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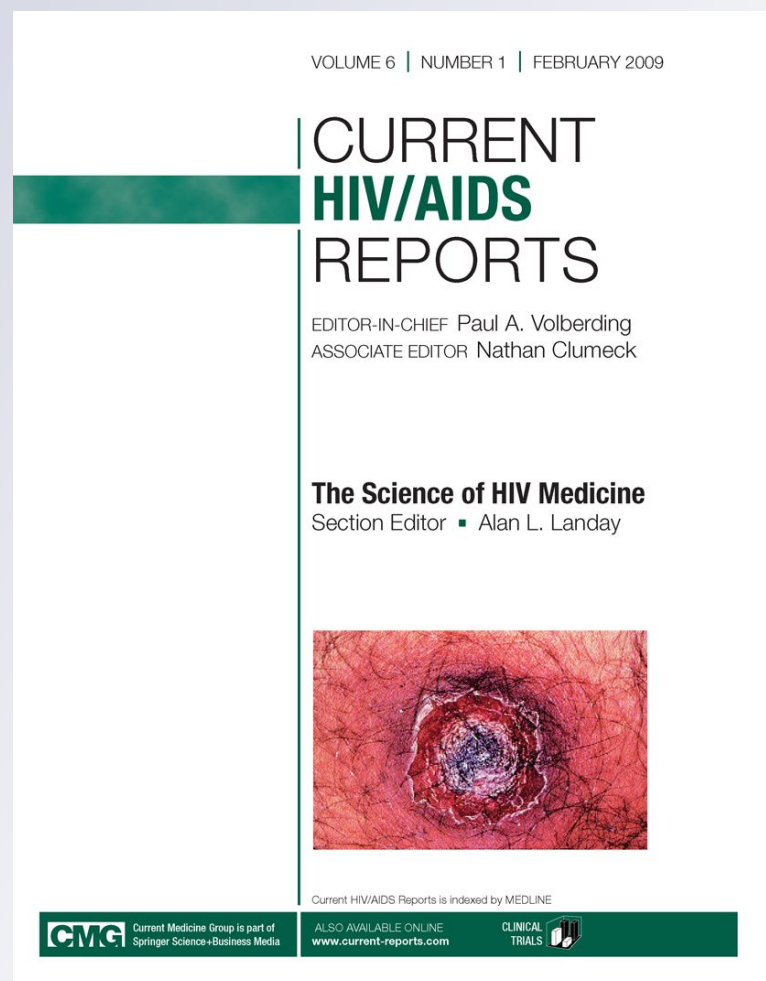
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Adding Fuel to the Fire: Alcohol's Effect on the HIV Epidemic in Sub-Saharan Africa

Judith A. Hahn · Sarah E. Woolf-King · Winnie Muyindike

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Abstract Alcohol consumption adds fuel to the HIV epidemic in sub-Saharan Africa (SSA). SSA has the highest prevalence of HIV infection and heavy episodic drinking in the world. Alcohol consumption is associated with behaviors such as unprotected sex and poor medication adherence, and biological factors such as increased susceptibility to infection, comorbid conditions, and infectiousness, which may synergistically increase HIV acquisition and onward transmission. Few interventions to decrease alcohol consumption and alcohol-related sexual risk behaviors have been developed or implemented in SSA, and few HIV or health policies or services in SSA address alcohol consumption. Structural interventions, such as regulating the availability, price, and advertising of alcohol, are challenging to implement due to the preponderance of homemade alcohol and beverage industry resistance. This article reviews the current knowledge on how alcohol impacts the HIV epidemic in SSA,

summarizes current interventions and policies, and identifies areas for increased research and development.

