, one intervention tested a group-delivered format combined with individually delivered sessions (45). A minority of studies evaluated group-delivered interventions (*n* = 4; 50–52, 54). The majority of interventions (*n* = 11) were delivered in-person by a trained interventionist. In contrast, one intervention employed a computer-delivered approach (46). Phone-delivered content was provided in two interventions; one study supplemented individually delivered intervention sessions with daily phone alcohol self-monitoring calls (42), while a second intervention delivered sessions either in person or via the phone (55).

Study Design

Across the 14 interventions reviewed, 13 of the studies (93%) were randomized controlled trials (RCTs; see Table 1). The number and types of control groups included in the research designs varied across the reviewed studies (see Table 1). Only one (7%) study did not include a comparison or control group (42). Across all reviewed studies, only a single study compared a behavioral intervention to both a wait-list-control group and additional comparison condition (55). All other investigations utilized a two group design comparing a behavioral intervention to one other condition. Of the 13 RCTs, 8 studies (62%) contrasted a behavioral intervention to a wait-list-control group or treatment as usual condition (43, 46–48, 51, 53–56). Two (15%) of the 13 RCTs provided referral information as the comparison condition (45, 57).

Treatment Length and Follow-Up Assessment Interval

As can be seen in Table 1, treatment protocols varied in the number and length of the treatment sessions and timing of follow-up assessments. In the shortest interventions, only one brief session was implemented (42, 46); these single intervention sessions were supplemented either by daily self-monitoring phone calls (42) or a brief booster session three months later (46). However, most programs employed multiple sessions (*Range:* 1–23, *Mean* = 8.5, *Mode:* 3) that were between 30 minutes and two hours in length (*Mean* = 76 minutes, *Mode:* 2 hours). An additional intervention provided ongoing case management services over one year, but did not report the total number or length of the case management sessions (57). The number of follow-up assessments ranged from two to six (*Mean* = 3.4, *Mode* = 2). The modal length of the follow-up assessment period across trials was 12 months (*Mean* = 11.4, *Range* = 2–25 months). Additionally, two trials included an immediate post-intervention assessment.

Sample Characteristics

Table 1 overviews the studies' sample sizes and racial/ethnic characteristics of study participants. Sample sizes ranged from 30 to 936 participants (*Mean* = 261.6, *Median* = 183.5). Most studies enrolled mixed gender samples (86%), but trials recruited a disproportionately higher number of males than females. The majority of participants were HIV-infected adults (79%), while three trials enrolled adolescents (43, 47, 48, 54). Nearly all trials (86%) were conducted in the US. Only two studies were conducted with international samples; one trial was conducted in Zambia (52), while a second study was conducted in Kenya (51).

Table 1 indicates studies that had alcohol-related inclusion criteria. Five studies enrolled HIV-infected individuals with problem drinking, which included different alcohol-related inclusion criteria across studies (42, 44, 45, 49, 51). Two studies enrolled individuals using other drugs (55) or those with substance dependence (57). In two other studies, participants had to endorse at least one risk behavior, of which alcohol was one (43, 46). In another study, enrollment was based on self-reported problematic substance use (including alcohol), unprotected sex, or poor ARV adherence (43). In a study conducted by Gilbert and colleagues, enrollment was based on problem substance use, problem alcohol use, or unprotected sex (46). Four studies had no alcohol or substance use eligibility criteria (47, 48, 50, 52, 53, 56).

Alcohol Measures

Table 2 provides a summary of the alcohol measures used in the reviewed studies. Studies assessed alcohol across dimensions including: alcohol frequency, alcohol quantity, binge drinking frequency, abuse or dependence symptoms, or other alcohol-related measures (e.g., alcohol use prior to sexual activity, alcohol use in conjunction with other substance use). The majority of studies (*n* = 9) assessed frequency of drinking. Alcohol frequency was assessed for the past week (42, 43), past two weeks (44), past month (42, 45, 49–51), or past three months (53, 54, 56). Of note, two trials assessed frequency of alcohol use in conjunction with marijuana use (53, 54, 56). The quantity of alcohol consumed was assessed by 7 studies over the time frames of the past week (42, 47, 48), past two weeks (44), or past month (42, 45, 49–51). Binge drinking frequency was measured during the past week (46), past month (45, 49, 50), and past 3 months (46) in four studies. Additionally, one study also classified the level of binge drinking in the past month (i.e., No drinking, Moderate drinking, but no binge drinking, Hazardous drinking with binge drinking) (50). Three studies measured symptoms of substance use abuse or dependence (49, 55, 57); one study assessed alcohol dependence individually (51). Abuse or dependence severity was assessed via the Addiction Severity Index (49, 57), or by reporting two or more substance dependence

symptoms (55). Additional alcohol-related measures included alcohol in conjunction with sexual risk (45, 52), number of substances used (including alcohol) (54, 55), and a combined alcohol and substance use frequency measure (43, 47, 48).

Efficacy of Interventions to Improve Alcohol Outcomes

This portion of the review focuses on the alcohol outcomes for each of the reviewed studies. First, outcomes regarding changes in alcohol frequency and quantity are reviewed. Next, a review of binge drinking outcomes is provided. Third, the impact of interventions on substance abuse or dependence symptoms is reviewed. Finally, we summarize the effect of interventions on other alcohol-related outcome measures. Table 3 provides an overview of outcomes across interventions.

Alcohol Frequency

When examining frequency of drinking over time, two studies found that both the intervention and control groups decreased frequency of drinking over time (44, 45). A third study without a control group noted that participants' drinking frequency decreased at the 2-month follow-up assessment, but did not significantly decrease at the 1-month assessment (42). Rotheram-Borus and colleagues found decreased frequency of alcohol or marijuana use over time only among participants who attended the intervention sessions (54). Overall, study participation was associated with decreased alcohol use frequency over the course of the trial.

