

Reducing binge drinking to prevent HIV among mineworkers in South Africa

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Introduction

The average salary of mineworkers in South Africa is about ZAR 2800 (400 US\$) per month. While this may seem like a small financial compensation for the tough working conditions and huge occupational hazard to which mineworkers are exposed, they are financially far better off than unemployed or informally employed South Africans, which comprise more than half of the South African adult population (1). Living in single-sex hostels, separated from their girlfriends, wives and children, and with few or no alternative to turn to, binge drinking and (commercial) sex are common choices for recreation among mineworkers in Southern Africa (2). In a recent survey among 1571 South African mineworkers in seven mines, 46.9% were current alcohol users and 15.3% matched the CAGE criteria for alcohol dependence. The same survey confirmed that binge drinking peaks immediately after pay day, which is usually every Friday (3).

Binge drinking is associated with numerous direct and indirect negative consequences: Besides elevated risks for intentional and unintentional injuries and long-term sequelae such as dementia and cognitive and emotional disorders, cardiovascular disease and hepatocellular carcinoma, binge drinking facilitates the acquisition and transmission of the Human Immunodeficiency Virus (HIV) and other sexually transmitted infections (STIs) due to increased sexual risk behaviour (4-6). In a meta-analysis, binge drinkers were more than twice as likely to be HIV infected than non-binge

drinkers (RR=2.20; 95% CI: 1.29-3.74) (7). In another meta-analysis, problematic drinking (OR=1.69; 95% CI: 1.45-1.97), and alcohol use in sexual contexts (OR= 1.98; 95% CI: 1.63-2.39) were both significantly associated with unprotected sex among HIV-infected individuals (8). The prevalence of HIV among mine workers in South Africa has been estimated to be as high as 27% to 29%, almost twice as high as the average HIV prevalence in the adult population (9-12).

To explore the potential of preventing new HIV infections among mineworkers by reducing binge drinking in this population, a mathematical model was developed that aims to capture the causal associations between binge drinking, sexual risk behaviours and HIV incidence.

Methods

The model estimates HIV incidence and 1-year cumulative risk of HIV acquisition based on the average transmission probability per unprotected sex act (taking STI co-factor effects into account), the relative risk of transmission if a condom is used, the fraction of sex acts in which condoms are used, the sex frequency within a sexual relationship, the number of sex partners per year and the prevalence of HIV among sex partners. Parameter values applicable to mineworkers who are not under the influence of alcohol, stratified by the three types of sex partners considered by the model, are shown in Table 1.

Table 1. Model parameters for risk of HIV infection in mineworkers who are not under the influence of alcohol

Variable	Parameter	Partner type (t)			Reference
		Sex worker	Casual commercial	non-commercial partner	
Average transmission probability per unprotected sex act	B(t)	0.006	0.004	0.002	(13)
Relative Risk of transmission if a condom is used	RRc	0.06	0.06	0.06	(14)
Fraction of sex acts protected by condoms	C(t)	0.9	0.5	0.3	(15)
Number of sex acts per relationship	N(t)	1	15	30	(16)
Number of sex partners per year	S(t)	8	2	0.5	(16)
HIV prevalence in sex partners	P(t)	0.4	0.25	0.15	(17)

Table 2. Model parameters related to binge drinking and associated sexual risk behaviours

Variable	Parameter	Partner type (t)			Reference
		Sex worker	Casual non-commercial	Main partner	
Fraction of mineworkers that engages in binge drinking	F	0.5	0.5	0.5	Model assumption
Probability of binge drinking with partner of type t	D(t)	0.6	0.3	0.05	Model assumption (8)
Odds ratio of using condoms after binge drinking	O	0.5	0.5	0.5	Model assumption
Multiplication factor of number of sex partners in mineworkers who engage in binge drinking	M(t)	2	2	1	Model assumption

The potential for an intervention aimed at reducing binge drinking to reduce HIV incidence among mineworkers crucially depends on the prevalence of binge drinking prior to the intervention, sexual risk behaviours associated with binge drinking, and how effective the intervention is in reducing binge drinking. The parameter values related to binge drinking and associated sexual risk behaviours are shown in Table 2.

In this analysis, it is assumed that interventions may result in a decrease in the fraction of binge drinking mineworkers and/or in a decrease in the probability of binge drinking with sex partners (as a result of a decreasing frequency of binge drinking in mineworkers who engage in this behaviour).

