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The Relationship Between Alcohol Consumption and Human Immunodeficiency Virus Infection and Risk Behaviour: A Systematic Literature Review of High-Risk Groups, with a Focus on South Africa

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1. Introduction

The most common mechanism for contracting the human immunodeficiency virus (HIV) is through unprotected sexual intercourse with an infected partner. Biological aspects in the acquisition of HIV such as biological susceptibility to HIV infection are also important, but infection with HIV cannot occur without the behavioural component of bodily fluids mixing between HIV-positive and HIV-negative individuals. This study will focus on the behavioural component of unprotected sexual activity and alcohol consumption in terms of risk for HIV infection.

Physiologically, alcohol use loosens inhibitions and impairs cognitive functions, which may lead to unsafe sexual behaviour, essentially unprotected sex. The relationship between alcohol use and the contracting of HIV is complex, as other confounding variables such as certain personality traits or alcohol expectancies also have an effect on both risky sex and alcohol consumption. These confounding variables may explain or partially explain the observed association between alcohol consumption, unsafe sex and HIV infection.

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Alcohol has been implicated in the transmission of HIV via unsafe sex in many systematic reviews examining this association. These literature reviews and meta-analyses have varied foci. Cook and Clark (2005) examined the association between alcohol consumption and sexually transmitted infections (STIs). Baliunas (2010) looked at alcohol consumption and risk for incident HIV. Fischer (2007) and Kalichman (2007) conducted global-level systematic review studies in Africa and sub-Saharan Africa (SSA) respectively. Woolf-King and Maisto (2011) conducted a narrative literature review that included qualitative and quantitative literature on the link of alcohol and high-risk sexual behaviour in sub-Saharan Africa. Pithey and Parry (2009) conducted a descriptive literature review examining studies that quantified the association between alcohol consumption and HIV in SSA. The results included a high-risk group category of shebeen/beerhall patrons and bar and hotel workers. Braithwaite et al., (2007) showed that alcohol consumption impacts negatively on people living with AIDS (PLWA). These reviews and the Braithwaite study, while consistently indicating a strong association, do not provide sufficient epidemiological evidence of causality between alcohol use and HIV sero-conversion. They only demonstrate that alcohol is an important correlate of sexual risk behaviour in populations.

However, event-level studies, such as the diary studies of Leigh (2008) and Room (2008), have provided less-convincing evidence than the aforementioned global-level studies for the link between alcohol use and HIV via unprotected sex. This can be attributed to the fact that event-level studies can better control for confounding variables. Conversely, Kiene (2008) showed in the first diary study in South Africa (SA) that moderate or higher drinking levels prior to sex increased the likelihood of unprotected sex.

Overall, the lack of conclusive evidence of a causal link between alcohol consumption and the transmission of HIV does not justify taking no action (Hill, 1965; Phillips 2004). No action implies that alcohol interventions as HIV prevention or treatment measures are not implemented. In addition, there is evidence that indicates that alcohol consumption has a harmful impact on the pathogenesis of HIV. Alcohol reduces an individual's immune response (Friedman et al., 2006), hence increasing the susceptibility of contracting HIV and other opportunistic infections. For an HIV-positive person on antiretroviral medication, alcohol has a negative effect on HIV treatment adherence (Hendershot et al., 2009). Furthermore, antiretroviral drugs (ARV) and alcohol are both metabolized by the liver. Long-term alcohol abuse can result in liver disease, which in turn affects the ability of the liver to metabolise the ARVs (Shuper et al., 2010). There is sufficient epidemiological evidence that alcohol consumption is linked to HIV progression (Parry et al., 2009). Furthermore, Rehm et al., (2009) and Gmel et al., (2011) modelled the impact of alcohol on ARV adherence and HIV mortality.

In light of the above evidence, the nexus of alcohol misuse and HIV is an important research arena, especially in SA, a country with one of the highest rates of HIV infection globally, as well as one of the highest per drinker alcohol consumption rates (Fritz et al., 2010). Sexually transmitted diseases are the leading risk factor for death and disability in SA, with 98% of these disability adjusted life years (DALYs) due to HIV / AIDS (Johnson et al., 2009). High alcohol consumption rates also translate into an enormous disease burden attributable to alcohol itself (Schneider et al., 2007). It is estimated that 5.6 million people are living with AIDS in SA with the adult prevalence at 17.8% in 2009 (UNAIDS, 2010). As is the case in the rest of SSA, high proportions of the general population in SA abstain from drinking alcohol (Obot 2007; Parry et al. 2005). The per capita annual alcohol consumption in SA is estimated

between 10.3 and 12.4 litres (Rehm 2004). However, those who do drink do so to intoxication, particularly during weekends (Parry et al., 2005). In SSA, the alcohol consumption per drinker is 19.5 litres alcohol (Roedcke et al., 2008). This figure is slightly higher in SA, at 20 litres per drinker per annum (Rehm et al., 2003). These high alcohol consumption levels for those who drink together with the high background prevalence of HIV do not augur well for the containment of the HIV epidemic in SA.

Alcohol consumption is a multi-dimensional variable that includes volume, consumption patterns, as well as the context of consumption. Although all these factors impact on the outcome of interest, in this case, unsafe sex, the context provides the platform for the physical and psychosocial factors to play out and interact, often synergistically, thus creating greater chances of contracting HIV. Chersich et al., (2010) points out that it is often the context of alcohol consumption that is particularly unsafe for adolescents, sex workers and migrant labourers in SA. These individuals tend to be generally more vulnerable to contracting HIV due to inexperience with alcohol and sex in the case of adolescents, or due to illegal or transient positions for the latter two groups, respectively.

A worrisome trend is the high alcohol consumption in certain sub-populations in SA, particularly emerging adults, farm workers and mine workers. For example, Madu and Matla (2003) reported that 39.1% of emerging adults consume alcohol. Problem drinking in farm workers has been estimated to be in excess of 65% (London, 2000) and over a quarter (26.3%) of HIV-positive mine workers were found to be meeting criteria for alcohol abuse (Säll et al., 2009). Moreover, in a sample of migrant women, alcohol use was a direct predictor of HIV-positive sero-status (Zuma et al., 2003). In a recent South African report, the definition of most at-risk populations (MARPs) for HIV/AIDS was expanded to include persons who drink excessively (Shisana et al., 2009).

Globally, there are two patterns on how the HIV epidemic presents in populations. In many SSA countries, there is a generalised epidemic, as opposed to other countries where it is concentrated in high-risk groups. SA is experiencing a so-called generalised HIV/AIDS epidemic, defined as having an HIV prevalence rate in the general population greater than 1%, with heterosexual intercourse being the predominant mode of HIV transmission. Sexual networking within the population is sufficient to sustain the epidemic, despite high-risk sub-populations that contribute disproportionately to the spread of the disease in SA (Ngom and Clark, 2003).

Notwithstanding the above, in the present review, we discuss the link between alcohol consumption, risky sexual behaviour, and the risk of HIV infection in high risk groups worldwide, with a particular focus on SA. This study will add to the accumulating evidence for delineating the causal pathways of alcohol use and risky sex to HIV infection. Many of the mediating factors in the causal web of alcohol use, unsafe sex and HIV acquisition tend to be more potent and hence easier to ascertain in some of these high risk groups. An important focus for HIV prevention research is to examine the role of alcohol with respect to risky sex in high HIV risk sub-populations.

Universally, sections of populations have higher HIV prevalence rates than the general population. HIV/AIDS MARPs usually include men who have sex with men (MSM), injecting drug users (IDUs) and sex workers. These high-risk groups have larger pooled odds ratios (ORs) of alcohol use and HIV-positive status than the general population (Fischer et al., 2007).

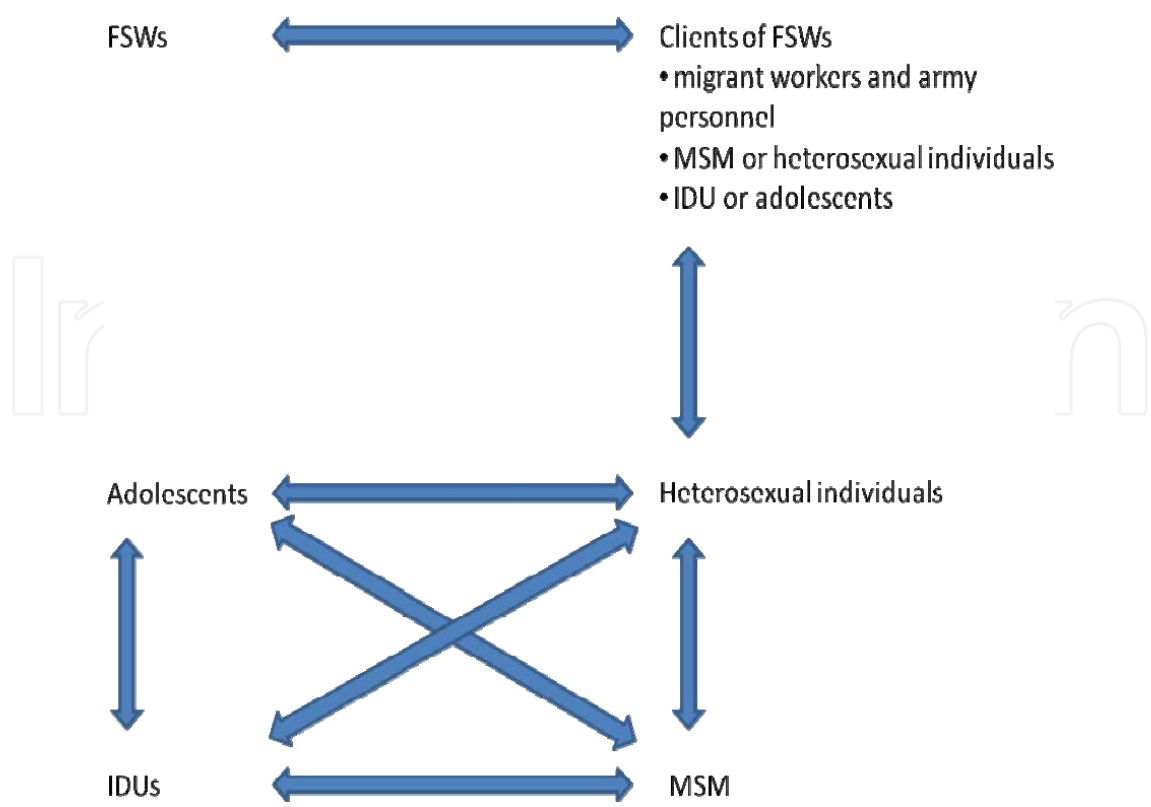


Fig. 1. Depicts female sex workers (FSWs) as key determinants for sex-concurrency for their clients, who include MSM and heterosexual individuals, who can be migrant workers, army personnel, adolescents and/or IDUs.

These high-risk groups engage in patterns of behaviour that carry elevated risk for HIV infection (Parry 2008a). A component of these lifestyles may include closed or interconnected social and sexual networks within these sub-populations with relatively high HIV sero-prevalence rates. In addition, “bridging” effects among individuals from these groups leads to a wider network of HIV transmission. Figure 1 is a model of a network of HIV transmission in the presence or absence of alcohol consumption among the selected high-risk groups reviewed in this paper.

