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men: 1% and 2% respectively). Among men, associations between heavy episodic drinking and sexual behaviour were especially pronounced. Compared with nondrinkers, episodic ones were 2.6 fold more likely to have transactional sex ($OR=1.7$ 95%CI 1.1–4.1) and 2.2 fold more likely to have a concurrent partner (95%CI 1.1–4.1). Alcohol use in men, regardless of measure, was strongly associated with having used physical force to coerce a partner into sex. Overall effects of alcohol on sexual behaviour were larger in women than men, and associations were stronger between all alcohol measures in women, and concurrency, transactional sex and having been forced to have sex.

Conclusions: Alcohol use and sexual behaviour are strongly linked among males and females. The Alcohol Use Disorders Identification Test (AUDIT) is a useful tool for identifying alcohol-related problems. This article is distributed under the terms of the Creative Commons Attribution International License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Attribution-NonCommercial-NoDerivs license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>) applies to the data made available in this article.

women, the initial stage was a systematic selection of 10% of all dwellings from a random starting point in the informal settlements. All eligible women in the selected dwelling were then invited to participate. Both informal settlements and hostels were visited several times to maximise participation.

Data were collected through face-to-face interviews in either IsiZulu or Sotho. Informed consent was obtained prior to study procedures.

Exposure and outcome measures

Alcohol use was assessed in three domains: any alcohol use, volume consumed and heavy episodic drinking patterns [40, 41]. Men or women reporting that they drink alcohol were classified as having any alcohol use. Volume of alcohol consumed was measured by two variables: the frequency of drinking and the total number of standard drinks (10 g/drink) in the past week. The latter was categorised as no drinking, moderate drinking (men: 1–14 drinks, women: 1–7 drinks), problem drinking (men: 15–21 drinks, women: 8–14 drinks) or heavy drinking (men: >21 drinks, women: >14 drinks). The limits for units in the past week are those commonly used to define ‘safe’ alcohol use in non-pregnant adults [42, 43]. Drinking frequency was used as a measure of volume drunk as is commonly done [40], whereby cumulative lifetime volume is estimated by a product of drinking frequency and number of units per drinking session. To measure heavy episodic drinking, participants were asked whether they had been drunk in the past week.

Other exposure variables assessed included socio-demographics and health status. Age was categorised as 18–24 years, 25–34 years and ≥ 35 years. Social cohesion was defined as how close participants felt to others around them (men with other hostels dwellers and women with those in the surrounding informal settlement). This was measured using a Likert scale with five levels, extending from ‘very close’ to ‘not very close’. Perceived safety was also measured using a Likert scale, ranging from ‘very safe’ to ‘very unsafe’. To assess exposure to violence, participants were asked when was the last time they had witnessed violence, with responses classified into whether or not this had occurred in the past three months. Perceived risk for HIV infection was determined by asking participants ‘What do you think your chances of getting HIV/AIDS are?’, again measured with a Likert scale, as is commonly done for this indicator [44]. Health status was also measured using a Likert scale from ‘very good’ to ‘poor’.

Sexual risk behaviours, the study outcomes, were assessed through four binary measures. Condom use at last sex, regardless of type of partner; concurrent partnerships (more than one sexual partner at time of survey); transactional sex (men who ever paid for or

gave goods for sex, and women who were ever paid or received goods for sex); and sexual violence, measured among men as ever having used physical force to have sex, or among women as ever been forced to have sex.

Statistical analyses

Stata version 13.0 (StataCorp, College Station, TX, USA) was used for analysis. We summarized the data using means and proportions. Differences between categorical variables were identified using chi-square tests and between ordinal categorical variables using the chi-square test for trend. Multivariate logistic regression models were developed to determine whether current

Table 2 Multivariate logistic regression models of association between different measures of alcohol use and sexual risk behaviour, by gender

Measures of alcohol use	No condom use at last sex AOR (95% CI)	Concurrent partnership AOR (95% CI)	Transactional sex AOR (95% CI)	Sexual violence ^c AOR (95% CI)
MEN (n = 1485)				
Current alcohol use ^a				
No	1	1	1	1
Yes				

Only 9% of women aged 18–24 were current drinkers, while rates were 14–15% in older age groups ($P < 0.001$). Rates of drinking in women from KwaZulu Natal (10%) were half that of women from Gauteng and other provinces ($P < 0.001$). Only 4% of women who completed secondary school currently drink, compared to 15% of

those with less education ($P < 0.001$). In women, current drinking was not associated with perceived risk for HIV. Rates of current drinking rose with a decline in health status (9% in those with very good health, 12% in good or fair health and 19% in those with poor health; $P = 0.004$). Lastly, women with STI symptoms were

Table 3

Table 3 Factors associated with heavy episodic drinking in men and current alcohol use among women in inner-city Johannesburg (Continued)

High risk	35	19.6		35	12.4	
Current smoker						
No	40	5.5	<0.001	82	8.9	<0.001
Yes	100	16.1		40	63.5	
Health status						
Very good	31	12.4	0.46 ^a	19	9.0	0.004 ^a
Good or fair	88	9.7		68	11.8	
Poor	22	10.6		37	18.7	
STI symptoms in past 6 months						
No	110	10.1	0.58	44	9.8	0.016
Yes	31	11.2		80	14.8	

STI

more likely to drink alcohol than those without such symptoms (15% versus 10%; $P = 0.016$).