When comparing drinking frequency between the intervention and control groups, findings were mixed. Three studies noted decreased drinking frequency among intervention participants relative to the control group (43, 45, 51). One efficacious intervention focused exclusively on alcohol reduction in a Kenyan sample (51). Papas and colleagues' study also found greater alcohol abstinence in the group-delivered CBT alcohol intervention condition (51). A second study provided CBT stress management training during 15 sessions (50). The third study impacting alcohol frequency targeted alcohol, substance use, sexual risk behaviors, and ARV adherence among adolescent HIV-infected individuals using MI (47, 48). Another study of a comprehensive substance use and HIV risk reduction intervention found decreased alcohol or marijuana use frequency relative to the control group (53, 56). While there was some evidence that interventions decreased drinking frequency, three interventions found no differences in drinking frequency between the intervention and control conditions (44, 49, 54). All three of these interventions focused on reducing alcohol along with other substances (49, 54), improving ARV adherence (44, 49), and decreasing sexual risk behaviors (54). Findings indicate inconsistency in the interventions' impact on drinking frequency relative to the comparison conditions.

Alcohol Quantity

The quantity of alcohol consumed per drinking occasion was an outcome measure in seven studies. Four studies found that the intervention group participants reported decreased quantities of alcohol consumed over time (42, 44, 45, 50). Additionally, three of these studies found that control group participants' quantity of alcohol consumed also decreased significantly over time (44, 45, 50).

Findings were mixed for between subjects' analyses examining intervention and control group differences in alcohol quantity. Three studies found no differences in the quantity of alcohol consumed between the intervention and control conditions (44, 45, 49). These interventions targeted multiple behaviors (e.g., ARV adherence, substance use, alcohol use, sexual risk behaviors) and employed either a brief MI approach (49) or combined MI with CBT (44) or a broader HIV risk reduction framework (45). In contrast, three other studies

noted lower quantity of alcohol consumed by participants in the intervention condition relative to the control condition (47, 48, 50, 51). These interventions provided cognitive behavioral stress management skills training for those with a trauma history (50), focused exclusively on alcohol reduction among a Kenyan sample (51), or employed MI targeting alcohol or other health behaviors among an adolescent sample (47, 48). While inconclusive and deserving of future research, there does seem to be promise for interventions with an exclusive focus on alcohol reduction delivered via multiple intervention sessions among those with problem drinking (51) or providing broader coping skills training (50), or intervening with younger samples via MI and prioritizing risk reduction behavior targets (47, 48).

Binge Drinking

When examining binge drinking, two studies found that both the intervention and control groups' decreased their frequency of binge drinking episodes over time (45, 50). In between group analyses, three studies found no differences between the intervention and control groups for the frequency of binge drinking episodes at the follow-up assessments (46, 49, 50). There was a single study that found a significant group by time interaction effect such that those in the intervention group reported a decreased frequency of binge drinking episodes relative to the control group (45). This intervention sought to reduce alcohol and sexual risk behaviors among a sample of HIV-infected men who have sex with men (45). Collectively, there is limited support for interventions' efficacy for reducing the frequency of binge drinking episodes. However, the study conducted by Velasquez and colleagues comprised of 8 group and individual MI and HIV risk reduction sessions shows promise for reducing binge drinking among HIV-infected individuals (45).

Abuse or Dependence

Three studies evaluated the extent to which interventions impacted HIV-infected individuals' abuse or dependence to alcohol and/or other substances (49, 55, 57). Both an 18-session HIV risk reduction intervention (55) and a brief MI intervention (49) found no differences in abuse or dependence symptoms over time or between the intervention and control conditions (49, 55). A third study demonstrated that both individuals in the 12-month case management intervention condition and those receiving a referral for additional services (control condition) had decreased scores on the Addiction Severity Index over the 18 months of follow-up (57). However, there were no differences between the case management intervention and control group for degree of abuse or dependence symptoms (57). Thus, across studies there is little support that extended case management, multi-session HIV risk reduction interventions, or brief MI interventions were efficacious in reducing symptoms associated with substance abuse or dependence.

Other Alcohol-Related Outcomes

Five studies measured other alcohol-related outcomes. A study enrolling both a US and Zambian sample examined a combined alcohol, drug, and sexual risk behavior index and found that both samples decreased their risk behavior engagement over 12 months (52). However, there were no differences between a group and individual HIV risk reduction intervention approach at either the 6- or 12-month follow-up assessments (52). A second study categorized participants into low-, moderate-, and high-risk groups based on patterns of alcohol and marijuana use (43). Those in the intervention condition were less like to be classified as being in the high-risk group (43). Among individuals endorsing alcohol in conjunction with sexual activity at baseline, the group-delivered alcohol and HIV risk reduction intervention condition participants endorsed decreased alcohol use and sexual behavior relative to the control condition (45). Two studies found that the number of drugs

used including alcohol did not differ between multi-session HIV risk reduction interventions and a wait-list control group (54, 56).

Review Summary

This review synthesized health promotion interventions' efficacy to improve alcohol outcomes. Findings were mixed for reductions in alcohol frequency and quantity between the intervention and comparison conditions. Approximately half of the studies found significant reductions in alcohol frequency and quantity between the intervention and comparison conditions. For measures of binge drinking frequency and symptoms of abuse or dependence, there was little evidence for intervention efficacy in these domains. Lastly, there was some evidence to suggest that the reviewed interventions reduced alcohol in conjunction with other health risk behaviors (e.g., unprotected sex). With the limited evidence for reduced alcohol use across measures, there is a clear need for future intervention efforts to address problem drinking in this population.

Methodological Critique and Implications for Future Research

To aid the development of future interventions to reduce alcohol use among HIV-infected individuals, there is a need to identify core active intervention components, particularly among interventions targeting multiple risk behaviors. Future trials would also benefit from improved alcohol measurement, inclusion of time- and dose-equivalent comparison conditions, and assessing clinical significance in addition to statistical significance. Future interventions should consider utilizing known theories of behavior change to determine which behavioral determinants of alcohol use in this population should be targeted for maximum efficiency and effectiveness, incorporate personalized feedback components to alcohol interventions, and consider the development of specialized alcohol modules for such interventions. There is also a need to develop more cost-effective, easily disseminated intervention approaches. These considerations are expanded upon below.