2. Materials and methods

We performed a systematic review of published literature using PubMed, searching for articles that contained information about alcohol drinking patterns and sexual risk behaviours. We limited the search to literature published in English. In order to obtain more focused results so that we could, where necessary, refer to South Africa, we also included the words “South Africa” for the search. However, we did not have “South Africa” as an exclusion criterion. We found over 4000 results using the key words “alcohol” and “HIV”, from which we selected 750 of the most recent publications (i.e. June 2008 to June 2010). Reading these articles, the majority were in vitro studies of alcohol or HIV, or were performed on animals, or they described molecular mechanisms or discussed only one of the risk factors; often sexual transmission and alcohol were referred to only once, in passing. For the period January 2008 to October 2010 there were 183 articles that pertained to humans. From the 183 articles, 107articles were selected. The main reason for discarding 76

articles was that they did not discuss alcohol consumption and risky sexual behaviour; the two variables were not linked in any way. The 107 articles were allocated to one or more of the six high-risk groups selected for the study. (Figure 2) Particular attention was paid to those papers that provided an indication of the drinking pattern (e.g. binge drinking, continuous drinking, alcohol abuse and alcohol intoxication) and the amount of alcohol consumed. Where the relationship between alcohol consumption and unprotected sex was quantified in the individual articles, this was captured and reported on.

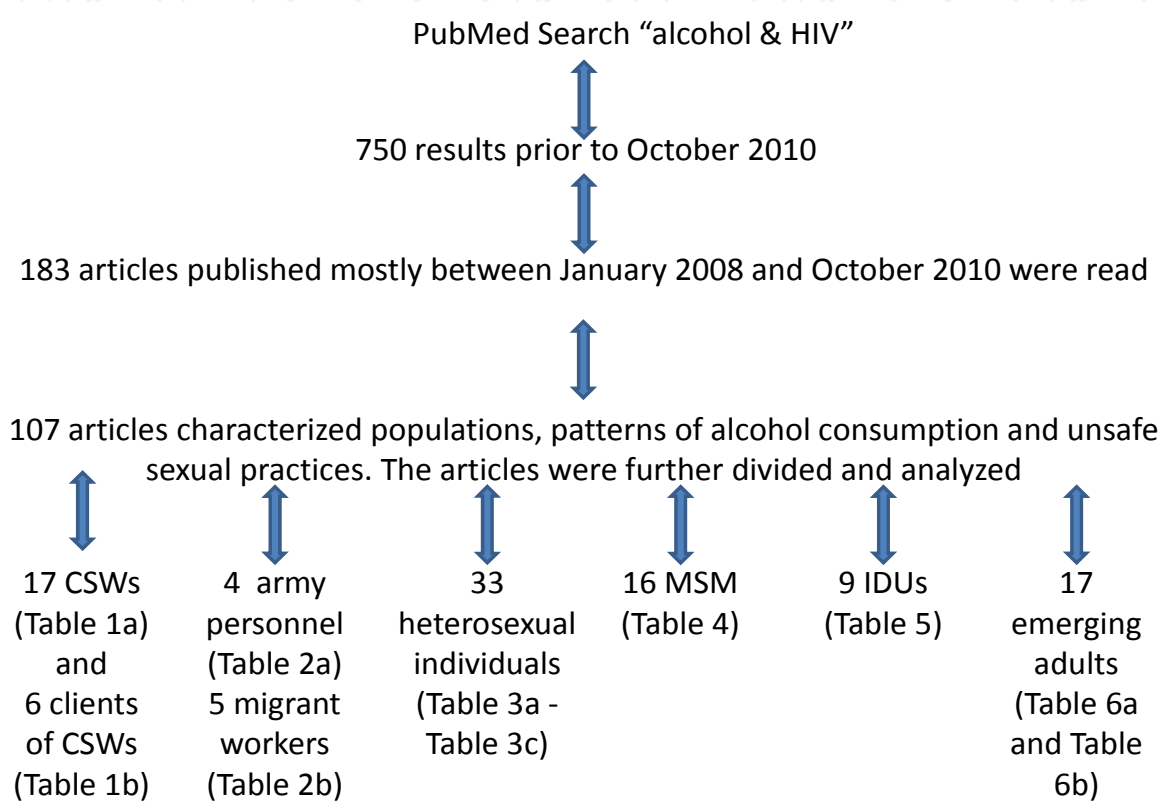


Fig. 2. Flow diagram of the systematic literature review

We also discuss a limited number of relevant papers published prior to 2008, which were used to emphasize some of the points that were not well represented in the more recent publications. These additional papers were obtained via a manual search of the reference sections of the articles obtained from the PubMed search.

3. Results

This section is divided into six subsections, corresponding to each of the six at-risk groups that are discussed in detail.

3.1 Female Sex Workers and their clients

The alcohol and condom use patterns of commercial sex workers (CSW), particularly FSWs, are described in Table 1a. In addition, the alcohol and condom use patterns of clients of the CSWs are described in Table 1b.

Sex with a customer is often accompanied by alcohol consumption, as shown by studies in Afghanistan (Todd et al., 2010), China (Rogers et al., 2002; Wang et al., 2010), India (Bowen et al., 2010; Go et al., 2010; Samet et al., 2010; Verma et al., 2010), Kenya (Chersich et al., 2007), Mongolia (Witte et al., 2010), the Philippines (Chiao et al., 2006; Morisky et al., 2010), Scotland (Thomas et al., 1990), South Africa (Wechsberg et al., 2005; Wechsberg et al., 2009), Tanzania (Fisher et al., 2008; Fisher et al., 2010), the United States (Nemoto et al., 2003), and Vietnam (Nemoto et al., 2008). Alcohol is also consumed by male clients of FSWs in India (Madhivanan et al., 2005; Rodríguez et al., 2010; Samet et al., 2010; Schensul et al., 2010; Verma et al., 2010), Scotland (Morgan Thomas et al., 1990), Sri Lanka (Dissabandara et al., 2009), Thailand (Havanon et al., 1993), and Zimbabwe (Fritz et al., 2002). In addition, FSWs often consume alcohol together with their clients, as observed in massage parlours and bars in Vietnam (Nemoto et al., 2008), the Philippines (Chiao et al., 2006), the United States (Nemoto et al., 2003), China (Wang et al., 2010), India (Rodríguez et al., 2010) and Tanzania (Fisher et al., 2008). An Indian study found that alcohol consumption for both FSWs and their male partners are above the national average for their respective genders (Samet et al., 2010). In a sample of 335 FSWs and 171 female non-SW in South Africa, FSWs were found to be more likely than females who were not sex workers to suffer from an alcohol abuse disorder (Wechsberg et al., 2009). Some women describe alcohol use as a way to please the partner, when this is what the partner wants (Witte et al., 2010).

3.2 Female Sex Workers

A sample of 48 FSWs report that they used alcohol in large amounts in order to decrease inhibitions prior to sex work and to cope with the stigma, psychological distress and violence brought about by their sex life (Witte et al., 2010). Other reasons for alcohol use were to conform to norms of sex partners who preferred them to be intoxicated and would pay more in these situations (Witte et al., 2010). Other groups also report that some FSWs use alcohol to make sex easier (Wechsberg et al., 2005; Nemoto et al., 2008; Todd et al., 2010). Drinking before sex with a client is linked with life-long inconsistent condom use in 454 FSWs (Wang et al., 2010). However, Wang et al. (2010) did not find a direct link between alcohol consumption, condom use, and STD prevalence, supporting the theory by Fisher et al. (2010) that the negative influence of alcohol on condom use is event-specific, rather than global. In support of this, the Mongolian study referred to earlier found that inconsistent condom use also occurs as a result of a partner being willing to pay more for unprotected sex, rather than due to alcohol use per se (Witte et al., 2010).

Generally FSWs who used alcohol before sex with a client, compared with those who did not, were more likely to use condom inconsistently and to be STD-positive (Wang et al., 2010). Eighty five percent of FSWs report that their clients sometimes refused to wear a condom. In a different study in a sample of 3412 FSWs alcohol consumption and HIV prevalence were found to be high whereas condom use was found to be very low suggesting an inverse relationship between alcohol and condom use (Verma et al., 2010).

Alcohol use has a significant association with having a non-paying male partner and having sex with more than three partners per day in 63.7% of FSWs (Verma et al., 2010). Alcohol use prior to sex leads to inconsistent condom use for both male migrant workers as well as for FSWs. HIV/AIDS education and an increase in a sex worker's ability to use a condom effectively have been linked with decreased alcohol consumption and more frequent

condom use, particularly among those FSWs who are also IDUs (Fisher et al., 2008; Strathdee et al., 2009; Morisky et al., 2010). A direct correlation between decreasing daily alcohol consumption and increasing consistent condom use was found in a sample of 911 FSWs (Morisky et al., 2010).

Studies conducted in India report inconsistent condom use among FSWs who consume alcohol (Bowen et al., 2010; Go et al., 2010; Rodríguez et al., 2010; Samet et al., 2010; Verma et al., 2010). The rate of inconsistent condom use was found to be very high and no significant differences were found between FSWs who consume alcohol (even in high quantities) and those who do not, in a sample of 211 HIV-positive FSWs (Samet et al., 2010). Fifty seven percent of women report to have used alcohol around the time when they first entered sex work (Bowen et al., 2010). The study in a sample of 220 FSWs (Bowen et al., 2010) found that alcohol and drug consumption has increased since the time these women entered into the sex trade industry.

To complicate matters even further, Chiao et al. (2006) report that alcohol consumption with a customer was accompanied by a significantly higher willingness to use a condom in a sample of 1,114 FSWs. Not surprisingly though, condom failure was also high in intoxicated FSWs or FSWs with intoxicated customers, and STD prevalence was significantly higher in FSWs who had sex with intoxicated customers than in FSWs who did not have sex with intoxicated customers (Chiao et al., 2006). However, alcohol consumption by the FSW did not increase the STD risk any further in this case. Similarly, FSWs who were intoxicated prior to sex were more prone to have STDs than FSWs who were not intoxicated, regardless of the partner's status (Chiao et al., 2006).

In a sample of 159 FSWs (53 working in massage parlours, bars/clubs and the street respectively), massage parlour FSWs report that alcohol consumption was inevitable for them, as it was part of the job (Nemoto et al., 2008). Alcohol consumption was higher for massage parlour and bar/club FSWs, where alcohol was often consumed with customers. In addition, 30% of street-FSWs were also IDUs, using mainly heroin (Nemoto et al., 2008). No significant association was found between condom use and having sex with a customer while under the influence of alcohol. Condom use for vaginal sex with a primary partner was very low, with over 65% of subjects reporting never having used a condom in this situation. Sex under the influence of alcohol was highest for massage parlour FSW and lowest for street FSWs. The trend was the same between sex with casual partners and sex with primary partners (Nemoto et al., 2008).

The risk of condom failure increased significantly if one or both of the partners had been drinking within two hours before sex (Fisher et al., 2010). Condoms are more likely to be used in unfamiliar places, with first-time partners, or if sex was transactional (Fisher et al., 2010). In addition, Fisher et al. (2010) observed that a condom is 10 times more likely to be used if the woman was involved in the decision. In support of this argument, an Indian study found that FSWs avoid using alcohol in order to remain alert throughout the encounter, and to decrease the risk of violence (Rodríguez et al., 2010). This corroborated findings by Go et al. (2010) who report that alcohol consumption before sex, by either the FSWs or her partner, is associated with forced sex in 522 FSWs. In 93 FSWs, Wechsberg et al. (2005) found that FSWs who have been sexually abused are more likely to use condoms inconsistently and to become HIV infected. Daily alcohol consumption was reported by 18% of this sample. Although not significant, women who have been physically abused were

more likely to use alcohol daily than those who were never physically abused. In contrast, those women who have never been sexually abused were less likely to consume alcohol daily than those who were sexually abused ($p < 0.05$) (Wechsberg et al., 2005). Another study found that binge drinking was statistically associated with sexual violence in 719 FSWs (Chersich et al., 2007).