Results

Under the behavioural and biological assumptions described above, the HIV incidence prior to any binge drinking prevention intervention

would be 3.4 cases per 100 person-years, an estimate consistent with empirical HIV incidence estimates from high-risk population groups (18). Two key conclusions can be drawn from the model output, shown in Figure 1. Firstly, the model suggests that the relative reduction in HIV incidence due to binge drinking reduction programmes would not exceed 35%, no matter how efficacious the programme would be in reducing binge drinking in the mineworkers. Secondly, the effects of a reduction in the number of binge drinking mineworkers and a reduction in the frequency with which they engage in binge drinking on the incidence are almost symmetric, but not linearly additive. Halving either the number of binge drinking mineworkers or the frequency with which they engage in binge drinking would lead to a 17%-18% reduction in HIV incidence. Halving both these quantities would reduce HIV incidence by 26%.

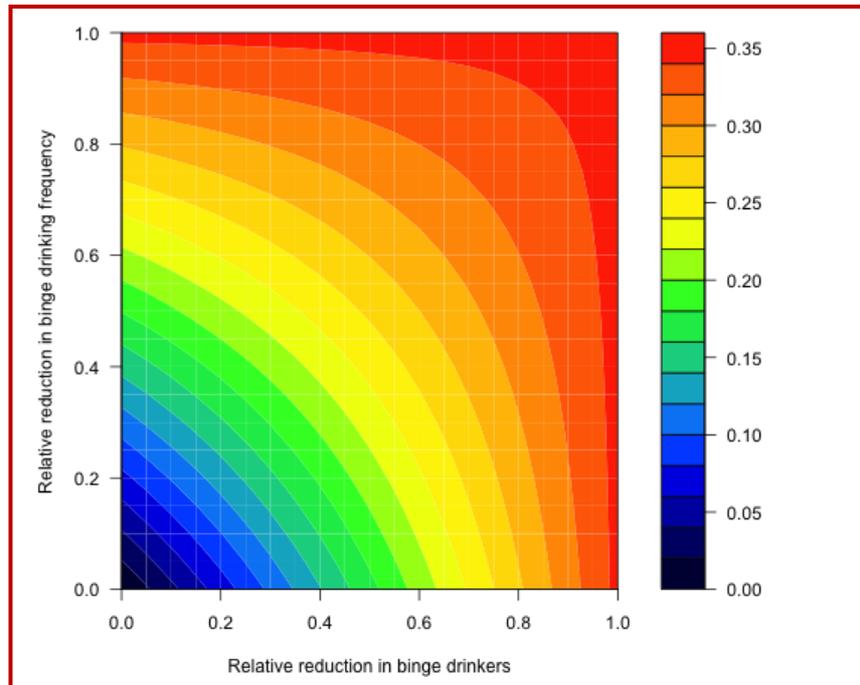


Figure 1. Relative reduction in HIV incidence as a function of an intervention's ability to impact on the fraction of mineworkers who engage in binge drinking and the frequency of binge drinking.

Discussion

Due to the socio-economic context of binge drinking among mineworkers, education and information campaigns alone are unlikely to have a sizeable, sustained effect on binge drinking and risky sexual behaviour (2, 19). While multi-level interventions to reduce binge drinking for prevention of HIV and other STIs have been called for by many authors (2, 4, 19, 20), the feasibility and effectiveness of such holistic HIV prevention interventions have not been confirmed. A first step would be a proof of concept study, investigating the feasibility of conducting a cluster randomised controlled trial of multi-level interventions to reduce binge drinking and sexual risk behaviour among mineworkers in South Africa, and thereby estimating the effects of multi-level interventions on binge drinking and unprotected sexual intercourse in this key population. Obvious and perhaps less obvious components of such an intervention might include: 1) an alcohol and risk awareness programme, 2) promotion of alternative recreational activities, 3) financial coaching and guidance, and 4) an alteration to the payment scheme from weekly payments on Fridays to either weekly payments on Mondays or to monthly payments.

Since the envisaged multi-component interventions aim to reduce binge drinking through individual-level and community-level components, “communities” of mineworkers, rather than individual mineworkers would need to be allocated to each of study arms. Practically, this could be achieved by inviting all mineworkers living in the same single-sex hostels to participate in the study and be allocated to one of the study arms. If financial or logistical constraints do not allow for a large enough number of hostels to be recruited to warrant randomization at the level of the hostels, hostels could be selected based on matching age distribution, training level, job description and pay scale of their occupants.

In light of the limited effectiveness of *classic* behavioural interventions for HIV prevention (21), and with no highly efficacious HIV vaccine available in the foreseeable future, it is appropriate and timely to consider interventions aimed at the seemingly obvious risk factor of binge drinking. Despite the high prevalence of binge drinking in key populations at high risk of HIV acquisition and transmission, and accumulating evidence for strong causal links between binge drinking and risky sexual behaviours, the potential for binge drinking reduction programmes to avert HIV infections has been under-explored. While such programmes would by no means provide a silver bullet solution to the HIV epidemic in South Africa, and would necessarily have to be complemented by other biomedical, behavioural and structural components in a comprehensive combination prevention package, it is worth a try. What have we got to lose?

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