Measurement of Intervention Outcomes and Processes

Need to identify active intervention ingredients and optimal delivery format—
The reviewed interventions typically implemented multi-session programs with numerous components included in the treatment package. Alcohol was not the only behavior targeted across interventions. Further assessment of the efficacy of individual treatment components to reduce alcohol use should be employed. There also was a range of intervention delivery approaches employed across studies, with the majority of interventions delivered face-to-face with HIV-infected individuals. To date, a single study (52) has assessed the extent to which delivery format (individual vs. group) impacted intervention outcomes and found comparable risk reductions between intervention formats. However, none of the interventions have assessed how interventionist characteristics (e.g., type of interventionist, training level) may impact intervention efficacy. Additionally, no studies have examined the extent to which intervention efficacy may differ by gender. Given the current practice of evaluating multi-faceted intervention packages delivered over the course of multiple sessions for combined gender samples, it is difficult to determine which intervention components, treatment process factors, or interventionist characteristics are responsible improvements in alcohol use.

Strategies to improve alcohol measurement—All of the reviewed studies assessed alcohol use via self-report measures. The accuracy of self-report data on alcohol use may be impacted by a variety of factors including the cognitive demands of recalling past behaviors and motivational biases that can lead people to mis-report their behavior (58–60). To improve the validity of self-reported alcohol use, studies would benefit from inclusion of

multiple alcohol measures, collection of collateral alcohol data (e.g., from significant others) (61), utilization of strategies to improve recall of alcohol use over longer periods of time (e.g., Timeline Followback; 62), inclusion of standard drink measures when assessing alcohol frequency and quantity, and collection of ecological momentary assessment data (63). Studies would also benefit from incorporating additional objective, biological alcohol measures. For example, blood alcohol concentration provides a measure of recent alcohol use. Recent advances to measure alcohol consumption over longer periods of time by an ethyl glucuronide or ethyl sulphate biomarkers collected via hair, fingernails, or urine offers additional promise for future assessment of alcohol use (64, 65).

Research Design and Data Analytic Concerns

Future studies should include comparison conditions with equivalent treatment intensity and length—The majority of studies compared an intervention condition to a no intervention control group. Only three studies evaluated the intervention against a comparison condition with equivalent intensity and length (44, 50, 55). In addition, only a single study compared the intervention to both a wait-list-control group and a time-matched comparison condition (55). To evaluate the efficacy of behavioral interventions, trials should include both a rival treatment and no intervention control group (65). Thus, future studies should utilize research designs that allow the effect of treatment intensity to be controlled for by using comparison treatments of equal length and intensity.

Literature focuses on statistical significance with little attention given to clinical significance—In the reviewed intervention literature, there was little attention to whether intervention outcomes were not only statistically significant, but evidenced some change of practical importance. Greater attention should be given to reporting whether change in outcome measures is clinically significant. In so doing, readers will be able to better gauge the extent to which improvement on these measures is indicative of change that is of practical importance to the participant. A number of methods for assessing clinical significance have been proposed (70–73). However, as Kazdin notes, clinical significance should be determined by the goals of an intervention (72). In the case of interventions to reduce alcohol use, clinical significance should focus less on frequency or quantity measures, but rather on measures of problem drinking, abuse, or dependence. Thus, future research should clearly identify treatment goals and provide measurements of the degree to which HIV-infected individuals evidence clinically significant alcohol improvement after completing the intervention.

Future Intervention Directions

Need to develop efficacious alcohol reduction interventions tailored to the unique needs of HIV-infected individuals—HIV poses a number of unique psychosocial challenges associated with living with a chronic, stigmatized disease (66, 67). These challenges are compounded by the fact that HIV-infected individuals experience high rates of alcohol abuse, drug abuse, and mental health difficulties (4). Given the complexity of challenges often faced by HIV-infected individuals, additional research is needed to more effectively address alcohol within the context of more comprehensive risk reduction interventions. An approach that demonstrated promise in improving overall psychosocial functioning and reducing alcohol use was a cognitive-behavioral stress management intervention approach (50). Additionally, prioritizing highest risk engagement within the context of individualized intervention approaches may improve intervention efficacy. It is noteworthy that the majority of interventions targeted alcohol consumption within the context of multiple other high-risk behaviors. Yet, as indicated, alcohol use has known effects on ARV medication adherence as well as interactive effects with ARV medications. Placing a priority and special focus on alcohol use within a cognitive-behavioral therapy

approach could provide a promising intervention strategy. More specifically, providing patients with personalized feedback about their level of alcohol use and allowing them to track their use over time could provide them with a concrete, behavioral target. Personalized feedback is known to be an efficacious and cost effective component of brief alcohol interventions (68). The use of concrete, measurable goals in CBT has been considered a key, active ingredient because they maximize efficiency (69). Thus, because change in alcohol use can have a broad-level impact on overall health in HIV patients through its impact on physiological status and on medication effects, specific targeting of alcohol use should be considered a priority.

Additionally, the development of interventions designed to target HIV-infected persons with problem drinking or alcohol dependence should consider basing these developments on known theories of behavior change. Webb and colleagues recently reviewed ten behavior change theories and their application to interventions for addictive behaviors (2010). Use of known theories of behavior change will allow researchers to identify better which behavior determinants (for alcohol and other targeted high-risk behaviors) are most important to target in interventions.

Need for more cost-effective, easily disseminated intervention approaches— Interventions have typically been administered in individual sessions led by an experienced clinical provider. These treatment programs have involved multiple sessions and a significant time commitment required to participate. Although individually delivered intervention approaches provide the added benefit of tailored intervention content and feedback, HIV-infected individuals may experience challenges attending all of the intervention sessions. Thus, the utility of such time-intensive interventions may be limited to a relatively small subset of patients who could otherwise benefit from such programs. Furthermore, implementation of numerous intervention sessions requires significant financial resources and may not be feasible in resource limited clinic settings. An important gap in the literature is to examine the efficacy of briefer, more cost-effective intervention approaches that can meet the needs of a broad range of HIV-infected individuals that could be incorporated within ongoing HIV medical care. One particularly promising intervention approach is the use of technology delivered programs to supplement face-to-face intervention content. For example, Aharonvich and colleagues developed a phone based alcohol monitoring intervention to supplement individual, face-to-face intervention content (42). Another approach may be the use of computer delivered interventions. Gilbert and colleagues implemented a single session computerized intervention targeting alcohol use, sexual risk behaviors, and ARV adherence (46). While this single computerized session did not reduce binge drinking frequency (46), computer delivered content may provide an additional strategy to increase intervention contact. This format affords participants greater confidentiality and flexibility of administration. They are also highly portable and can be implemented in a variety of contexts. For resource limited outpatient settings, the use of computerized interventions may be more feasible and cost effective to reach a wider subset of patients.