In a study of Thai army conscripts, several male respondents reported that they use alcohol as a socially-acceptable excuse to not use a condom, and they relied on the FSW to put on the condom (MacQueen et al., 1996). On the same note, Nemoto et al. (2008) explained their finding that condom use was lowest in FSWs working in bars and clubs as customers of these women insisted that a condom is not used. In the same study, one massage parlour FSW argued that she tried to convince her partner to wear a condom, but she sometimes agreed to have unprotected sex because the partner would pay better (Nemoto et al., 2008). Condom negotiation is often hindered by having an inebriated partner. Women often compromise as they have low bargaining power (Nemoto et al., 2008; Rogers et al., 2002). At the same time, fear of violence often diminishes the power of a woman to negotiate condom use (Witte et al., 2010). In comparison, a Chinese study found that 63% of FSWs refused to provide sexual services to partners who refused to wear a condom (Rogers et al., 2002).

Not surprisingly, condom use is not the only determinant of HIV infection. Nemoto et al. (2008) found the highest HIV prevalence (18%) in street FSWs, the group that had the lowest rate of inconsistent condom use. Sex under the influence of alcohol was lowest for street FSWs, with either casual or main partners, and it was highest for massage parlour FSWs. Sex under the influence of alcohol was overall higher with main partner, and condom use was lower (Nemoto et al., 2008). Interestingly, sex under the influence of alcohol, at least with a main partner, was reported by 100% of massage parlour FSWs interviewed, yet none of these women were found to be HIV-positive (Nemoto et al., 2008). The same group also found no HIV-positive Asian masseuses in a sample of 100, although STD prevalence was quite high at 94% (Nemoto et al., 2003). In this case, condom use was higher among Asian-American masseuses, with both casual partners and the main partner (Nemoto et al., 2003). In contrast, a Philippine study reports that sex with an intoxicated customer was higher among street FSWs, and STD prevalence was high in these situations (Chiao et al., 2006).

In India, Verma et al. (2010) found a significant association between alcohol use and having more than three partners per day, both paying and not paying. In these cases, condom use is minimal, and this problem is even more pronounced in migrant FSWs who travel greater distances (Verma et al., 2010). Greater alcohol consumption was associated with a higher number of sex partners in a sample of 1044 FSWs working in bars and hotels (Fisher et al., 2008). It appears to be alcohol consumption, rather than the pattern of drinking, that is linked with HIV risk factors (Chersich et al., 2007). Chersich et al. (2007) found lifetime alcohol consumption, rather than binge drinking, to be linked with being seropositive. At the same time, daily drinking and consuming more than the equivalent of 11 beers in one week are strongly associated with being HIV-positive (Fisher et al., 2008). In addition, HIV risk was positively correlated with the amount of alcohol consumed per drinking occasion, peaking for 3 drinks per occasion, which is less than the level necessary to qualify a woman as a binge drinker. Daily drinkers were nearly four times more likely to be HIV-positive when compared with non-drinkers (Fisher et al., 2008). Alcohol users are more likely to have multiple sex partners (bar and hotel patrons) and are more likely to be HIV-positive (Fisher

et al., 2008). In addition, everyday alcohol consumption and binge drinking were significantly associated with inconsistent condom use (Chersich et al., 2007). Despite binge drinking being associated with higher sex risk factors, it did not increase HIV prevalence. Furthermore, binge drinking is associated with sexual violence (OR 1.85, CI 1.27-2.71, $p < 0.001$) and other STDs (OR 1.56, CI 1.00-2.41, $p = 0.048$) (Chersich et al., 2007). Among life-long alcohol abstainers, HIV prevalence was significantly lower than it was among FSWs who had ever consumed alcohol. However, the drinking pattern did not have any significant effect on the HIV status, as the study did not find an association between binge drinking and a higher chance of contracting HIV, than among those who had ever consumed alcohol (Chersich et al., 2007).

3.3 Clients of Commercial Sex Workers

A study of 206 male and three female clients of CSWs found that over 55.0% of CSWs were perceived to be under the influence of alcohol by their clients (Thomas et al., 1990). Interestingly, alcohol consumption did not influence condom use when the CSW was a female, but was negatively associated with condom use with a male CSW (Thomas et al., 1990). Condom use is event-specific for FSWs (Fisher et al., 2010; Wang et al., 2010), and the same can be said for clients of FSWs. Havanon et al. (1993) report that visiting FSWs is a socially acceptable for married men in the Thai society. In a study of 181 male clients of FSWs, condom use was found to be influenced by the perceived "cleanliness" of the establishment and the FSW, as well as the perceived number of sex partner that she has had, rather than one's state of inebriation. Condom use was higher for students (Havanon et al., 1993). Being drunk is not reported as a reason for not using condoms. In a sample of 84 single male drinkers (aged 18 to 29 years), lower condom use was observed when sex took place away from the brothel, or when a certain level of intimacy with the CSW was achieved. However, no association between alcohol consumption and condom use with a CSW was reported (Schensul et al., 2010).

Sex with a FSW while under the influence of alcohol was high in a sample of 1741 men in an STD clinic. Ninety two percent reported sex with a FSW, with 66% having done so under the influence of alcohol (Madhivanan et al., 2005). Sex while under the influence of alcohol was associated with unprotected sex, anal sex, multiple FSW partners, and a history of STDs (Madhivanan et al., 2005). In a sample of 205 HIV-positive men 26% reported inconsistent condom use with a FSWs and this was found to be correlated with alcohol consumption (Samet et al., 2010). Condom use was slightly higher among younger individuals (Samet et al., 2010), which is similar to findings by Havanon et al. (1993) in Thailand.

In a sample of 324 male drinkers, the number of drinking days was associated with the number of unprotected sex episodes with casual partners of CSWs, as well as having sex while intoxicated (Fritz et al., 2002). At least one episode of sex while intoxicated during the previous six months was reported by 31% of subjects. Sixty nine percent of these men reported doing so with casual partners or CSWs. Having sex while intoxicated was linked with a 20-fold higher chance of having unprotected sex with a casual partner, and a 27-fold higher chance with a CSW. The number of drinking days was correlated with the number of episodes of unprotected sex with casual partners, episodes of paying for sex, and having sex while intoxicated (Fritz et al., 2002). There was also a strong link between having sex while intoxicated and HIV sero-conversion. Of HIV-positive men, 35.7% report to have drunk to

intoxication on more than 16 days in the past month. Having sex while intoxicated was associated with a positive HIV status in 37% of the male subjects interviewed. Having sex while intoxicated in the last 6 months was significantly associated with recent sero-conversion (OR 4.5, CI 1.0-19.4) (Fritz et al., 2002).

3.4 Army personnel and migrant workers

The alcohol and condom use patterns of army personnel and migrant workers are described in Table 2a and Table 2b, respectively.

3.4.1 Army personnel

Alcohol abuse is a common problem in army personnel, both active personnel and veterans. Alcohol abuse in this population has been linked with non-monogamous heterosexual sex, including sex with CSWs (MacQueen et al., 1996; Brodine et al., 2003; Tavarez et al., 2010). In a study of 498 sexually-active male military personnel, alcohol abusers were found to be more prone to have multiple sex partners, have sex with CSWs, and use condoms inconsistently. Nineteen percent of individuals, mainly unmarried men, reported having sex with a CSW. The odds of having multiple sex partners were higher in individuals suspected of alcohol abuse. Nineteen percent of the sample reported sex with a CSW, while 93% of this subgroup was believed to suffer from probable alcohol abuse problems. Individuals with suspected alcohol abuse problems were twice as likely to engage in non-monogamous sex, with inconsistent use of condoms. Two hundred and sixteen individuals reported being in non-monogamous relationships, with inconsistent condom use; of these, 86.6% report probable alcohol abuse problems (Tavarez et al., 2010).

In a small sample of 76 young male army conscripts, the majority of the subjects reported using alcohol in a social setting, where all the individuals in the group would drink. Alcoholic beverages were often consumed in brothels, where the subjects would also have access to FSWs. In this context, alcohol was used to decrease inhibitions when interacting with the women, and to increase sexual pleasure (MacQueen et al., 1996). On the other hand, condoms were reported by army personnel to decrease sexual pleasure, and alcohol consumption provided a socially acceptable excuse not to use a condom (MacQueen et al., 1996).

Brodine et al. (2003) argued that the types of HIV infections identified in a large cohort of 520 recently-infected HIV-positive military personnel reflected the areas of the world where the soldiers were deployed, providing evidence of unprotected sex, possibly with CSWs. For example, 488 patients were infected with HIV-1 subtype B. Individuals with non-subtype-B HIV were likely to be married, and they were likely to have contacted the virus from CSWs outside the USA. Forty four percent of these subjects were heavy alcohol users, this was higher than the overall HIV cohort (OR 2.3, CI 0.6-10.3) (Brodine et al., 2003).

In 881 HIV-positive veterans, Conigliaro et al. (2003) found that hazardous drinking was common. Hazardous drinking was linked to disease progression, as well as the co-occurrence of other conditions such as hepatic co-morbidity and anaemia. Alarming, hazardous drinking predominated in younger individuals and those with detectable viral loads (Conigliaro et al., 2003).

3.5 Migrant workers

As is the case for army personnel, migrant and seasonal workers are another group of individuals who live away from their spouses. Gupta et al. (2010) differentiate between temporarily mobile individuals and permanently mobile individuals. In India for example, most migrants travel in order to provide better conditions for their families, and this may make these individuals less prone to risky sexual behaviour (Gupta et al., 2010). At the same time though, a positive association between the length of time that an individual is mobile for and the number of lifetime sexual partners, including paid sex, was found in a national survey of 124385 women (15 to 49 years) and 74369 men (15 to 54 years) (Gupta et al., 2010). Higher alcohol consumption and a high prevalence of STDs were observed in those migrants who were mobile for the longest periods of time, who used alcohol almost daily, and who engaged in risky sex such as sex with multiple partners and paid sex. A higher incidence of having more than two lifetime partners was found in individuals who used alcohol almost daily (OR 2.94, CI 2.67-3.22, $p < 0.001$) (Gupta et al., 2010). Rodríguez et al. (2010) report that male migrant workers consume alcohol in order to build up the courage to seek out FSWs, overcome emotional distress and prolong the sexual encounter. Similar to the study on young army conscripts (MacQueen et al., 1996), the behaviour of inebriated clients mitigates against FSWs negotiating condom use. Fear of violence affected the negotiation of condom use, sometimes derailing it altogether (Rodríguez et al., 2010).