Keywords Alcohol consumption · HIV · Sub-Saharan Africa · Unprotected sex · HIV acquisition · HIV transmission · Alcohol biomarkers · Antiretrovirals · Antiretroviral adherence · HIV disease progression · Alcohol treatment · Alcohol policy

Introduction

Sub-Saharan Africa (SSA) has the highest prevalence of HIV infection in the world (5% overall), with an estimated rate of 1.9 million new infections per year [1]. The areas with the highest prevalence of HIV are South and East Africa, with the highest prevalence of HIV in Swaziland (25.9%). However, while prevalence is somewhat lower in West Africa, there are a large number of persons infected, such as in Nigeria (3.6 million persons) due to the high population size.

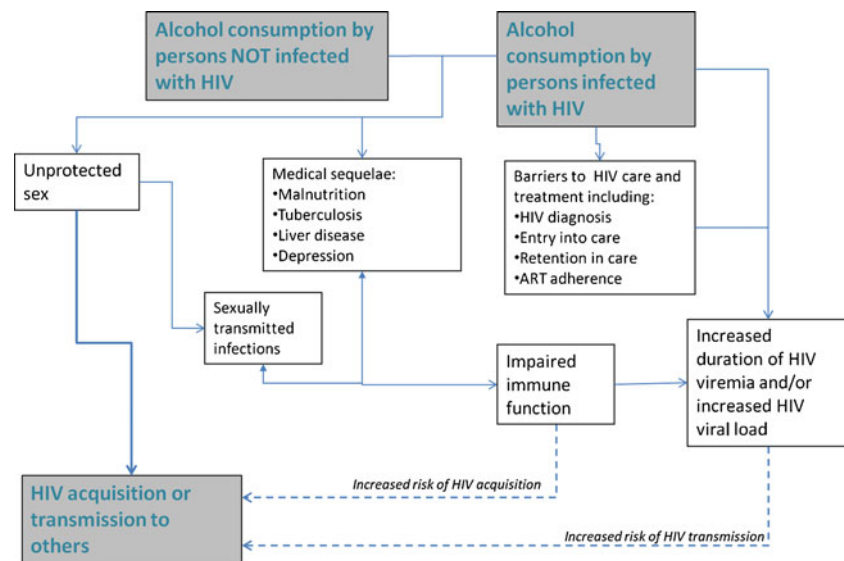
Alcohol consumption is a growing health concern worldwide, and the prevalence of heavy episodic drinking among drinkers is the highest in Africa [2•]. Alcohol consumption likely has a large impact on the HIV epidemic in SSA via behavioral pathways such as sexual risk-taking behaviors and decreased self-care behaviors such as poor medication adherence (Fig. 1). Alcohol may also impact biological pathways such as impaired immunity, which can increase susceptibility to HIV infection as well as other infections and accelerate HIV disease progression once infected. In this article we describe the state of knowledge of the behavioral and biological effects of alcohol consumption on the HIV epidemic in SSA, and review current strategies for decreasing alcohol consumption and alcohol-related sexual risk behavior in SSA.

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Fig. 1 The potential impact of alcohol consumption on HIV acquisition and HIV transmission. Alcohol consumption can directly impact HIV acquisition and transmission via sexual risk behavior, but may also increase the risk via co-infections that affect the immune system as well as decreased access to medical care and adherence to antiretroviral therapy (ART)



Patterns of Alcohol Consumption in Sub-Saharan Africa

Alcohol consumption is a major cause of morbidity and mortality worldwide, and almost 4% of deaths worldwide are attributed to alcohol consumption, as reported in the World Health Organization (WHO) 2011 Global Status Report on Alcohol and Health [2•]. The WHO divides countries into six regions, and the Africa Region is comprised of most of the countries in sub-Saharan Africa, while the Eastern Mediterranean Region includes the countries of North Africa. The overall per capita adult (age >15 years) level of alcohol consumption in the Africa Region is 6.15 L of pure alcohol per year. This amount of pure alcohol translates into 120 L of 5% alcohol by volume (ABV) beer or 15.4 L of 40% ABV spirits. The per capita adult alcohol consumption figure for the Africa Region (6.15 L) is close to the worldwide average of 6.13 L per capita per year. However, because an estimated 70.8% of adults 15 years and older in the African region are past year abstainers, the per capita alcohol consumption in this region is 21.1 L of pure alcohol per year among those who do not abstain from drinking. Nevertheless, there is large variability in alcohol consumption by country in this area, with the per capita alcohol consumption among drinkers ranging from 3.7 to 37 L of pure alcohol [2•]. Heavy episodic drinking, defined as drinking 60 g or more of pure alcohol in one occasion, is estimated to occur weekly in 25% of drinkers in the Africa Region. This prevalence is the highest of the six WHO regions, and well above the world estimate of 11.5% of drinkers engaging in heavy episodic drinking at least weekly. Heavy episodic drinking is reported to be on the rise in a population-based sample in South Africa [3].