Conclusions

Alcohol use disorders are common among HIV-infected individuals and may result in a number of deleterious health outcomes. Despite the prevalence of alcohol use disorders among HIV-infected individuals and potential for adverse health consequences, efficacious behavioral interventions to reduce alcohol use among this population are lacking. Future intervention efforts are urgently needed to reduce alcohol use within the context of multiple health behavior targets. Cognitive behavioral approaches that incorporate personalized feedback along with prioritizing risk behavior targets show particular promise. Ultimately,

efficacious alcohol reduction interventions for HIV-infected individuals offer the promise of improving the overall quality of life and long-term medical outcomes of this patient population.

Acknowledgments

References

1. CDC. Estimated HIV incidence among adults and adolescents in the United States, 2007–2010. HIV Surveillance Supplemental Report. 2012; 17

2. WHO. Global HIV/AIDS Response: Epidemic update and health sector progress towards universal access. 2011

3. CDC. HIV Surveillance Report, 2011. 2013:23.

4. Klinkenberg WD, Sacks S. Mental disorders and drug abuse in persons living with HIV/AIDS. AIDS Care. 2004; 16:S22–S42. [PubMed: 15736820]

5. Pence BW, Miller WC, Whetten K, Eron JJ, Gaynes BN. Prevalence of DSM-IV-defined mood, anxiety, and substance use disorders in an HIV clinic in the Southeastern United States. Journal Of Acquired Immune Deficiency Syndromes. 2006; 42:298–306. [PubMed: 16639343]

6. Galvan FH, Bing EG, Fleishman JA, et al. The prevalence of alcohol consumption and heavy drinking among people with HIV in the United States: Results from the HIV Cost and Services Utilization Study. Journal of Studies on Alcohol. 2002; 63:179–186. [PubMed: 12033694]

7. Chander G, Lau B, Moore RD. Hazardous alcohol use: a risk factor for non-adherence and lack of suppression in HIV infection. Journal Of Acquired Immune Deficiency Syndromes (1999). 2006; 43:411–417. [PubMed: 17099312]

8. Michel L, Carrieri MP, Fugon L, et al. Harmful alcohol consumption and patterns of substance use in HIV-infected patients receiving antiretrovirals (ANRS-EN12-VESPA Study): relevance for clinical management and intervention. AIDS Care. 2010; 22:1136–1145. [PubMed: 20824566]

9. Sullivan LE, Goulet JL, Justice AC, Fiellin DA. Alcohol consumption and depressive symptoms over time: A longitudinal study of patients with and without HIV infection. Drug and Alcohol Dependence. 2011; 117:158–163. [PubMed: 21345624]

10. Persidsky Y, Ho W, Ramirez SH, et al. HIV-1 infection and alcohol abuse: Neurocognitive impairment, mechanisms of neurodegeneration and therapeutic interventions. Brain, Behavior, and Immunity. 2011; 25:S61–S70.

11. Weber E, Morgan EE, Iudicello JE, et al. Substance use is a risk factor for neurocognitive deficits and neuropsychiatric distress in acute and early HIV infection. Journal of Neurovirology. 2013; 19:65–74. [PubMed: 23250704]

12. Neuman MG, Monteiro M, Rehm J. Drug Interactions Between Psychoactive Substances and Antiretroviral Therapy in Individuals Infected With Human Immunodeficiency and Hepatitis Viruses. Substance Use & Misuse. 2006; 41:1395–1463. [PubMed: 17002989]

13. Barve S, Kapoor R, Moghe A, et al. Focus on the liver: Alcohol use, highly active antiretroviral therapy, and liver disease in HIV-infected patients. Alcohol Research & Health. 2010; 33:229–236. [PubMed: 23584064]

14. Braithwaite RS, Bryant KJ. Influence of alcohol consumption on adherence to and toxicity of antiretroviral therapy and survival. Alcohol Research & Health. 2010; 33:280–287. [PubMed: 23584069]

15. Salmon-Ceron D, Lewden C, Morlat P, et al. Liver disease as a major cause of death among HIV infected patients: role of hepatitis C and B viruses and alcohol. Journal Of Hepatology. 2005; 42:799–805. [PubMed: 15973779]

16. Matthews GV, Rockstroh J. HIV and hepatitis C coinfection. Current Opinion In HIV And AIDS. 2011; 6:449–450. [PubMed: 22001889]

17. Ferrari LF, Levine JD. Alcohol consumption enhances antiretroviral painful peripheral neuropathy by mitochondrial mechanisms. European Journal of Neuroscience. 2010; 32:811–818. [PubMed: 20726883]

18. Braithwaite RS, McGinnis KA, Conigliaro J, et al. A temporal and dose-response association between alcohol consumption and medication adherence among veterans in care. Alcoholism, Clinical And Experimental Research. 2005; 29:1190–1197.

19. Grierson J, Koelmeyer RL, Smith A, Pitts M. Adherence to antiretroviral therapy: factors independently associated with reported difficulty taking antiretroviral therapy in a national sample of HIV-positive Australians. HIV Medicine. 2011; 12:562–569. [PubMed: 21554524]

20. Carrieri MP, Spire B, Lert F, Michel L. Time to combine intervention with prevention in countries where HIV is also driven by hazardous drinking. Addiction. 2013; 108:221–222. [PubMed: 22900983]

21. Hendershot CS, Stoner SA, Pantalone DW, Simoni JM. Alcohol use and antiretroviral adherence: review and meta-analysis. Journal Of Acquired Immune Deficiency Syndromes. 2009; 52:180–202. [PubMed: 19668086]

22. Samet JH, Horton NJ, Meli S, Freedberg KA, Palepu A. Alcohol consumption and antiretroviral adherence among HIV-infected persons with alcohol problems. Alcoholism, Clinical And Experimental Research. 2004; 28:572–577.