There are also migrant populations that traditionally have low levels of condom use. Xiao et al. (2010) argue that migrants with a low level of education are unlikely to use a condom regardless of whether they use alcohol or not. While no association was found between alcohol consumption of any kind and condom use in migrants, overall alcohol consumption was high in migrant workers (Lin et al., 2005; Rhodes et al., 2010). In addition, a high number of sexual partners, buying or selling sex, and a history of STDs were common occurrences (Lin et al., 2005; Rhodes et al., 2010). In 2153 sexually experienced young rural-to-urban migrants (1425 male and 728 female), levels of intoxication were elevated among migrants compared to the general population (Lin et al., 2005). Intoxication was more prevalent among male migrants than among female migrants ($p < 0.001$). Alcohol intoxication was associated with multiple sex partners (OR 3.07, CI 1.91-4.95) and buying sex (OR 5.46, CI 2.97-10.04) in males. Intoxicated respondents were significantly more likely to engage in premarital sex and have multiple sexual partners, as well as purchase and sell sex, compared to non-intoxicated respondents (Lin et al., 2005). In a sample of 100 Mexican migrant workers, 10 (40%) of 25 individuals who report having sex in the past 3 months had done so under the influence of alcohol (Rhodes et al., 2010).

In 7602 male migrants, alcohol consumption was found to be linked to having a higher probability of contacting a FSW, and of engaging in unprotected sex (Verma et al., 2010). Those migrants who contacted FSWs were more likely to use alcohol before sex than other migrants. Both alcohol consumption and unprotected sex were higher for those migrants who were mobile for longer periods of time (Verma et al., 2010). Condom use was furthermore inconsistent when male migrants reported alcohol consumption prior to sex with casual partners (OR 0.7, CI 0.6-0.9, $p < 0.01$). Even higher rates of unprotected sex were found when male migrants consumed alcohol and contacted FSWs (OR 2.7, CI 2.1-3.5). About 15% of the total sample of male migrant workers reported sex with FSWs in the last 12 months prior to the survey. The proportion of total male migrant workers who reported

sex with both paid (including FSWs) and unpaid partners in the last year prior to the survey was significantly higher among alcohol users than among the non-users. Among the sub-sample of male migrant workers who are clients of FSWs, inconsistent condom use with non-paying casual partners is significantly higher if they used alcohol prior to sex than those who did not consume alcohol prior to sex (Verma et al., 2010). The number of alcoholic drinks per week was positively associated with unprotected intercourse acts with casual partners in the past 3 months ($p=0.009$) (Amirkhanian et al., 2010).

3.6 Heterosexual couples

The alcohol and condom use patterns of at-risk heterosexual individuals are described in Table 3a, Table 3b and Table 3c.

3.6.1 Heterosexual couples in the United States with unknown HIV status

Raj et al. (2009a) did not find the amount of alcohol consumed before sex to be important with regard to the likelihood of condom use in a sample of 617 at-risk African American men. Fifty three percent of the sample reported never using a condom with the main female partner, and 21% reported never using a condom with casual female partners. Forty nine percent (102) of the sample who reported drinking before sex and 49.1% (53) of the sample who reported drinking to intoxication before sex had unprotected sex. Binge drinking was furthermore found to be associated with sex trade involvement (OR 2.2, CI 1.4-3.5) (Raj et al., 2009a).

In a sample of 301 high-risk males and females, mostly African-Americans living in poor neighbourhoods, binge drinking during the past 30 days was linked with unprotected and casual sex (Towe et al., 2010). However, O'Leary et al. (2006) argued that alcohol consumption is one of several contributors to the HIV epidemic affecting certain at-risk groups, particularly African-Americans.

In a sample analyzing 56 sexual events experienced by 28 homeless women, condoms were used in 19 of these events (Ryan et al., 2009). Condom use was higher when the relationship was perceived as casual, as opposed to more serious. On the other hand, condom use appeared lower when the woman was under the influence of alcohol, however statistical significance could not be established due to the low number of cases investigated (Ryan et al., 2009). Higher condom use with casual partners than main partner was also reported by a sample of 221 incarcerated women (57% identified themselves as white) (Rosengard et al., 2005), as well as 2,864 women (80% African-American) living in high-risk communities throughout the country (Lauby et al., 2001). Binge drinking was reported to lower the intention of the respondents to use a condom at the next sexual encounter with a casual partner (Rosengard et al., 2005). Additionally, the frequency of bingeing, were negatively correlated with the likelihood of condom use (Lauby et al., 2001). Having exchanged sex for money or drugs was also negatively associated with condom use, particularly with a main partner (Lauby et al., 2001).

In a sample of 136 low-income heterosexual women experiencing physical violence by a male partner (63.2% African-American), Cavanaugh et al. (2010) found that while intoxication did not bring about sexual abuse, it may have influenced the partner's decision not to wear a condom, and 14.0% of the sample report that they were frightened to ask their

partner to wear one (Cavanaugh et al., 2010). In a sample of 158 predominantly immigrant Hispanic adult females, the level of intoxication of both the woman and her male sex partner was linked to a younger age of oral sex debut and more life-time sex partners (Dillon et al., 2010). In contrast, Wilson et al. (2010) found that alcohol consumption 5 or more days a week was not linked to having more than 3 sex partners in the past year, but it was associated with all the other risk factors (i.e. having a same sex partner ($p=0.01$), sex with a CSW ($p=0.002$), higher prevalence of other STDs ($p=0.002$)) in a sample of 128 male Mexican immigrants.

At the same time, while binge drinking was correlated with unprotected anal sex in 436 high-risk heterosexual females (70% black), it was only marginally correlated with a past-year history of STDs, but not HIV (Jenness et al., 2011). A history of sexual coercion while under the influence of alcohol was, however, found to be linked with a low likelihood of condom use in 5857 heterosexually active women (67% white). Women who were given alcohol or drugs at coerced sex were more likely to have multiple sex partners and engage in substance abuse (Stockman et al., 2010).

3.6.2 HIV-positive heterosexual couples in the United States

In a sample of 535 HIV-positive African-American couples, alcohol dependency, by either partner, was found to not affect condom use (The NIMH Multisite HIV/STD Prevention Trial for African American Couples Group, 2010). However, this ethnic group is still at risk of HIV infection due to the high number of concurrent sexual partners and concurrent sexual partnerships were found to be especially prevalent among females who scored positive for alcohol abuse (The NIMH Multisite HIV/STD Prevention Trial for African American Couples Group, 2010). While observing that alcohol use decreased the frequency of condom use in 326 AIDS patients, Gerbi et al. (2009) found that ethnicity does not influence this behavior. The frequency of alcohol use was correlated with a higher number of sex partners ($p=0.003$) and lower condom use ($p=0.001$) (Gerbi et al., 2009).

In a sample of 187 sexually active HIV-positive women (aged 18–61) in ambulatory care, binge drinking was found to double the likelihood that a condom was not used at last vaginal sex. Twenty five percent of the sample was classified as binge drinkers (Theall et al., 2007). Sixty two percent of women were found to have used condoms inconsistently. Although alcohol consumption had no influence on the woman's preference to use a condom, the partner has an easier time manipulating the woman into engaging in unprotected sex when the woman was under the influence of alcohol (Theall et al., 2007). In a predominantly white sample of 262 patients (i.e. only 23.7% of participants were African-American) alcohol use is still associated with a higher likelihood of having sex with multiple partners (Stein et al., 2005). In this sample, the negative effect of alcohol on condom use becomes more apparent. Both the likelihood of having any sex and that that sex was unprotected were associated with any alcohol use, number of alcohol use days, number of drinks per drinking day, number of binge drinking days, and hazardous drinking. (Stein et al., 2005).

3.6.3 Heterosexual couples outside of the United States

In a sample of 1370 women in Tanzania, Kapiga et al. (1998) observed that 5.5% of their sample (3.8% of non-drinkers and 9.4% of drinkers) seroconverted during the period

between baseline and follow-up (i.e. a period of 1 to 3 years). Even though condom use was comparable between alcohol drinkers and non-drinkers, sero-conversion risk was found to be higher for those who consumed alcohol (Kapiga et al., 1998). In a Tanzanian sample of men, Ghebremichael and Paintsil (2009) found condom use with a main partner to be low after alcohol consumption in a sample of 789 men, even though 6.5% of the subjects were identified to be HIV-positive. Alcohol abuse was associated with higher STD prevalence. Most of these individuals (88%) were in monogamous relationships, and condom use was therefore low. The only risk behaviour associated with HIV was numerous sex partners in the past 3 years (12% of population) (Ghebremichael and Paintsil, 2009).

Alcohol may enable males to release repressed feelings brought about by social hardship (Emusu et al., 2009), and alcohol abuse by the male partner is a strong indicator of both physical and sexual violence in African countries, with rape being common in these situations (Phorano et al., 2005; Seedat et al., 2009). Since sex is often unprotected in these cases, both the perpetrator and the victim are in danger of acquiring HIV in the case of sero-discordant partnerships. Alcohol abuse by the male partners of 26 women was associated with sexual violence and the sexual abuse of women in this study (Emusu et al., 2009).

In South Africa, sexual violence brought about by alcohol abuse was identified in a sample of 428 men with multiple concurrent female sexual partners. Again, condom use was found to be low in these episodes of sexual violence (Townsend et al., 2011). Alcohol consumption (55%, CI 49.3%-60.2%) and unprotected sex (76.5%, CI 71.5%-81.3%) were found to be HIV risk factors (Townsend et al., 2011).

In a sample of 292 men and 219 women in STD care in South Africa, individuals with a drinking problem were also more likely than individuals without a drinking problem to also be IDUs and to share injection equipment (OR 6.3, CI 2.3 to 17.2, $p < 0.01$), have had an IDU partner (OR 4.6, CI 2.1 to 10.2, $p < 0.01$), have two or more sex partners in the past 3 months (OR 3.0, CI 1.9 to 4.4, $p < 0.01$) and to exchange sex for money or a place to stay (OR 4.8, CI 2.4 to 9.2, $p < 0.01$) (Kalichman et al., 2006). However, no association between problem drinking and engaging in MSM sex was found (Kalichman et al., 2006). Unprotected serodiscordant sex was identified in 1052 men and 679 women being treated in an STD clinic. While the likelihood of using a condom for each serodiscordant sex episode was high overall, alcohol consumption was significantly associated with an increased number of sexual partners, thus leading to a relatively high number of unprotected incidents (Kalichman et al., 2010). Alcohol use before sex was associated with HIV-positive individuals (12 of 34, 36%) and engaging in unprotected serodiscordant sex versus protected sex (31 of 184, 26%) (OR 2.1, CI 0.9-5.0, $p > 0.05$) (Kalichman et al., 2010).

In a sample of 2,618 primary care patients in South Africa (63.8% female and 36.2% male), the prevalence of risky sexual behavior was 26% (Avalos et al., 2010). Sexual risk taking was overall higher for younger individuals (18 to 24 years old), and for men. Among people reporting at least one sexual risk behavior, 51.9% reported hazardous alcohol consumption ($p < 0.001$). Hazardous alcohol consumption was associated with five of the six sexual risk behaviours analyzed: having a partner who ever traded sex for drugs, transportation, or money; having a partner who used injection drugs; having a partner who had an STI; having multiple partners; or failing to use a condom at last intercourse ($p < 0.05$ for all risk behaviours) (Avalos et al., 2010). Similar findings emerged from a study conducted on 488

participants (Andersson et al., 2009). Again, male gender was significantly associated with more sex partners in the previous six months ($p < 0.001$), more casual/anonymous partners ($p < 0.001$) and more one-night stands ($p < 0.001$). Perhaps most worrisome is the finding that males engaged in unprotected sex with known/suspected HIV-positive partners (Andersson et al., 2009).