There are some notable patterns of alcohol consumption in the WHO Africa Region by sex and religion. Overall, a higher

proportion of women compared to men abstain (78.1% vs 63.1%, respectively) and Muslims, who make up 29.6% of the population in sub-Saharan Africa [4], are forbidden by religious law from drinking alcohol. The total level of alcohol consumption is low (< 2.5 L of pure alcohol per capita) in countries that are predominantly (> 75%) Muslim; however, among those who do consume alcohol, the level of alcohol consumption is frequently high [5].

Measurement of Alcohol Consumption in SSA

The WHO report states that 31.4% of alcohol consumption in the Africa Region is from unrecorded alcohol, ie, alcohol produced outside of the formal commercial channels and not reported to the government [2•]. Such alcohol is usually homemade; brewed, fermented, or distilled from locally grown grains or fruits. The amount of unrecorded alcohol consumption in the WHO report was estimated by comparing consumption survey data to commercial sales data [6]. However, surveys of alcohol consumption are limited by the fact that it is difficult to estimate the volume of absolute alcohol in homemade alcoholic beverages, because such drink sizes and alcohol concentrations may vary widely. Surveys of alcohol consumption, including all types of alcohol, may also be biased if participants under-report their alcohol consumption, due to stigma, gender roles, or religious beliefs. Groups for which alcohol consumption may be under-reported include women [7] and Muslims [5]. Persons with HIV on antiretroviral therapy (ART) may under-report their alcohol consumption in fear that the ART will be revoked [8]. Using a biomarker of heavy alcohol consumption that is very specific (ie, results in very few false positives), we estimated that approximately 15% of those starting ART in Mbarara, Uganda and

reporting no alcohol consumption had in fact engaged in heavy alcohol consumption in the prior month [9]. Therefore, we suggest that due to the difficulty in measuring alcohol consumption and in gaining accurate self-report, estimates for alcohol consumption in the Africa region should be viewed with caution.

The studies of the effect of alcohol consumption on the behavioral and biological outcomes in SSA reviewed below may also be subject to under-report and other difficulties in quantifying the volume of alcohol consumed. Research studies have utilized a wide variety of measures of alcohol consumption, making them difficult to compare. Measures of alcohol consumption typically include any alcohol consumed (yes/no), the quantity of alcohol consumed, whether a threshold for harmful or hazardous alcohol consumption was exceeded, and whether diagnostic criteria for alcohol abuse or dependence were met. Commonly used scales for determining hazardous alcohol consumption thresholds include the 10-question WHO Alcohol Use Disorders Identification Test (AUDIT) [10], and a shorter scale comprised of the first three questions of the AUDIT, known as the AUDIT-C [11]. The studies also used varying time periods for which alcohol consumption is reported, eg, 1 year or past month. Lastly, studies categorizing persons as current alcohol consumers versus others may be biased by including “sick quitters” with lifetime abstainers. Therefore, we caution that due to the difficulties in quantifying alcohol consumption in SSA, estimates of the effects of alcohol consumption on the HIV epidemic in SSA may be difficult to interpret.