23. Balfour L, Kowal J, Silverman A, et al. A randomized controlled psycho-education intervention trial: Improving psychological readiness for successful HIV medication adherence and reducing depression before initiating HAART. AIDS Care. 2006; 18:830–838. [PubMed: 16971295]

24. Paterson DL, Swindells S, Mohr J, et al. Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. Annals of Internal Medicine. 2000; 133:21–30. [PubMed: 10877736]

25. Clavel F, Hance AJ. HIV drug resistance. The New England Journal Of Medicine. 2004; 350:1023–1035. [PubMed: 14999114]

26. Simoni JM, Montgomery A, Martin E, et al. Adherence to antiretroviral therapy for pediatric HIV infection: a qualitative systematic review with recommendations for research and clinical management. Pediatrics. 2007; 119:e1371–e1383. [PubMed: 17533177]

27. Moore DM, Zhang W, Yip B, et al. Non-medically supervised treatment interruptions among participants in a universally accessible antiretroviral therapy programme. HIV Medicine. 2010; 11:299–307. [PubMed: 20002777]

28. Yuan Y, L'Italien G, Mukherjee J, Iloeje UH. Determinants of discontinuation of initial highly active antiretroviral therapy regimens in a US HIV-infected patient cohort. HIV Medicine. 2006; 7:156–162. [PubMed: 16494629]

*29. Azar MM, Springer SA, Meyer JP, Altice FL. A systematic review of the impact of alcohol use disorders on HIV treatment outcomes, adherence to antiretroviral therapy and health care utilization. Drug and Alcohol Dependence. 2010; 112:178–193. This paper provides a review of the effects of alcohol use disorders among HIV-infected individuals on antiretroviral medication adherence, health care utilization, and biological endpoints. [PubMed: 20705402]

30. Samet JH, Cheng DM, Libman H, et al. Alcohol Consumption and HIV Disease Progression. JAIDS: Journal of Acquired Immune Deficiency Syndromes. 2007; 46:194–199.

31. Cunningham WE, Sohler NL, Tobias C, et al. Health services utilization for people with HIV infection: comparison of a population targeted for outreach with the U.S. population in care. Medical Care. 2006; 44:1038–1047. [PubMed: 17063136]

32. Kim TW, Kertesz SG, Horton NJ, Tibbetts N, Samet JH. Episodic homelessness and health care utilization in a prospective cohort of HIV-infected persons with alcohol problems. BMC Health Services Research. 2006; 6:19–19. [PubMed: 16504167]

33. Gordon AJ, McGinnis KA, Conigliaro J, et al. Associations between alcohol use and homelessness with healthcare utilization among human immunodeficiency virus-infected veterans. Medical Care. 2006; 44:S37–S43. [PubMed: 16849967]

34. Theall KP, Amedee A, Clark RA, Dumestre J, Kissinger P. Alcohol consumption and HIV-1 vaginal RNA shedding among women. Journal of Studies on Alcohol and Drugs. 2008; 69:454–458. [PubMed: 18432389]

35. Homans J, Christensen S, Stiller T, et al. Permissive and protective factors associated with presence, level, and longitudinal pattern of cervicovaginal HIV shedding. Journal Of Acquired Immune Deficiency Syndromes. 2012; 60:99–110. [PubMed: 22517416]

36. Stein M, Herman DS, Trisvan E, et al. Alcohol Use and Sexual Risk Behavior Among Human Immunodeficiency Virus-Positive Persons. Alcoholism: Clinical and Experimental Research. 2005; 29:837–843.

37. Hasse B, Ledergerber B, Hirschel B, et al. Frequency and Determinants of Unprotected Sex among HIV-Infected Persons: The Swiss HIV Cohort Study. Clinical Infectious Diseases. 2010; 51:1314–1322. [PubMed: 21034200]

38. Dirks H, Esser S, Borgmann R, et al. Substance use and sexual risk behaviour among HIV-positive men who have sex with men in specialized out-patient clinics. HIV Medicine. 2012; 13:533–540. [PubMed: 22435363]

39. Theall KP, Clark RA, Powell A, Smith H, Kissinger P. Alcohol consumption, ART usage and high-risk sex among women infected with HIV. AIDS and Behavior. 2007; 11:205–215. [PubMed: 16897350]

40. Saggurti N, Raj A, Mahapatra B, et al. Prevalence and correlates of non-disclosure of HIV serostatus to sex partners among HIV-infected female sex workers and HIV-infected male clients of female sex workers in India. AIDS and Behavior. 2013; 17:399–406. [PubMed: 22810892]

**41. Samet JH, Walley AY. Interventions Targeting HIV-Infected Risky Drinkers: Drops in the Bottle. Alcohol Research & Health. 2010; 33:267–279. This paper conducted a review of studies with HIV-infected individuals with past or current unhealthy alcohol use and studies with samples comprised of 10% or more currently using alcohol. [PubMed: 23584068]

42. Aharonovich E, Hatzenbuehler ML, Johnston B, et al. A low-cost, sustainable intervention for drinking reduction in the HIV primary care setting. AIDS Care. 2006; 18:561–568. [PubMed: 16831783]

43. Murphy DA, Chen X, Naar-King S, Parsons JT. Alcohol and marijuana use outcomes in the Healthy Choices motivational interviewing intervention for HIV-positive youth. AIDS Patient Care and STDs. 2012; 26:95–100. [PubMed: 22191456]

44. Parsons JT, Golub SA, Rosof E, Holder C. Motivational interviewing and cognitive-behavioral intervention to improve HIV medication adherence among hazardous drinkers: a randomized controlled trial. Journal Of Acquired Immune Deficiency Syndromes. 2007; 46:443–450. [PubMed: 18077833]

45. Velasquez MM, von Sternberg K, Johnson DH, et al. Reducing sexual risk behaviors and alcohol use among HIV-positive men who have sex with men: A randomized clinical trial. Journal of Consulting and Clinical Psychology. 2009; 77:657–667. [PubMed: 19634959]

46. Gilbert P, Ciccarone D, Gansky SA, et al. Interactive "Video Doctor" counseling reduces drug and sexual risk behaviors among HIV-positive patients in diverse outpatient settings. Plos One. 2008; 3:e1988–e1988. [PubMed: 18431475]

47. Naar-King S, Wright K, Parsons JT, et al. Healthy Choices: Motivational enhancement therapy for health risk behaviors in HIV-positive youth. AIDS Education & Prevention. 2006; 18:1–11. [PubMed: 16539572]