In another South African study of 395 participants (195 males and 200 females), Wong et al. (2008) observed that while alcohol abuse is still higher in men than in women ($p = 0.001$), women who were recently abused (past 30 days) by their partner were more likely than not to suffer from problem drinking (OR 3.0, CI 1.5 – 5.9, $p = 0.0005$) and depression (odds ratio 3.1, CI 1.5 – 6.2, $p = 0.005$). No correlation between intimate partner violence and depression, alcohol abuse, and sexual risk behaviours were identified in men. Any 30 day alcohol use was only marginally associated with intimate partner violence ($p = 0.08$). For men, intimate partner violence was however linked to the abuse of various drugs ($p = 0.02$) (Wong et al., 2008). Lifetime and past 6 month exposure to intimate partner violence were both comparable between males and females. Lifetime exposure to intimate partner violence was very close to 100% for both genders. Also, rates of depression and sexual risk behaviour were comparable between men and women (Wong et al., 2008).

In a sample of 112 women [60 Black and 52 Coloured (mixed race) persons], ethnic differences in terms of drinking patterns were observed, despite both groups reporting that they had sex while under the influence of alcohol (Wechsberg et al., 2008). For Black women, more alcohol consumption was linked to more frequent sex, although they often reported having only one partner. On the other hand, Coloured women were more likely to have multiple partners (1.53 partners in the past 30 days for Coloured women, vs. 0.98 for Black women) (Wechsberg et al., 2008).

Hargreaves et al. (2002) found an interesting link between alcohol use, age, socio-economic status and HIV prevalence. In a sample of 622 males and 893 females, they observed that alcohol consumption increased with both age and socio-economic status, for both men and women (Hargreaves et al., 2002). Drinking alcohol in the last month was significantly associated with HIV infection for both males and females aged 25–49 years. For both males (OR 1.7, CI 1.0–2.8) and females (OR 1.8, CI 1.0–3.3), there was a high correlation between high alcohol consumption and HIV acquisition. There is also a correlation between non-condom use and HIV infection (OR 3.1, CI 1.3–7.4). Condom use was higher for younger individuals in general, and for women with a higher socio-economic status. Overall, Hargreaves et al., (2002) found that past month drinking was significantly associated with HIV infection in individuals 25–49 years of age.

In a sample of 181 alcohol and/or drug-dependent men and women in India, binge drinking was found to be negatively associated with being HIV-positive, or also being an IDU (Raj et al., 2009b). Moreover 40% of the sample was also IDUs, and 70% of the entire sample reported two or more sex partners in the past three months. Raj et al. (2009b) argue that the effects of alcohol on HIV infection may be masked by the already low rate of condom use in their sample.

In another study conducted in India, current alcohol consumption was found to be associated with higher odds of having premarital sex in a sample of 1,642 never married males and 778 never married females aged 15–24 years. This association was significant in males only (Kumar et al., 2010).

Being under the influence of alcohol by the man was also reported as a reason for risky premarital and extramarital sex among samples of both HIV-positive (Thomas et al., 2009) and HIV-negative individuals in India (Berg et al., 2010). Condom use was very infrequent among males in the HIV-positive sample, comprising of 100 women and 77 men, and it was nonexistent among women. The women however did not blame alcohol consumption for their risky behaviour (Thomas et al., 2009). In an HIV-negative sample of 486 married men living with their wives, drinking was found to lead to domestic violence (Berg et al., 2010), similar to some of the African studies reviewed above. Drinking in public venues means that these men would also have access to FSWs, thus increasing both their and their spouses' risk of HIV infection (Berg et al., 2010). In addition, a direct correlation between the level of alcohol consumption and the degree of domestic violence was found. Heavy drinkers (two or three times a week or more and have three or four drinks or more on a typical day when they are drinking) were 3.5 times and 6.5 times more likely to engage in this behaviour when compared to overindulgent (once a week or less and have three or four drinks or more on a typical day when they are drinking) drinkers and social drinkers (one or two drinks on days in which they drink), respectively (Berg et al., 2010).

In a large sample of 12,617 subjects in India, alcohol consumption was linked to new HIV infections in men only (Dandona et al., 2008). For women, the only significant HIV risk factor was multiple male sex partners (OR 17.85, CI 4.20-75.84) (Dandona et al., 2008). The severity of the alcohol misuse shows a linear association with HIV risk taking in a sample 1137 males (Nayak et al., 2010). Compared to non-hazardous drinking, alcohol abuse (OR 2.35, $p < 0.05$) and alcohol dependence (OR 3.55, $p < 0.001$) were significantly associated with risk behaviour. Among 433 drinkers (38.1% of the entire sample), the prevalence of hazardous drinking was 56.4%. While condom use is not discussed, current drinking is associated with HIV risk factors in general (OR 6.15, CI 3.70-10.22, $p < 0.001$) (Nayak et al., 2010). S.K. Singh et al., (2010) in a study conducted in India, found that married men find themselves in situations where they are expected to drink more and to have sex with partners other than their spouses, but at the same time they are expected to use condoms with these partners. As a consequence, condom use with casual partners was found to be 14 times higher than with main partners, regardless of whether the men were married or not ($p < 0.01$) (S.K. Singh et al., 2010).

3.7 Men Who Have Sex with Men

Using a large sample of 1,050 in-care HIV-positive individuals (496 MSM (47% of the entire sample)), Golin et al. (2009) found that binge drinking at least once a week and alcohol consumption before sex were more prevalent in MSM than they were in women and heterosexual men (Golin et al., 2009). The likelihood of having unprotected sex was higher for MSM than it was for men who have sex with females (MSW), but it was lower than it was for women. In addition, the proportion of MSM who reported that alcohol consumption made sex less safe was higher than the sample average (Golin et al., 2009). Alcohol, at all levels of use, was associated with increased sexual risk taking in a sample of 262 HIV-positive individuals (47 MSM). In a study of 166 sexually active individuals, 99 (59.6%) reported unprotected sex (Stein et al., 2005). Increased odds of having any form of sex, including unprotected sex, was associated with any use of alcohol, number of alcohol use days, number of drinks per drinking day, number of binge drinking days, and hazardous

drinking. In this sample, MSM were identified as engaging in unprotected sex almost three times as often as any other group, including IDUs ($p < 0.05$) (Stein et al., 2005). In general, hazardous drinkers were found to be 5.64 times more likely to have multiple partners and to engage in unprotected sex, when compared to non-hazardous drinkers ($p < 0.01$). This was once again more pronounced in MSM (Stein et al., 2005). The number of drinks on a typical drinking day was positively associated with unprotected sex in 321 methamphetamine-using, HIV-positive MSM ($p < 0.05$) (Semple et al., 2010). In a sample of 478 AIDS-positive MSM, Bouhnik et al., (2007) found that unprotected sex with casual partners was widespread, and it was even more frequent with main partners than it is with casual partners, putting the regular partner at risk of HIV-infection. In comparison to their American counterparts, French MSM are more prone to unprotected sero-discordant sex following binge drinking (Bouhnik et al., 2007). While protected sex is higher with casual partners than with regular partners, further evidence that alcohol consumption still lowers the likelihood of protected sex with a casual partner is provided by Folch et al. (2009). In a cohort of 850 MSM, alcohol use before sex was associated with unprotected sex with casual partners (Folch et al., 2009).

Alcohol use before sex has been directly linked with HIV sero-conversion. In a large cohort of 4,295 initially HIV-negative MSM who were in a non-monogamous relationship with an HIV-negative partner, Koblin et al. (2006) attribute 29% of sero-conversions within a 48 month period to alcohol use. Overall, 72.1% of men reported using alcohol or drugs before having sex. Sero-conversion was achieved mainly through unprotected sex with a large number of sex partners. The highest risk of sero-conversion (32.3%) was associated with having four or more male partners (OR 2.84, CI 1.72 to 2.69) (Koblin et al., 2006). Problem drinking was associated with unprotected sex with a sero-discordant male partner, as well as unprotected vaginal or anal sex with female partners and transgender partners among 197 African-American MSM (Reisner et al., 2010). Problem drinking was also associated with unprotected sex with a transgender person (OR 5.23, CI 1.26-21.69, $p < 0.02$) and unprotected vaginal or anal sex with a female (OR 3.25, CI 1.70-6.24, $p < 0.004$) (Reisner et al., 2010).

The link between education and alcohol abuse in MSM populations is unclear. While Reisner et al., (2010) in the US and Tripathi et al., (2009) in Estonia in a sample of 79 MSM report that alcohol being linked to unprotected sex is a more frequent problem among individuals without a university degree, Mackesy-Amiti et al., (2010) found alcohol dependence to be relatively high in a sample of 187 MSM made up predominantly of employed individuals with a college education or higher. Even in this sample of well-educated individuals, both receptive and insertive unprotected anal sex were reported by almost one third of the sample, and 32% reported sex with a partner whose HIV status was positive or unknown (Mackesy-Amiti et al., 2010). In a sample of 378 black MSM, higher monthly income, as well as purchasing and exchanging alcohol and drugs for sex were linked with a higher likelihood of being HIV-positive (Lane et al., 2009).

The risky sexual behaviour of MSM is likely to have wider ramifications than the group itself, as 83.8% of a sample of 68 African-American MSM report concurrent sexual relations with both males and females (Operario et al., 2009). Alcohol consumption and sex while under the influence of alcohol were high in this population, as were concurrent unprotected

relationships with both males and females. There was evidence for concurrent partnerships across gender groups as well as concurrent unprotected sex partners. Overall, 73.5% reported having had recent (3 month) concurrent sexual partnerships with more than one gender group (Operario et al., 2009).

Alcohol consumption has been found to be associated with unprotected MSM in other countries as well. Studies from Canada (Lambert et al., 2009), Australia (Prestage et al., 2009), Spain (Folch et al., 2009), Estonia (Tripathi et al., 2009) and Mexico (Mendoza-Pérez et al., 2009) report this. In addition, Lambert et al., (2009) report alcohol consumption two hours before sex was higher when the partner was casual, than when the partner was in a stable relationship with the subject of the study in a sample of 965 MSM who reported having sex with a partner with whom they were not in a couple relationship at last sexual episode. Van Griensven et al., (2010) found that alcohol consumption led 823 MSM to have more frequent sex, as well as more unplanned sex, with both casual and male CSWs. At the same time, sex frequency was not linked to condom use (van Griensven et al., 2010). In a sample of 566 MSM, Tsui and Lau (2010) argue that the way in which an MSM picks his partner will determine the type of risk that he is willing to take, in terms of condom use, as well as the likelihood that they will consume alcohol prior to sex. To this avail, Chinese MSM who recruit their partners from public venues are more likely to consume alcohol and to have multiple sex partners, while MSM who recruit their partners through the internet are more likely to have unprotected sex, be infected with STDs, and buy or sell sex, independent of alcohol consumption (Tsui and Lau, 2010).