Alcohol Consumption as a Risk Factor for Sexually Acquired HIV in SSA

The dominant mode of HIV transmission in SSA is through heterosexual sex. A large body of research in SSA has revealed a consistently strong correlation between alcohol use and high-risk sexual behavior [12, 13••], as well as associations with HIV infection [12, 13••, 14, 15]. A recent narrative review of the literature in SSA identified 86 empirical studies (16 qualitative, 70 quantitative) on the topic and revealed that alcohol consumption is associated with an increase in a variety of behaviors that enhance risk for HIV infection including unprotected sex, sex with multiple partners, transactional sex, and coercive sex [13••]. Consistent with these findings, a recent meta-analysis of the literature of studies conducted in SSA found that individuals who consume alcohol (compared to abstainers) have a higher odds of HIV infection (OR=1.57, 95% CI=1.42–1.72), with the odds of HIV infection in “problem drinkers,” using several definitions, twice that of non-drinkers (OR=2.04, 95% CI=1.61–2.58) [14].

Women often have additional risk for acquisition of HIV due to their male partners’ alcohol use, which is associated with decreased condom use, increased likelihood of sexual coercion and violence leading to unprotected sex, and increased pressure to engage in unprotected transactional sex [13••].

The research conducted to date has been dominated by cross-sectional research designs that typically correlate some measure of alcohol use with a measure of high-risk sexual behavior and/or with HIV infection status (ie, global association studies). It is arguable that these associations might also be attributable to personality traits, psychiatric disorders, and/or consumption of alcohol at drinking venues, because they are associated with both alcohol consumption and sexual risk behavior and HIV [16, 17]. Event-level studies, ie, studies that elicit reports of the alcohol consumed during a specific sexual event and the sexual risk behavior that occurred at that event, allow for investigation of the temporal association between alcohol consumption and high-risk sexual behavior and thus provide more definitive evidence of causality. To date, only two published event-level studies have occurred in SSA. Both of these found significant associations between alcohol consumption prior to sex and unprotected sex acts [18, 19]. More event-level data are needed in order to identify the mechanisms underlying the correlation between alcohol consumption and risk for acquiring or transmitting HIV. In the meantime, appropriate interventions targeting the co-occurring risks of alcohol use and high-risk sexual behavior that increases risk for HIV infection should be developed and implemented.

Alcohol Consumption as a Risk Factor for Reduced HIV Testing, Entry into Care, and Retention in Care Prior to Initiating ART

Initiating ART early in the course of HIV disease is an important factor in reducing HIV morbidity and mortality [20–22], as well as onward transmission to others [23]. However, a series of events that must occur before ART can be initiated, namely, HIV testing and diagnosis, linkage to HIV care, and retention in HIV care prior to ART initiation if immediate treatment is not available. Alcohol consumption is a potential barrier to health care utilization [24], yet, as we review below, little is known about how alcohol consumption affects utilization of HIV testing and care in SSA.

As of 2008, only 22% of persons aged 15–49 in SSA knew their HIV status [25]. Recognized barriers to HIV testing in SSA include low perceived risk of HIV infection, stigma, fear of being identified as infected with HIV, low accessibility of testing, and difficulty in returning for results

[26]. Yet few studies have addressed whether alcohol consumption is a barrier to HIV testing, or facilitates HIV testing via increased awareness of HIV risk. Among women attending antenatal care clinics in South Africa, increased alcohol consumption, as measured by the AUDIT-C, was associated with significantly decreased odds of HIV testing at prior antenatal visits in univariate but not multivariable analysis [27]. In contrast, in a study of high-risk women in South Africa, those who reported alcohol abuse within the past year (Diagnostic and Statistical Manual of Mental Disorders IV criteria) had higher odds of accepting HIV testing when offered as compared to those without alcohol abuse [28].

Alcohol use may also affect returning for HIV test results in places where rapid testing is not used. A study of pregnant women in Tanzania found that the odds of the women receiving their HIV test results 1 week after testing were significantly decreased for those reporting that they themselves or their partners consumed alcohol [29]. In addition, the odds of previously receiving HIV test results among women receiving antenatal care in South Africa decreased with increasing AUDIT-C score in multivariable analysis [27].