48. Naar-King S, Lam P, Wang B, et al. Brief report: maintenance of effects of motivational enhancement therapy to improve risk behaviors and HIV-related Health in a randomized controlled trial of youth living with HIV. Journal Of Pediatric Psychology. 2008; 33:441–445. [PubMed: 17905800]

49. Samet JH, Horton NJ, Meli S, et al. A randomized controlled trial to enhance antiretroviral therapy adherence in patients with a history of alcohol problems. Antiviral Therapy. 2005; 10:83–93. [PubMed: 15751766]

50. Meade CS, Drabkin AS, Hansen NB, et al. Reductions in alcohol and cocaine use following a group coping intervention for HIV-positive adults with childhood sexual abuse histories. Addiction. 2010; 105:1942–1951. [PubMed: 20840176]

51. Papas RK, Sidle JE, Gakinya BN, et al. Treatment outcomes of a stage 1 cognitive-behavioral trial to reduce alcohol use among human immunodeficiency virus-infected out-patients in western Kenya. Addiction. 2011; 106:2156–2166. [PubMed: 21631622]

52. Jones DL, Weiss SM, Chitalu N, et al. Sexual Risk Intervention In Multiethnic Drug And Alcohol Users. American Journal Of Infectious Diseases. 2007; 3:169–176. [PubMed: 18629378]

53. Wong FL, Rotheram-Borus MJ, Lightfoot M, et al. Effects of behavioral intervention on substance use among people living with HIV: the Healthy Living Project randomized controlled study. Addiction. 2008; 103:1206–1214. [PubMed: 18494840]

54. Rotheram-Borus MJ, Lee MB, Murphy DA, et al. Efficacy of a preventive intervention for youths living with HIV. American Journal of Public Health. 2001; 91:400–405. [PubMed: 11236404]

55. Rotheram-Borus MJ, Swendeman D, Comulada WS, et al. Prevention for substance-using HIV-positive young people: telephone and in-person delivery. Journal Of Acquired Immune Deficiency Syndromes 1999. 2004; 37(Suppl 2):S68–77. [PubMed: 15385902]

56. Rotheram-Borus MJ, Desmond K, Comulada WS, Arnold EM, Johnson M. Reducing risky sexual behavior and substance use among currently and formerly homeless adults living with HIV. American Journal of Public Health. 2009; 99:1100–1107. [PubMed: 18799777]

57. Sorensen JL, Dilley J, London J, et al. Case management for substance abusers with HIV/AIDS: a randomized clinical trial. The American Journal of Drug and Alcohol Abuse. 2003; 29:133–150. [PubMed: 12731685]

58. Schroder KE, Carey MP, Vanable PA. Methodological challenges in research on sexual risk behavior: II. Accuracy of self-reports. Annals of Behavioral Medicine. 2003; 26:104–123. [PubMed: 14534028]

59. Catania JA, Gibson DR, Chitwood DD, Coates TJ. Methodological problems in AIDS behavioral research: influences on measurement error and participation bias in studies of sexual behavior. Psychol Bull. 1990; 108:339–362. [PubMed: 2270232]

60. Weinhardt LS, Forsyth AD, Carey MP, Jaworski BC, Durant LE. Reliability and validity of self-report measures of HIV-related sexual behavior: progress since 1990 and recommendations for research and practice. Archives of Sexual Behavior. 1998; 27:155–180. [PubMed: 9562899]

61. Midanik LT. Validity of self-reported alcohol use: a literature review and assessment. British Journal of Addiction. 1988; 83:1019–1030. [PubMed: 3066418]

62. Fiellin DA, McGinnis KA, Maisto SA, Justice AC, Bryant K. Measuring alcohol consumption using Timeline Followback in non-treatment-seeking medical clinic patients with and without HIV infection: 7-, 14-, or 30-day recall. Journal of Studies on Alcohol and Drugs. 2013; 74:500–504. [PubMed: 23490581]

63. Shiffman S. Ecological momentary assessment (EMA) in studies of substance use. Psychological Assessment. 2009; 21:486–497. [PubMed: 19947783]

64. Jones J, Jones M, Plate C, et al. Liquid Chromatography-Tandem Mass Spectrometry Assay to Detect Ethyl Glucuronide in Human Fingernail: Comparison to Hair and Gender Differences. American Journal of Analytical Chemistry. 2012; 3:83–91.

65. Junghanns K, Graf I, Pflüger J, et al. Urinary ethyl glucuronide (EtG) and ethyl sulphate (EtS) assessment: Valuable tools to improve verification of abstention in alcohol-dependent patients during in-patient treatment and at follow-ups. Addiction. 2009; 104:921–926. [PubMed: 19466918]

66. Bower, JE.; Kemeny, ME.; Fawzy, FI. Group interventions for individuals with serious medical illness. In: Chesney, M.; Antoni, MH., editors. Innovative approaches to health psychology: Prevention and treatment lessons from AIDS. Washington D.C: American Psychological Association; 2002. p. 197-218.

67. Kalichman, SC.; Catz, SL. Stressors in HIV infection. In: Nott, KH.; Vedhara, K., editors. Psychosocial and biomedical interactions in HIV infection. Amsterdam Netherlands: Harwood Academic Publishers; 2000. p. 31-60.

68. Riper H, van Straten A, Keuken M, et al. Curbing problem drinking with personalized-feedback interventions: A meta-analysis. American Journal of Preventive Medicine. 2009; 36:247–255. [PubMed: 19215850]

69. McGinn LK, Sanderson WC. What allows cognitive behavioral therapy to be brief: Overview, efficacy, and crucial factors facilitating brief treatment. Clinical Psychology: Science and Practice. 2001; 8:23–37.