3.8 Injecting drug users

Being an injecting drug user is a risk factor for HIV infection (Sander et al., 2010). In a large, longitudinal study of drug users (72% male, 90% African-American) IDUs were found to be at increased risk of greater alcohol consumption compared to non-IDUs. As greater alcohol consumption is further linked to having more sex partners, a greater risk of HIV infection exists among IDUs (Sander et al., 2010). Among IDUs, alcohol consumption and binge drinking in particular have been found to be associated with needle sharing (Arasteh and Des Jarlais, 2009; Matos et al., 2004; Poudel et al., 2010; Stein et al., 2000), multiple sex partners (Arasteh and Des Jarlais, 2009; Chan et al., 2010; Matos et al., 2004; Poudel et al., 2010), sex under the influence of alcohol and/or drugs (Chan et al., 2010), sex with CSWs (Arasteh and Des Jarlais, 2009), sex with a paying customer (Matos et al., 2004), unprotected sex (Arasteh and Des Jarlais, 2009; Chan et al., 2010; Jenness et al., 2010; Matos et al., 2004), and injecting three or more times a day (Matos et al., 2004). For example, the odds ratio for sharing needles while intoxicated (compared to being sober) was 2.1 (CI 1.1-4.3) in a sample of 557 IDUs (89.4% male) (Matos et al., 2004). In the same sample, alcohol intoxication is associated with exchanging sex for money or drugs (Matos et al., 2004). Increasing alcohol use and alcohol addiction was associated with more frequent needle sharing and increased HIV transmission in a population of 196 (68% male, 85% white) active IDUs in care (Stein et al., 2000). In this sample, alcohol abusers were more likely to share needles than non-abusers (OR 2.3, CI 1.2-4.4, $p=0.01$), and a direct correlation between increasing alcohol consumption and more frequent needle sharing was found (Stein et al., 2000). Condom use was higher when neither partner was intoxicated, and it was higher overall when the partner was deemed as casual, as opposed to a main partner in 1253 HIV-positive IDUs (81% male, 50% Hispanic, 36% African-American) (Arasteh and Des Jarlais, 2009).

Using a large sample of 9,519 adolescent IDUs (71.6% male, 41.4% Caucasian), Chan et al. (2010) found that the degree of risk taking is comparable between male and female subjects. The most prevalent sexual risk behaviour was having multiple sexual partners (39.3% of the sample). Gender differences were still identified, with women reporting more unprotected sex than men as well as sex with more IDU partners, while men reported more sex partners than women (Chan et al., 2010). Moreover, women were more likely to be IDUs themselves, when compared with men. These women were also more likely to have sex while under the influence of alcohol or drugs, and to trade sex for money or drugs (Chan et al., 2010). About 7% of adolescents reported using alcohol or drugs to make sex last longer or hurt less. Older age was associated with higher risk taking in terms of sex while under the influence of alcohol or drugs, unprotected sex, and multiple sex partners (Chan et al., 2010). On the other hand, higher education, older age and female gender were both associated with lower alcohol consumption, particularly binge drinking, among IDUs (Sander et al., 2010). African-American youth were less likely to engage in sexual activities after consuming alcohol or drugs, yet they were generally more likely to engage in sex with multiple partners. Additionally, there seems to be an association between the severity of substance abuse and the degree of risk taking leading to STDs (Chan et al., 2010).

The overall risk of having an IDU partner among 601 at-risk, non-IDU heterosexuals (57.4% female, 78.5 Black) was 13.8%. Binge drinking at least once a week was associated with a significantly higher risk of having an IDU sexual partner (OR 1.73, CI 1.08–2.76, $p=0.02$) (Jenness et al., 2010). Partners of IDUs were found to abuse alcohol and non-injectable drugs, and to practice unprotected sex with multiple partners (Jenness et al., 2010). HIV prevalence was high in this cohort of heterosexual New York individuals, and higher odds of testing positive for HIV were found among older individuals, and among those who had IDU sex partners (Jenness et al., 2010). A high prevalence of HIV was reported in another study analyzing a cohort of 296 IDUs (Poudel et al., 2010). In this study, 59% of 213 sexually-active participants reported multiple sex partners (Poudel et al., 2010).

In a sample of 240 IDUs, Parry et al. (2008a) found that needle sharing takes place primarily with close friends and less frequently with strangers. In addition, HIV-positive IDUs report being more responsible about their disposal practices (Parry et al., 2008a). Interestingly, Parry et al., (2008a) found that IDUs often have sex with CSWs and MSM, thus creating a “bridging” effect, where HIV can be spread among individuals from these three vulnerable groups. At the same time, IDUs can also be CSWs or MSM themselves. In a sample of 78 IDU MSM, drug use led to sexual risk taking and needle sharing, despite HIV risk knowledge being high (Parry et al., 2008a). Further “bridging” was observed in this study, as these MSM would have sex when high with both men and women (Parry et al., 2008a).

3.9 Emerging adults

3.9.1 United States

The findings of studies looking at the link between alcohol and HIV risk behaviours are listed in Table xx. When looking at emerging adults in the United States, males seem to be the ones more likely to consume alcohol prior to sex (Apostolopoulos et al., 2003; Murphy et al., 2009; Alleyne et al., 2010; Nkansah-Amankra et al., 2010). The major risk factor associated with alcohol consumption was identified as having multiple sex partners

(Alleyne et al., 2010; Nkansah-Amankra et al., 2010). Within a sample of 1,474 high school students (grades 9–12), Latino males were found to take the most risks in terms of sexual behavior (Nkansah-Amankra et al., 2010). These risks include low HIV education, high alcohol consumption, particularly current binge drinking, and a high number of sex partners (Nkansah-Amankra et al., 2010). Ethnicity has also been linked to risk taking for university students. For example, in a sample of 222 black students and 335 white students, Hou (2009) found that African-American students were safer in terms of condom use and alcohol consumption prior to sex, but at the same time were 1.71 times as likely to engage in vaginal sex as white students, and they start doing so at a younger age (Hou, 2009). Another study looking at a large sample of American adolescents also found a lower level of sexual abstinence among African-American subjects, but at the same time more individuals in this group indicated that they always or almost always used a condom. Values for white and Latino individuals were comparable (Murphy et al., 2009). Alcohol consumption was found to be lowest in African-American women within a sample of 425 undergraduate-students enrolled full-time (Randolph et al., 2009). Frequent drinking for non-African-American women and frequent binge drinking for older men were once again linked to a higher number of sex partners. At the same time, younger age and a better understanding of the HIV risk were associated with higher prevalence of condom use for both men and women (Adefuye et al., 2009; Randolph et al., 2009). In addition, certain personality traits, for example sensation seeking, impulsivity, and disinhibited behavior due to alcohol consumption were indicators of unprotected sex in two samples ($n=270$ and $n=490$, respectively) of sexually-active college students (Sheer and Cline, 1995; Xiao et al., 2010). In a sample of 390 students, having consumed at least one drink in the past 30 days was associated with not using a condom in both males (OR 1.24, CI 0.57-2.72, $p \leq 0.05$) and females (OR 1.81, CI 1.06-3.10, $p=0.04$). Having consumed alcohol in the past 30 days was a predictor of no condom use for females, especially those over 30 years of age (OR 3.43, CI 1.33-8.86, $p=0.01$) (Adefuye et al., 2009). The implications of this finding must be considered in light of the fact that many of these women also report fewer partners, and condom use is overall low in monogamous relationships (Adefuye et al., 2009). No link between number of sexual partners and condom use was found (Sheer and Cline, 1995; Randolph et al., 2009). At the same time, planned sex (OR 1.28, CI 1.04–1.59) and sex with a casual partner (OR 3.84, CI 2.30-6.41) were linked with higher condom prevalence in a population of 112 adolescents (Morrison et al., 2003). While Morrison et al. (2003) did not find a link between either alcohol consumption or the amount of alcohol consumed before sex and condom use, Murphy et al. (2009) found a direct positive correlation between the amount of alcohol consumed and the degree of risk taking in a large sample of 8,208 youth. Unfortunately, the latter study failed to separate condom use from the number of sexual partners, when discussing high risk behaviour (Murphy et al., 2009).

Two other at-risk categories of emerging adults have been identified: club goers and spring breakers. Binge drinking was associated with sex after drinking in a sample of 308 young adults at nightclubs (Wells et al., 2010). The number of drinking days, especially binge drinking days, was positively associated with sex after drinking, and white subjects indicated more frequent drinking. Younger club-goers were more likely to have sex after drinking than older respondents (OR 1.75, CI 1.01-3.03). Younger club-goers also reported less safe sex after drinking (OR 2.34, CI 1.22-4.50) (Wells et al., 2010). For this group, drinking frequency was associated with less safe sex, however the amount of alcohol

consumed was not important, as no association between unsafe sex and binge drinking was found (Wells et al., 2010). In a sample of 532 spring breakers (321 female and 211 male), 49% of men and 38% of women reported having sex as a direct result of drinking (Apostolopoulos et al., 2003). In this group, one third of individuals report that alcohol consumption led them to have unprotected sex, and the ratios were comparable between males and females (Apostolopoulos et al., 2003).

Alcohol drinking has been associated with dating violence in a population of 2438 high school students (grades 9 to 12) (Alleyne et al., 2010). Alcohol consumption during the last sexual experience was significantly higher in males than in females ($p < 0.01$). At the same time, condom use ($p < 0.001$) and multiple sex partners in the last 3 months ($p < 0.01$) were also higher in males. Interestingly, men reported to have experienced more dating violence, but females have experienced more forced sex (Alleyne et al., 2010). In a study on undergraduate students in southern US, older respondents reported more frequent binge drinking episodes, but these are once again accompanied by a higher number of sex partners and a higher likelihood of condom use (Randolph et al., 2009). The group reporting the lowest alcohol use was African-American females (Randolph et al., 2009).

3.9.2 Outside of the United States

Young individuals use alcohol “to have fun”. A study conducted among 490 sexually active college students in China revealed that despite knowing the risk associated with unprotected sex, alcohol consumption diminished condom use (Xiao et al., 2010). While there seems to be almost general consensus that alcohol consumption leads to sex, the link between alcohol use and condom use is less clear. For example, alcohol use was linked to sexual initiation in two samples of secondary school students. However, condom use was very high in a sample of 768 students (Tavares et al., 2009), while it was more inconsistent in a sample of 3,575 students (Campo-Arias et al., 2010). In the latter study, alcohol consumption was linked to risky sexual behaviour (OR 2.50, CI 95%, 1.3-5.1) (Campo-Arias et al., 2010). Tavares et al. (2009) attribute these differences to a better education and wider access to information regarding HIV/AIDS that was available to the students in their sample.

Several African studies, particularly from South Africa, will be discussed below. In a sample of 511 individuals, Singh K. et al. (2010) found that the highest number of sexually-active teenagers was among those recruited from venues that served alcohol. Individuals recruited in the nightlife/drinking venues, particularly 15 to 24 year olds reported the greatest alcohol consumption. Among them particularly women with the highest number of sexual partners reported the riskiest sex. This sample does not report the highest condom use (Singh K. et al., 2010). In a large sample of 4,724 young women and 4029 young men (12-25 years), having ever used alcohol was significantly associated with a lower age of first sex for both men and women (McGrath et al., 2009). In a study on 661 grade 9 students, alcohol and HIV prevention education affected HIV-related risk factors (Karnell et al., 2006). While it did not have any effects on alcohol-related risk factors in those individuals who had already had sex before pre-test, fewer students who had not had sex prior to pre-test were likely to drink or to report that their partner drank prior to sex. Sexual activities while under the influence of alcohol were significantly reduced ($p < 0.05$), and females increased their sex refusal self-efficacy ($p < 0.05$) following intervention (Karnell et al., 2006). Perhaps worrisome is the

finding by Morojele et al. (2006b) that some of the boys from a sample of 61 adolescents (12 to 17 years) stated that they could obtain a more positive status by having multiple sex partners, and by having unprotected sex. In addition, some boys enjoyed the thrill of having multiple sex partners (Morojele et al., 2006b).