Linkage to care after diagnosis is also necessary for early and effective HIV care. A proxy for poor linkage to care and/or late HIV testing is advanced disease stage at initial clinic presentation. Few studies have reported on the association between late presentation and alcohol consumption in SSA, and the results have been mixed. On one hand, a case control study in an HIV clinic in Ethiopia found an association between late presentation (WHO HIV stage 3 or 4 or CD4 cell count < 200) and frequent alcohol consumption [30], while a cross sectional study of an HIV clinic in Uganda found that alcohol consumption in the past year was associated with presentation with early-stage HIV (WHO HIV stage 1 or 2) [31].

Retention in HIV care has also been recognized as a key predictor of improved HIV treatment outcomes [32] and decreased mortality [33, 34]. For those who enroll in HIV care before they are eligible for ART, retention in clinical care may be challenging. For example, 49%–89% of clinic patients in South Africa and Zambia who were not yet eligible for ART failed to return for care within 1 year of their initial clinic visit [35–37]. However, we are not aware of any study of the effects of alcohol consumption on retention in HIV care prior to initiating ART in SSA.

In summary, while some studies suggest that alcohol consumption may be a barrier to HIV testing, returning for HIV test results, and early linkage to care, there are other studies to the converse; therefore, more research is needed to better understand the relationship between alcohol consumption and utilization of HIV testing and HIV care.

Alcohol Consumption as a Risk Factor for Decreased ART Adherence

Suboptimal adherence to ART is the primary risk factor for lack of viral suppression and development of drug-resistant HIV viremia, and alcohol is an important barrier to ART adherence. A recent meta-analysis found that those who used alcohol or drank relatively more were 50%–60% less likely to be classified as adherent compared with those who abstained or drank relatively less [38]. However, none of the 40 studies in the meta-analysis were conducted in SSA [39]. Several recent quantitative and qualitative studies conducted in SSA have reported associations between alcohol consumption and ART adherence [39–50], while a few studies have found no association [51, 52] or did not measure or report on alcohol consumption [53, 54]. We echo the opinion that research focused on the effect of alcohol consumption on ART adherence specifically in SSA is needed [39], and note that careful consideration must be paid to methods of measuring alcohol consumption in this setting because under-report is likely [9]. We emphasize under-report because in a series of focus group meetings and key informant interviews in Kenya, Zambia, and Rwanda, discrepancies arose between reports by ART providers that alcohol problems in treatment are minimal, while patients reported that alcohol consumption on ART is common [8]. We also found surprisingly low levels of self-reported heavy alcohol consumption among those initiating ART in Uganda during the early phase of ART introduction [55]. We suggest that biological markers of alcohol consumption will be useful in examining the effect of alcohol consumption on ART adherence in SSA.

Alcohol Consumption may Increase Biological Susceptibility to and Transmissibility of HIV Infection

Alcohol consumption may affect susceptibility to HIV infection via several pathways (Fig. 1). First, alcohol consumption is associated with altered immune response, affecting several components of the innate and/or adaptive immune system, which may increase susceptibility to HIV infection [56]. Acute alcohol intake can depress or inhibit inflammatory pathway activation, while chronic alcohol consumption leads to increased proinflammatory responses. Both chronic and acute alcohol consumption lead to impaired adaptive immune response [56]. A recent study of adolescents in Cape Town showed that those with alcohol use disorders engaging in weekend drinking but no other substance use or psychiatric diagnoses ($n=18$), compared to light drinking or abstinent controls ($n=19$), had decreased T-lymphocyte counts, a condition that might make them susceptible to infections [57]. The impaired

immune response associated with alcohol consumption as well as behavioral factors increase susceptibility to other infections such as tuberculosis [58, 59] and sexually transmitted infections, and depression [60], malnutrition [61], and liver disease [62]. These conditions themselves may further depress the immune system and thus increase susceptibility to HIV infection.