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Table 1

Overview of studies' sample characteristics, alcohol-related inclusion criteria, study design, intervention components, and assessment time points

Study Citations	Sample Size by Gender (Sample size included in analyses); Ethnicity	Alcohol Inclusion Criteria	Study Conditions	RCT	Number (Length) of Intervention Sessions	Core Intervention Components	Assessment Time Points
(42)	N = 25 men, 5 women; 52% Hispanic, 39% African-American, 7% Caucasian, 3% Other	✓	E: Individual AU + Daily phone calls		E: 1 (30 min) + 90 phone calls	MI	Pre, daily self-report over 3 mos, 1 mos, 2 mos
(43)	N = 74 men, 41 women; 78% African American, 9% Hispanic, 4% Caucasian, 8% Other	✓	E: Individual AU, SU, RR C: WLC	✓	E: 4 (60 min)	MI, RR	Pre, 3 mos, 6 mos, 9 mos, 12 mos, 15 mos
(44)	N = 103 male, 27 women; 66% African American, 18% Hispanic, 6% Caucasian, 11% Other	✓	E: Individual MAT, AU C: Individual MAT, AU: Education only	✓	E: 8 (60 min) C: 8 (60 min)	MI, CBT	Pre, 3 mos, 6 mos
(45)	N = 253 men; 54% African American, 20% Hispanic, 17% Caucasian, 9% Other	✓	E: Group + Individual AU, RR C: Referral information	✓	E: 4 Group (Length NR) + 4 Individual (Length NR)	SOC, MI, RR	Pre, 3 mos, 6 mos, 9 mos, 12 mos
(46)	N = 370 men, 101 women; 50% African American, 29% Caucasian, 13% Hispanic, 8% Other	✓	E: Computerized SU, AU, RR C: TAU	✓	E: 1 (30 min) + 1 booster at 3 mos (NR)	MI, SOC	Pre, 3 mos, 6 mos
(47, 48)	N = 34 men, 30 women, 1 transgendered; 88% African American, 3% Caucasian, 2% Hispanic, 8% Other	✓	E: Individual SU, AU, RR, MAT C: WLC	✓	E: 4 (60 min)	MI, CBT	Pre, 3 mos, 6 mos, 9 mos
(49)	N = 123 men, 28 women; 30% Caucasian, 47% African American, 23% Other	✓	E: Individual MAT, SU, AU C: TAU	✓	E: 1 (60 min) + 1 (30–45 min) at 3 weeks + 1 (15–30 min) at 1 mos + 1 (15–30 min) at 3 mos	MI	Pre, 1 mos, 2 mos, 3 mos, 6 mos, 12 mos, 13 mos
(50)	N = 130 women, 117 men; 68% African American, 17% Hispanic, 10% Caucasian		E: Group SM C: Support group	✓	E: 15 (90 min) C: 15 (90 min)	CBT, SM	Pre, post, 4 mos, 8 mos, 12 mos

Study Citations	Sample Size by Gender (Sample size included in analyses); Ethnicity	Alcohol Inclusion Criteria	Study Conditions	RCT	Number (Length) of Intervention Sessions	Core Intervention Components	Assessment Time Points
(51)	$N = 75$, Gender NR; Ethnicity NR	✓	E: Group AU C: TAU	✓	E: 6 (90 min)	CBT	Pre, post, 1 mos, 2 mos, 3 mos
(52)	US sample: $N = 187$ women; 73% African American, 9% Hispanic, 8% Caucasian, 4% Haitian, 8% Other Zambia sample: $N = 303$ men; 32% Ngoni/Nsenga/Tumbaka, 30% Bemba, 16% Tonga/Mambwe/Namwanya, 22% Other		E: Group RR C: Individual RR	✓	E: 3 (120 min) C: 3 (120 min)	RR	Pre, 6 mos, 12 mos
(53)	$N = 739$ men, 197 women; 45% African American, 32% Caucasian, 15% Hispanic, 8% Other		E: Individual SM, RR, SU, MAT C: WLC	✓	E: 5 (90 min)	CM, SM, RR	Pre, 5 mos, 10 mos, 15 mos, 20 mos, 25 mos
(54)	$N = 224$ men, 86 women; 27% African American, 37% Hispanic, 19% Caucasian, 17% Other		E: Group SU, AU, RR C: WLC	✓	E: 23 (120 min)	RR	Pre, 9 mos, 15 mos
(55)	$N = 137$ men, 38 women; 42% Hispanic, 26% African American, 23% Caucasian, 8% Other		E: Individual SU, AU, RR (in person) C1: Individual SU, AU, RR (by phone) C2: WLC	✓	E: 18 (120 min) C1: 18 (120 min)	RR	Pre, 3 mos, 6 mos, 9 mos, 15 mos
(56)[†]	$N = 216$ men, 54 women; 26% Caucasian, 56% African American, 12% Hispanic, 7% Other		E: Individual SU, AU, RR, SM C: WLC	✓	E: 15 (90 min)	CM, SM, RR	Pre, 5 mos, 10 mos, 15 mos, 20 mos, 25 mos
(57)	$N = 139$ men, 51 women; 43% African American, 42% Caucasian, 7% Hispanic, 8% Other	✓	E: Individual AU, SU, RR C: Brief education and referral	✓	E: CM over 12 mos (Number and length of sessions NR)	CM	Pre, 6 mos, 12 mos, 18 mos

Notes: When multiple papers were written on a single intervention trial, study citation numbers for these papers are listed in succession.

[†]This study conducted a subset analysis from (53).

NR: Not reported; E: Experimental condition; C: Comparison/control condition; AU: Alcohol Use reduction intervention content; SU: Substance Use reduction intervention content; RR: Risk Reduction for sexual risk and HIV transmission risk behaviors; SM: Stress Management; MAT: Medication Adherence Training; WLC: Wait-list-control; TAU: Treatment As Usual; RCT: Randomized

Controlled Trial; min: Minutes; MI: Motivational Interviewing; CBT: Cognitive Behavioral Therapy; SOC: Stages of Change; CM: Case Management; Pre: Pre-intervention assessment; Post: Immediate post-intervention assessment; mos: Months.