4. Discussion

It is difficult to summarise the findings across the studies within the selected high risk groups and more so across the high risk groups because of the varied study designs, the difficulty of accurate measurements of the variables and the complexity of the subject matter. Female commercial sex workers are a particularly vulnerable group for contracting HIV group as they experience additional risk for contracting HIV resulting from biological susceptibility and factors related to gender inequality that often involves economic dependence on sexual partners. However this designation, namely the most at risk of the high risk groups may not be that relevant as there are often, sexual partnerships across the high risk groups as well as between the high risk groups and the general population.

4.1 Female Sex Workers (Table 1a)

The 17 selected studies in this group reflect a wide range of alcohol use patterns. HIV status is not reported in many of the studies. In general, alcohol use is more likely lead to inconsistent condom use. Chersich et al. (2007) in a study conducted in Mombasa, Kenya found that binge drinking was associated with inconsistent condom use (OR 1.59, CI 1.00-2.53, p=0.047). Furthermore, condom use appears to be a function of the situation in which a woman finds herself in, and the amount of control that she has over the situation. The use of alcohol by commercial sex workers and their clients also leads to more aggressive behaviour and sexual violence; the latter generally excludes condom use.

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status
Todd et al. 2010	Jalalabad, Kabul, and Mazar-I-Sharif, Afghanistan	Only 4.7% of 520 FSWs report having ever used alcohol	30.2% of FSWs had ever used a condom with a client Of these, 38.2% (60) report always using condoms with clients	Prevalence of HIV was 0.19%
Rogers et al. 2002	Beijing, China	42% of women and 32% of their clients report alcohol consumption during sex work	61% of women reported consistent condom use	
Wang et al. 2010	Nanning, Guangxi Zhuang, China	29.4% of women reported having had sex with their clients after drinking alcohol	Inconsistent condom use over their life time was significantly associated with drinking alcohol before having sex with a client (p<0.05)	
Bowen et al. 2010	Nagaland, India	Alcohol use is widespread 68.5% of FSWs interviewed were regularly using alcohol or other drugs	Condom were used 65.3% of times in the past week	
Go et al. 2010	Chennai, Tamil Nadu, India	Women who had a strong tendency to drink alcohol before sex were more likely to have more partners and to have experienced forced sex	Women who reported >20 days of alcohol consumption in the last 30 days were more likely to have unprotected sex	

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status
Samet et al. 2010	Mumbai, India	Overall, 38% of FSWs drink 11% are alcohol dependent 32% are heavy alcohol consumers (>7 drinks per week or >3 drinks on a single occasion)	90% of women reported inconsistent condom use during transactional sex over the last year	HIV-positive
Verma et al. 2010	India	62.0% report alcohol consumption in the last month 53.8% report alcohol consumption prior to sex	Overall, inconsistent condom use was reported 58.5% of times	39.9% who had ever consumed alcohol were HIV-positive 37.3% (84/225) of binge drinkers 23.2% (36/155) of lifetime-alcohol abstainers
Chersich et al., 2007	Mombasa, Kenya	33.0% were binge drinker 44.7% were non-binge drinkers 22.4% were abstainers	Binge drinking was associated with inconsistent condom use (OR 1.59, CI 1.00-2.53, p=0.047)	
Witte et al. 2010	Ulaanbaatar and Darkhan Uul, Mongolia	92% of women consume alcohol on a typical day (19%, 1 to 2 drinks; 29%, 3 to 4 drinks; 27%, 5 to 6 drinks; 4%, 7 to 9 drinks; 13%, 10 or more drinks) 44% (n=21) consumed five or more drinks per day 19% had consumed alcohol before commercial sex 37% reported engaging in sex with inebriated customers	69% (n=33) reported using condoms inconsistently with paying partners 38% (n=18) reported being less likely to use a condom with a paying partner after using alcohol	
Chiao et al. 2006	Southern Philippines	Education about HIV/AIDS decrease the daily amount of alcohol consumed 18% of women reported daily alcohol use during the previous 30 days	Alcohol consumption with a customer was significantly associated with condom use (p<0.01) Education about HIV/AIDS increases the likelihood that a condom would be used	
Morisky et al. 2010	Southern Philippines	FSWs were more likely that female non-SWs to be diagnosed with an alcohol or drug abuse disorder	Sexual abuse was associated with a lower chance of using a condom (p<0.01)	19.0% were HIV-positive HIV prevalence was 22.4% among alcohol drinkers, and 9.5% among abstainers
Wechsberg et al. 2005	Pretoria, South Africa		Not discussed	
Wechsberg et al. 2009	Pretoria, South Africa			
Fisher et al. 2008	Moshi, Tanzania	73.9% women in the cohort had consumed alcoholic beverages and the prevalence of problem drinking at baseline was 34.6%	Interestingly, non-drinkers were more likely to have not used a condom during their last sex	The use of a condom appears to be more a function of situational negotiation and the woman's control over the outcome Condoms were used consistently 91% of times for vaginal sex. Only 17% of respondents report always using a condom with their main partner
Fisher et al. 2010	Moshi, Tanzania	The greatest risk of condom failure (19.4%) occurred when the woman alone had been drinking (OR 14.05, CI 4.03-50.41)		
Nemoto et al. 2004	San Francisco, California, United States	67% report some alcohol consumption during the past 30 days 14% report consuming alcohol with a customer		No woman reported being HIV-positive
Nemoto et al. 2008	Chi Minh City, Vietnam	89% of participants report alcohol consumption in the past year A total of 71% of FSWs report having had sex under the influence of alcohol A total of 90% of FSWs report consuming alcohol with customers	Inconsistent condom use was reported by 85% of bar/club FSWs, 72% of massage parlour FSWs, and 68% of street FSWs	Prevalence among those who had an HIV test was 7%; 18% of the street FSWs tested positive; 7% of bar/club FSWs tested positive

Table 1a. Female Sex Workers

4.2 Clients of Commercial Sex Workers (Table 1b)

In the 6 selected studies in this group many reported high levels of alcohol consumption. In one study by Havanon et al. (1993) in Thailand, 82% report that drinking accompanies commercial sex. Samet et al. (2010) for a study in Mumbai, India, shows heavy alcohol consumption was significantly associated with inconsistent condom use in male clients of FSWs (OR 2.40, CI 1.21-4.77, p=0.01). Not all selected studies in this group reported HIV status.

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Madhivanan et al. 2005	Mumbai, India	Men who report sex with a FSW, they were more likely to have consumed alcohol before sex (OR 1.5, CI 1.2-1.9, p<0.001)	Men who report sex with a FSW were more likely to have had unprotected sex (OR 1.9, CI 1.4-2.6, p<0.001)	1683 subjects had an HIV test with HIV prevalence of 14%	Heterosexual males
Samet et al. 2010	Mumbai, India	44% of men were heavy alcohol users (>14 drinks per week or >4 drinks on a single sitting)	Heavy alcohol consumption was significantly associated with inconsistent condom use in male clients of FSWs (OR 2.40, CI 1.21-4.77, p=0.01)	HIV-positive	Heterosexual males
Thomas RM et al. 1990	Edinburgh, Scotland	Over 75% (sometimes) and 40% (regularly) of subjects consumed alcohol before contacting a CSW	Alcohol use was inversely associated with condom use with male CSWs (p=0.027), but not with FSWs		Mostly male subjects: 175 had contacted FSWs; 26 had contacted MSWs; 5 had contacted both FSWs and MSWs
Dissabandara et al. 2009	Sri Lanka	54.5% used alcohol on a regular basis (weekly or more) 16.8% reported daily alcohol consumption	Of 67.3% of subjects who report having sex with a CSW, only 14.4% reported regular condom use		Heterosexual males
Havanon et al. 1993	Thailand	82% report that drinking accompanies commercial sex, while 74% of them report to have been drunk	Nearly 50% of subjects usually use condoms, and students usually use condoms 77% of times		Males
Fritz et al. 2002	Harare, Zimbabwe	84% of subjects identified themselves as alcohol drinkers	Sex while intoxicated was associated with 20 times more unprotected sex with casual partners and 27 times more unprotected sex for those paying for sex	Overall, 96 subjects were HIV-positive	Male

Table 1b. Clients of Commercial Sex Workers

4.3 Army personnel (Table 2a)

People who live for prolonged periods far from their home may be considered migrants. Among army personnel and migrant workers alcohol consumption is very high, leading to multiple sex partners, including CSWs. HIV status is provided in three of the four studies in this group. Studies on army personnel show inconsistent condom use coupled with alcohol consumption, with many in non-monogamous relationships (Brodine et al., 2003; MacQueen et al., 1996; Tavarez et al., 2010).

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Tavarez et al. 2011	Border-crossing zones on the western border of the Dominican Republic	Alcohol abuse is a predictor of sex with a CSW (OR 4.80, CI 2.00-11.30, p<0.001)	Alcohol abuse is an indicator of non-monogamous, unprotected sex (OR 2.8, CI 1.7 -4.4)		Male
MacQueen et al. 1996	Phitsanuloke Province, Northern Thailand	Alcohol consumption is described as very high in this qualitative study	Alcohol virtually eliminates the willingness of the male to use a condom	7% of men were HIV-positive	Heterosexual Males
Brodine et al. 2003	United States	64% of the cohort reported moderate to heavy alcohol consumption, defined as five drinks per session, two to three times monthly 351 (40.40%) are present drinkers 289 (33.1%) are binge drinkers (≥6 drinks on 1 occasion) 310 (35.5%) were hazardous drinkers (binge drinkers or scored ≥8 on AUDIT)	Overall, condom use was very limited, and this can be attributed to alcohol use during sex	HIV-positive	Heterosexual Males
Conigliaro et al. 2003	Pittsburg, Pennsylvania			HIV-positive	99% of the sample were male MSM made up 36% of the sample

Table 2a. Army Personnel

4.4 Migrant workers (Table 2b)

There were five studies selected for this group. One study by Gupta (2010) showed that HIV prevalence was higher among migrants than it was among non-migrants (0.60% versus. 0.33%), particularly those who drank almost every day (1.36%). Xiao et al. (2010) argue that migrants with a low level of education do not use condoms whether they bring into play alcohol or not. Verma et al. (2010) illustrated greater alcohol consumption and higher rates of unprotected sex for migrants who were away from home for prolonged periods. This study, conducted in India, reported alcohol use prior to sex in general as significantly higher in highly mobile, male migrant workers (OR 1.5, CI 1.2-1.7).

4.5 Heterosexual couples

4.5.1 In the United States with unknown HIV status (Table 3a)

Ten studies were selected for inclusion in this group. In a study by Cavanaugh et al., 2010, a woman’s alcohol problem was associated with unprotected sex with a non-monogamous primary partner. In an earlier study by Lauby et al., 2001 binge drinking correlates with low condom use with both main partner and casual partners (p<0.001) Condom use was lower overall with main partner than it was with casual partners.

4.5.2 HIV-positive heterosexual couples in the United States (Table 3b)

Five studies were selected for this group. One by Theall et al. 2007 found that alcohol consumption was associated with the partner refusing to use a condom. Another, based on findings by The NIMH: Multi-site HIV/ STD-Prevention Trial for African American-Couples Group, 2010 showed that females were less likely to be alcohol dependant (9.09%) than males (14.96%), (OR 1.65, CI 1.15-2.36). Alcohol use correlated with a higher number of sex partners and lower condom use (Gerbi et al., 2009).