Discussion

This study among men and women who are mostly internal migrants and at high risk for HIV [29], showed that alcohol use is associated with unsafe sexual behaviours in this population, though patterns of associations differ between genders. Being drunk in the past week was the strongest predictor of perpetrating sexual violence in men and of unsafe sexual behaviours more generally. On the whole, alcohol consumption was even more strongly associated with sexual risk behaviour among women than in men. Odds of the three unsafe sexual behaviours among females who currently drink were 3.2 to 5.9 fold higher than non-drinkers, while the corresponding odds were only 1.6 to 2.3 in their male peers. Clearly, this population, with notable levels of socio-economic vulnerability, is marked by very high levels of alcohol and sexual risk behaviours.

As in other studies in South Africa [46, 47], considerably fewer women than men drink, but women who do have especially harmful drinking patterns, which are often characterised by frequent heavy drinking episodes. Moreover, the high unemployment rate and considerably lower income among females may mean that those who drink have to depend on men for alcohol. Older men who had an income were much more likely to drink than younger unemployed men, and thus were probably able to purchase drinks for women and offer them transactional sex. The very strong association between transactional sex and alcohol use supports the assertion that alcohol is linked with sexual and other exchanges between men and women in this population [13, 48, 49]. In one study in Cape Town, South Africa, women with food insecurity had higher sexual risk behaviours than

other women, with the associations between food and risky sex being fully mediated through women's alcohol use [49]. Also, that drinking in females per se, rather than type of drinking as in men, was associated with sexual behaviour, suggests that being present in a drinking venue may be the key risk for women, rather than the degree to which they engage with alcohol [48]. In fact, few of the associations showed a dose-dependent relationship between alcohol use in men and sexual behaviour, though such associations have been demonstrated previously [50–52].

The juxtaposition of single-sex male hostels and adjacent to informal settlements populated by impoverished women likely means that informal drinking venues in the areas (also called shebeens) play a key role in building social cohesion and cementing connections between these populations. Opportunities for drinking and for sexual encounters often co-exist in particular physical locations and the social dynamics that are generated in these locations [13, 53]. Patrons of drinking venues similar to those in the study site reported entering these places with an expectation of securing casual sex [3]. Sexual partners found at these drinking venues are more likely to have multiple sexual partners and to engage in unprotected sex than partners met elsewhere [54, 55]. These drinking venues are also often physically unsafe [38], perhaps accounting for the high levels of violence witnessed by drinkers in our study.

The linkages between alcohol use among men and using force to have sex, consistent with findings elsewhere [5, 56, 57], warrant discussion. Among males, both heavy alcohol use and sexual conquest may serve as markers of masculinity, which taken to their extremes can extend into sexual violence [58]. Drinking venues that encourage heavy alcohol consumption may thus propagate the social norms that underlie coercion and

gender-based imbalances in sexual relationships [48]. Clearly, the links between alcohol and the perpetration of sexual violence, in itself, warrants stronger efforts to control alcohol use in South Africa.

The associations noted in the study between alcohol use and sexual behaviour may be accounted for by sex-related alcohol expectancies [59]. These are the anticipated effects of drinking alcohol, such as increased sexual pleasure and sexual riskiness, which then predict the likelihood of these consequences actually taking place [23, 60, 61]. Alcohol outcome expectancies were not studied in this population, but, potentially, the men and women who believed that alcohol would increase their sexual riskiness, may well have acted out those beliefs, which accounts for their high levels of concurrency and transactional sex. That we did not detect an association between alcohol and condom use might be due to the use of a weak indicator of condom use in the study, but also may reflect the mixed findings noted in other reports of associations between condom use and alcohol, with a few studies actually finding higher condom use among drinkers [51, 62]. Clearly, prospective data based on event-level indicators such as condom use while feeling drunk or after drinking are better suited to elucidating causal pathways between alcohol use and unsafe sex [63, 64].

Study limitations

The cross-sectional nature of this analysis limits the ability to infer causal associations between alcohol use and sexual risk. For example, women who are victims of sexual violence may drink as a means of coping, rather than having experienced rape as a result of drinking. Also, the settings in which drinking takes place were not assessed; they are key mediators of linkages between alcohol use and sexual behaviour. Further, data on drinking and sexual behaviours were self-reported, and thus subject to recall, social desirability and other biases. However, the consistent nature of the findings across a range of alcohol and sexual behaviour measures suggests that the results are valid, despite these limitations.

Conclusions

Compared with the general population, the effects of alcohol on sexual behaviours are especially heightened among high-risk populations, such as sex workers and men who have sex with men [63]. This study suggests that these effects also hold true for high-risk male and female migrant groups in inner-city areas. More rigorous interventions, at both local and macro level, are needed to alleviate alcohol harms and to tackle the alcohol-HIV nexus, especially among already vulnerable groups. These should target the specific dimensions of alcohol use that are harmful (such as heavy episodic drinking in men), assist women who

drink to do so in a safer manner and address the linkages between alcohol and sexual violence.

Abbreviations

HIV:

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