Table 2

Type and description of alcohol use measures included in the reviewed studies

Study Citations	Alcohol Frequency	Alcohol Quantity	Alcohol Measures Binge Drinking	Abuse or Dependence	Other
(42)	• Past week • Past month	• Past week • Past month			
(43)	• Past week	• Past week			• Alcohol and marijuana risk groups: Low-risk, Moderate-risk, High-risk (based on frequency of use)
(44)	• Past 2 weeks	• Past 2 weeks • Past 2 weeks: # total drinks/# drinking days			
(45)	• Past month	• Past month	• Past month: (5 or more drinks per occasion)		• Past month: Drinking and unprotected sex
(46)			• Past week: > 14 drinks for men • Past week: > 7 drinks for women • Past 3 months: Number of binge drinking occasions (5 or more drinks for men; 4 or more drinks for women)		
(47, 48)		• Past week: Most number of drinks			
(49)	• Past month	• Past month (maximum number per day) • Past month: Average # drinks:	• Past month: Hazardous drinking (3 or more drinks per occasion for women; 4 or more	• Addiction Severity Index	

Alcohol Measures

Study Citations	Alcohol Frequency	Alcohol Quantity	Binge Drinking	Abuse or Dependence	Other
		Quantity/ frequency	drinks per occasion for men)		
(50)	• Past month	• Typical number of drinks per occasion	• Past month: >28 drinks for women (3 or more drinks per occasion)		
		• Past month: Frequency of drinking past month x Typical number of drinks	• Past month: >56 drinks for men (4 or more drinks per occasion for men)		
			• Level of drinking: None, moderate (less than binge level), hazardous (binge level)		
(51)	• Past month	• Past month			
(52)					• Risk index: Alcohol use, drug use, sexual risk
(53)	• Past three months: Alcohol or marijuana				
	• Past three months: weight by substance (0: none, 1: alcohol, 2: marijuana, 3, 4: other substances)				
(54)	• Past 3 months (dichotomous measure; dichotomous alcohol or marijuana)				• Number of drugs used (including alcohol)
(55)				• 2 or more symptoms of dependency	• Number of drugs used (including alcohol)
(56) [†]	• Past 3 months (alcohol or marijuana)				

Alcohol Measures

Study Citations	Alcohol Frequency	Alcohol Quantity	Binge Drinking	Abuse or Dependence	Other
(57)				• Addiction Severity Index	

Notes: When multiple papers were written on a single intervention trial, study citation numbers for these papers are listed in succession.

†This study conducted a subset analysis from (53).

Table 3

Interventions' impact on alcohol use outcomes

Study Citations	Alcohol Measures				
	Alcohol Frequency	Alcohol Quantity	Binge Drinking	Abuse or Dependence	Other
(42)	Within Subjects: • E no decreased alcohol frequency at 1 mos. • E decreased alcohol frequency at 2 mos.	Within Subjects: • E decreased alcohol quantity at 1 mos, 2 mos.	N/A	N/A	N/A
(43)	Between Subjects: • E lower alcohol frequency relative to C.	N/A	N/A	N/A	Between Subjects: • E reduced likelihood of High-risk group membership (based on alcohol and marijuana use) than C.
(44)	Within Subjects: • E and C decreased alcohol frequency over time. Between Subjects: • No difference between E and C for alcohol frequency.	Within Subjects: • E and C decreased alcohol quantity over time. Between Subjects: • No difference between E and C for alcohol frequency.	N/A	N/A	N/A
(45)	Within Subjects: • E and C decreased alcohol frequency over time. Between Subjects: • E decreased alcohol frequency relative to C.	Within Subjects: • E and C decreased alcohol quantity over time. Between Subjects: • No difference between E and C for alcohol frequency.	Within Subjects: • E and C decreased binge drinking frequency over time. Between Subjects: • E decreased binge drinking frequency relative to C.	N/A	Between Subjects: • E decreased alcohol and unprotected sex relative to C for those who reported drinking/ unprotected sex at baseline.
(46)	N/A	N/A	Between Subjects: • No difference between E and C at for binge	N/A	N/A

Study Citations	Alcohol Measures				
	Alcohol Frequency	Alcohol Quantity	Binge Drinking	Abuse or Dependence	Other
(47, 48)	N/A	Within Subjects: • E continued decrease in quantity from 6 mos to 9 mos Between Subjects: • E decreased alcohol quantity relative to C.	N/A	N/A	N/A
(49)	Between Subjects: • No difference between E and C for alcohol frequency.	Between Subjects: • No difference between E and C for alcohol quantity.	Between Subjects: • No difference between E and C for binge drinking frequency.	Between Subjects: • No difference between E and C on Addiction Severity Index.	N/A
(50)	N/A	Within Subjects: • E and C decreased alcohol quantity over time. Between Subjects: • E reduced alcohol quantity relative to C (significant time x condition interaction).	Within Subjects: • E and C decreased binge drinking frequency over time. Between Subjects: • No difference between E and C for binge drinking frequency (time x condition interaction *ns*)	N/A	N/A
(51)	Between Subjects: • E had reduced percentage of drinking days relative to C. • E had higher alcohol abstinence prevalence relative to C.	Between Subjects: • E had reduced alcohol quantity relative to C.	N/A	N/A	N/A
(52)	N/A	N/A	N/A	N/A	Within Subjects: • US and Zambia sample: Both E and C drinking frequency.

Alcohol Measures

Study Citations	Alcohol Frequency	Alcohol Quantity	Binge Drinking	Abuse or Dependence	Other
					decreased combined alcohol, drug, sex risk outcome over time Between Subjects: • US and Zambia samples: No difference between E and C for combined alcohol, drug, sex risk outcome
(53)	Between Subjects: • E reduced alcohol or marijuana use relative to C.	N/A	N/A	N/A	N/A
(54)	Within Subjects: • E reduced alcohol or marijuana frequency among E attendees. Between Subjects: • No difference between E and C for alcohol or marijuana frequency.	N/A	N/A	N/A	Within Subjects: • No reduction in number of drugs among E attendees. Between Subjects: • No difference between E and C for number of drugs used.
(55)	N/A	N/A	N/A	Between Subjects: • No difference between E and C for 2 or more symptoms of dependency	Between Subjects: • E: No difference between E and C for number of drugs used
(56) [†]	Between Subjects: • E reduced alcohol or marijuana use frequency over relative to C.	N/A	N/A	N/A	N/A
(57)	N/A	N/A	N/A	Within Subjects: • E and C decreased on Addiction Severity Index.	N/A

Alcohol Measures

Study Citations	Alcohol Frequency	Alcohol Quantity	Binge Drinking	Abuse or Dependence	Other
				Between Subjects:	
				• No difference between E and C on Addiction Severity Index.	

Notes: When multiple papers were written on a single intervention trial, study citation numbers for these papers are listed in succession.

†This study conducted a subset analysis from (53).

N/A: Not applicable because the study did not assess that alcohol measure. E: Experimental intervention condition; C: Comparison/control condition; mos: Months; *ns*: Not significant