Alcohol consumption may increase the infectivity of those infected with HIV via both biological and behavioral routes (Fig. 1). Alcohol consumption may increase immune activation and the rate of viral replication, and increase the concentration of HIV in the semen and in the vagina [63]. As discussed above, alcohol consumption may be associated with delayed entry into HIV care and decreased ART adherence, thereby increasing the duration that a patient is viremic and the cumulative risk of onward transmission. Also, as noted above, alcohol consumption is a risk factor for several conditions and co-infections that may also be associated with increased HIV viral load and therefore increased infectiousness and risk of transmission [64].

Alcohol Consumption as a Risk Factor for HIV Disease Progression

We recently reviewed the literature to examine the evidence for a biological effect of alcohol consumption on HIV disease progression, beyond the behavioral effect of alcohol consumption on ART adherence [65]. While several experimental studies have supported the evidence for an effect of heavy alcohol consumption on simian immunodeficiency virus progression in macaques, the results of human observational studies have been much more mixed. Of the several prospective studies conducted in the pre-highly active ART era [66–73], none found a positive association between alcohol consumption and the onset of AIDS, and three more recent studies found no association between heavy alcohol consumption and CD4 cell count or HIV viral load after controlling for ART use [74–76]. On the other hand, two prospective studies that examined those *not on ART* found that heavy alcohol consumption was associated with lower CD4 cell count [77] and shorter time to CD4 cell count <200 cells/mm³ [78]. Only one study of this issue was conducted in Africa [73]. Therefore, this question is unresolved, and more work is needed, especially in SSA, where both HIV and heavy alcohol consumption are common.

Individual and Peer-Based Interventions

While studies have consistently found a link between alcohol consumption and sexual risk for HIV, only a small

number of behavioral interventions to reduce sexual risk behavior in SSA have explicitly addressed alcohol use in sexual contexts. The studies were conducted among several populations: persons testing positive for HIV at counseling and testing sites [79], sexually transmitted infection clinic patients [80], drug-using women [81] and drug-using women who traded sex [82], and drinking establishment patrons [83, 84]. All of these studies found significant decreases in various measures of sexual risk behavior and some reported decreases in alcohol consumption after conducting the intervention [79, 81, 82]. However, the conclusions from these studies are somewhat limited for several reasons. First, the follow-up period for the studies ranged from 1 month to 1 year, and the study effects appear to have dissipated as the follow-up time increased. In one study the differences in unprotected sex and alcohol use before sex between the study arms found at 3 months dissipated by 6 months in a study with 6 months of follow-up [83]. In another study, the differences between study arms in unprotected sex persisted at 6 months but the differences in consuming alcohol before sex did not persist [80]. A large study of a peer-delivered intervention found significant decreases in sexual risk behavior overall; however, there were no differences between the intervention and the control groups 1 year after implementation of the intervention [84]. Another limitation is that two of the studies had no untreated control groups [79, 81], so it is not possible to determine whether the observed reductions in risk behavior would have occurred in the absence of the interventions.

While alcohol-related sexual risk behavior reduction is needed, it is also important to determine ways to reduce alcohol consumption itself due to its multifactorial effect on the HIV epidemic in SSA (Fig. 1). Several effective measures to reduce alcohol consumption are widely available in the US; however, few have been examined or implemented in SSA [85]. One approach, cognitive behavioral therapy, was recently tested in a stage 1 trial of feasibility in Kenya [86••]. The intervention, delivered over a 6-week period to persons in HIV care by paraprofessionals, showed significant reductions 90 days after completion in percent drinking days and drinks per day compared to usual care [86••]. Other approaches, such as support groups and 12-step programs exist in some of the large urban areas in SSA, but are not widespread [8]. Brief interventions, ie, client-focused counseling to reduce alcohol consumption, have been highly effective in many settings [87]. In SSA, brief interventions that are integrated into HIV testing and counseling [79, 88] and primary care [89–91] have shown feasibility, but are still in early stages of development and implementation. With increased attention being paid to “Seek, Test, and Treat” as a way to end the HIV epidemic that relies on frequent and widespread

HIV testing, integration of brief interventions to reduce alcohol consumption into HIV testing programs has the potential to reach a large number of persons. More work is needed to develop approaches that are effective, feasible, and can be scaled up to reach a large number of people.

Policy Interventions to Reduce Alcohol Consumption and its Effects on the HIV Epidemic

Given the ubiquitous nature of alcohol consumption and the high level of heavy drinking in SSA, policy initiatives are needed, overall and in the context of the HIV epidemic. Little attention has been paid to alcohol consumption in HIV policy, beyond the recognition of increased sexual risk associated with alcohol consumption [8]. Strategic plans for HIV are needed that explicitly address not only the risk of HIV acquisition, but also of the additional impact of alcohol consumption on other facets of the HIV epidemic [17].

Health organizations and governments have increasingly paid attention to the broad-reaching health and social effects of alcohol consumption. In 2010, the World Health Assembly of the WHO endorsed resolution WHA63.13, a global strategy to reduce the harmful effects of alcohol [92]. The recommended policies, based on available evidence of efficacy [93•], include national awareness campaigns, controls on the availability of alcohol, taxes on alcohol, regulations on the marketing of alcohol, drunk driving laws and checks, and treatment for alcoholism. However, restrictions or taxes on commercial alcohol may serve to fuel the home-brewed and home-distilled markets [94].

Other than minimum legal drinking ages (typically 18), there are few regulations on alcohol in SSA. As of 2008, out of the 46 countries in the WHO Africa region, only 10 countries have alcohol policies and 16 countries have regulations on advertising alcohol [95]. In addition, existing regulations are not enforced [8]. Barriers to implementing policies to regulate alcohol include “human resource constraints (competence and capacity), alcohol-related problems among health care workers, denial, and a reluctance to tackle problems” [96]. Another concern is the level of participation of the alcohol beverage industry in designing alcohol policy, evidenced by almost identical policy documents from Lesotho, Malawi, Uganda, and Botswana [97]. These documents call for industry self-regulation to manage marketing and promotions, and conducting public education campaigns to reduce alcohol consumption. However, these strategies are known to be ineffective as compared to more aggressive policies to limit the availability of alcohol [93•]. Evidence-based policies and action are needed to reduce alcohol consumption overall and to incorporate alcohol reduction strategies into HIV programs.

Conclusions

Alcohol affects the HIV epidemic on multiple fronts, especially in SSA where both HIV infection and heavy drinking are at high levels. The potential synergy of alcohol-related behaviors such as increased sexual risk and lower utilization of health care with alcohol-related biological factors such as increased susceptibility and infectivity makes alcohol consumption fuel for the fire of the HIV epidemic in SSA. However, despite, or perhaps because of, the ubiquity of alcohol consumption worldwide and in SSA, very little attention has been paid to its major role in the HIV epidemic [98•]. As a result, there are gaps in the research into the ways alcohol affects sexual behavior, access to HIV testing and care, adherence to ART, and HIV progression in SSA. Future research should account for the preponderance of homemade alcohol and the likelihood of under-report.

Few methods have been tested or implemented to reduce alcohol consumption itself or alcohol-related sexual risk behavior among persons at risk for HIV and those already infected with HIV in SSA. There have only been a handful of individual-level interventions to reduce sexual risk behavior in the context of alcohol consumption, with modest results. Behavioral interventions to reduce alcohol consumption itself may be promising, though further work is needed to determine how to scale up these approaches and to determine whether they have collateral benefits on sexual risk behavior. Structural interventions to regulate alcohol as recommended by the WHO can play an important role in decreasing alcohol consumption [92]; however, governments will need to overcome resistance by the alcohol beverage industry and devise ways to regulate sales of homemade alcohol. Policies that focus on reducing alcohol consumption and alcohol-related sexual risk should be integrated into HIV strategies. In summary, the enormous challenge that alcohol poses to ending the HIV epidemic in SSA needs to be addressed via increased research on mechanisms and interventions as well as forward progress in the policy arena.

Disclosure No potential conflicts of interest relevant to this article were reported.

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- Of major importance

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