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Lin et al. 2005	Beijing and Nanjing, China	34.6% of the participants had been intoxicated at least once during the previous month	No association between alcohol intoxication and condom use was found		Both males and females
Gupta et al. 2010	India	6408 (8.6%) of men drink once a week 2358 (3.2%) of men drink almost daily	Condom use with a paid partner was highest for those who used alcohol almost daily (p<0.001)	HIV prevalence was higher among migrants than it was among non-migrants (0.60% vs. 0.33%), particularly those who drink almost every day (1.36%)	Both males and females
Verma et al. 2010	India	Alcohol use prior to sex in general is significantly higher in highly mobile male migrant workers (OR 1.5, CI 1.2-1.7)	Approximately one third of men report inconsistent condom use with paid partners		Heterosexual males
Amirkhanian et al. 2010	St. Petersburg, Russia	Participants report consuming 4.3 drinks per week	Mean percentage of condom use was 35.0%		Males
Rhodes et al. 2010	North Carolina, United States	Nearly 10% of the sample reported drinking alcohol every day or nearly every day Nearly 58% reported binge drinking during the past year	Alcohol consumption does not decrease condom use		Heterosexual males

Table 2b. Migrant Workers

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Lauby et al. 2001	Philadelphia and Pittsburgh (Pennsylvania), Portland (Oregon), Oakland and San Francisco (California)	Binge drinking correlates with low condom use with both main partner and casual partners (p<0.001)	Condom use was lower overall with main partner than it was with casual partners		Heterosexual females
Rosengard et al. 2005	Rhode Island Department of Corrections Women’s Division	17.2% report weekly binge drinking	From 40% of women who report casual partners in the past 3 months, 47% of them report consistent condom use		Heterosexual females
O’Leary et al. 2006	A representative sample of the United States population (census data), with particular focus on Georgia, Louisiana, Alabama, Florida, South Carolina, North Carolina and Mississippi	There are significantly fewer lifelong drinkers in this region, particularly in the disproportionately-affected populations, such as African-American individuals, and young African-American females	Not discussed		Heterosexual males and females
Ryan et al. 2009	Los Angeles county, California	15 of 56 sexual events involved alcohol consumption	Condoms were used in 19 of 56 sexual events A woman’s alcohol problem was however associated with sexual risk behaviour (OR 1.24, CI 0.46-3.54); 11.0% of women report unprotected sex with a non-monogamous primary partner		Heterosexual females
Cavanaugh et al., 2010	New Haven, Connecticut	89.7% of women used alcohol in their life 50.7% of women have used alcohol to intoxication during the past 6 months			Heterosexual females
Dillon et al. 2010	Miami, Florida	Alcohol intoxication before sex was associated with younger age of oral sexual debut (p<0.01), as well as more sex partners (p<0.01)	Not discussed		Heterosexual females

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Jenness et al. 2011	New York City, New York	41.7% were binge drinkers	Overall, 38% of women had unprotected anal intercourse 47.3% of those who had unprotected anal sex in the past year were binge drinkers	9% were HIV +	Heterosexual females
Stockman et al. 2010	Nationally-representative sample of the United States	Approximately 30% of women were given alcohol or drugs prior to sexual coercion	Among 1085 women with more than 1 male sex partner in the past year, 69.0% reported no condom use at last vaginal sex 84% reported having unprotected sex during the past 12 months		Heterosexual females
Towe et al. 2010	Baltimore, Maryland	Binge drinking during the past 30 days is linked with unprotected sex (OR1.18, CI 1.04-1.33, p=0.008)	Unprotected sex was higher with a main partner (84%), compared to a casual partner (63%)	10 (3%) were HIV +	Heterosexual males and female
Wilson et al. 2010	Dallas, Texas	92.2% of the sample consume alcohol; 14.4% of those reporting alcohol consumption do so more than 5 times a week	Of the 108 men who reported having had sex in the past year, 54% reported very limited or non-existent condom use. Only 17% report always using a condom		Heterosexual males

Table 3a. Heterosexual Couples in the United States with Unknown HIV Status

Study Authors	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Subject-Gender and Sexual Orientation
Stein M. et al. 2005	Brown University, Providence Rhode Island	Hazardous drinking has a statistically higher association for having any sex compared to binge drinking (p=0.0001 vs. p=0.001)	A higher probability of unprotected sex was associated with any use of alcohol	HIV-positive	67% of patients were self-identified as heterosexual
Theall et al. 2007	New Orleans, Louisiana	Approximately 25% of the women were classified as bingers	Alcohol consumption was associated with the partner refusing to use a condom (OR 1.58, CI 1.30-8.41)	HIV+; 16% report that their last partner was also HIV +	Heterosexual females; 23% report more than one male partner in the last year
Gerbi et al. 2009	Montgo-mery, Alabama	Men were significantly more likely than women to drink alcohol before sex	Alcohol use before sex was correlated with lower condom use (74% of those who do not drink before sex vs. 43% of those who drink before sex report using condoms most of the time, p=0.0001)	AIDS-positive	Heterosexual males and females
Golin et al. 2009	Seven HIV clinics in six US cities	6% of the sample report always using alcohol before sex, and 63% never using alcohol before sex	12.3% of the sample report unprotected sex with an at-risk partners in the past 3 months	HIV-positive	Heterosexual males
The NIMH: Multi-site HIV/ STD-Prevention Trial for African American-Couples Group, 2010	Atlanta, Los Angeles, New York Philadelphia	Females were less likely to be alcohol dependant (9.09%) than males (14.96%) (OR 1.65, CI 1.15-2.36)	Condom protected sex was significantly lower in females (p=0.0018)	One partner in the couple was HIV +	Heterosexual males and females

Table 3b. HIV-positive Heterosexual Couples in the United States

4.5.3 Outside of the United States (Table 3c)

Eighteen studies were included for this group: An Indian study by Kumar et al, 2010, found that current consumption of alcohol is associated with premarital sex among males only (OR 3.5, CI 2.53-4.83, $p<0.001$).¹ The study also found that condom use in rural areas was lower than in urban areas however this was significant only for males. In SA, violence, often of a sexual nature, perpetrated by men under the influence of alcohol, against women is of particular concern (Seedat et al., 2009). In a Cape Town study condom use was found to be low in these episodes of sexual violence (Townsend et al., 2011).

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Dandona et al. 2008	Guntur district, Andhra Pradesh, India	Consuming alcohol before sex was associated with HIV in males only (OR 3.60, CI 2.08-8.22)	Not discussed	Not quantified	Heterosexual males and females
Thomas BE et al. 2009	Chennai, India	16.7% of men and 0% of women report alcohol consumption	More than 80% of men 100% of women reported that they did not use condoms	HIV-positive	Heterosexual males and females
Berg et al. 2010	Navi Mumbai, India	Drinking patterns ranged from social drinking to overindulgent and heavy drinking	Not discussed		Heterosexual males
Kumar et al. 2011	Guntur district, Andhra Pradesh, India	Current consumption of alcohol is associated with premarital sex among males only (OR 3.5, CI 2.53-4.83, $p<0.001$)	Condom use in rural areas was lower than in urban areas, however this was significant only for males		Heterosexual males and females
Nayak et al. 2010	Karnataka, India	Among drinkers, the mean quantity of alcohol consumed was 60 g (5 drinks) 15% of the sample used alcohol 4 or more times a week	Not discussed		Heterosexual males
Singh SK et al. 2010	Navi Mumbai, India	Mean thirty day mL of alcohol consumed was approximately 230 and less than 5% of drinkers, drank over 1000 mL a month	High alcohol consumption correlates with high condom use ($p<0.002$)		Heterosexual males
Hargreaves et al, 2002	Kisumu, Kenya	For both men (48%) and women (15%), highest alcohol consumption in the past month was among those 25-49 years with a higher socio-economic status	Condom use was higher among males (31.1%) and females (16.8%) 15-24 years, with a higher socio-economic status	HIV prevalence was 19.8% in males and 30.2% in females	Heterosexual males and females
Raj A et al. 2009(b)	St. Petersburg, Russia	72% reported alcohol consumption during the past 30 days 64% reported binge drinking – 93% of these were alcohol dependent	88% report unprotected sex with a main partner, while 76% report unprotected sex with a casual partner	8% of binge drinkers and 28% of non-binge drinkers were HIV+ ($p<0.001$)	Heterosexual males and females
Kalichman et al. 2006	Cape Town, South Africa	Alcohol consumption in the context of sex was higher for individuals reporting a drinking problem (OR 24.4, CI 14.3-41.4, $p<0.01$) and for individuals whose partner reported a drinking problem (OR 5.1, CI 3.1-8.5, $p<0.01$)	No association between problem drinking and condom use was found		Heterosexual males and females

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Wechsberg et al. 2008	Cape Town, South Africa	At baseline, Black women report alcohol use on more days in the past month than Colored women (13.55 vs. 5.82, $p<0.001$)	Black women were more likely to use a condom (50% vs. 15%) and to have only one partner (main)		Heterosexual females
Wong et al. 2008	Cape Town, South Africa	High levels of problem drinking were found among both men (58%) and women (42%)	Not discussed		Heterosexual males and females
Andersson et al. 2009	Soweto, South Africa	Males reported higher rates of heavy alcohol use ($p<0.001$)	Substance use and male gender predicted higher risk behaviours, including inconsistent condom use	HIV-negative	Heterosexual males and females
Avalos et al. 2010	Cape Town, South Africa	Hazardous alcohol use was reported by 12.6% of the entire sample	Multiple sex partners and inconsistent condom use were the two most common sexual risk behaviours reported		Heterosexual males and females
Kalichman et al. 2010	Cape Town, South Africa	In a multivariate analysis, alcohol use was significantly associated with unprotected sex with serodiscordant partners (OR 2.5, CI 1.0-6.5, $p<0.05$)	Condom use was generally high for HIV-positive individuals, however it was low when engaging in seroconcordant sex	1479 (85%) of the sample was tested for HIV 218 (12%) of those tested were HIV +	Heterosexual males and females
Townsend et al. 2011	Cape Town, South Africa	Problem alcohol use was associated with both physical and sexual intimate partner violence, with inconsistent condom use	Physical intimate partner violence was associated with inconsistent condom use		Heterosexual males
Kapiga et al. 1998	Dar es Salaam, Tanzania	29.5% of subjects consumed alcohol	Condom use was not different between drinkers and non-drinkers	All women started off HIV-negative Drinking was associated with risk of HIV (OR 2.43, CI 1.54-3.82)	Heterosexual females
Ghebremichael and Paintsil, 2009	Moshi district, Tanzania	About 33% of the participants were categorized as alcohol abusers	80% of subjects never used condoms in the past 12 months, and only 6% used them often	6.5% of men were HIV-positive	Heterosexual males
Emusu et al. 2009	Kampala, Jinja and Mbale, Uganda	Alcohol abuse by HIV-positive male partners often resulted in them perpetrating unprotected sex	Unprotected	About half of the women were HIV-negative (and their male partners were HIV +), and the other half were HIV+ (and their male partners were HIV-negative)	Heterosexual females

Table 3c. Heterosexual Couples Outside of the United States

4.6 Men Who Have Sex with Men (MSM) (Table 4)

Drug and alcohol abuse is reported to be particularly high among men who have sex with men; this has implications for risky sexual practices. Eleven studies were selected for inclusion in this group, some studies included only HIV-positive and some HIV-negative participants. In one study by Koblin et al., 2006, of initially HIV-negative persons, 29% of sero-conversions in the cohort was attributed to alcohol use (odds ratio 2.54, CI 1.83 to 3.53). In one study, MSM were identified as engaging in unprotected sex almost three times as often as any other group, including IDUs (Stein et al., 2005). Like the American MSM, the French MSM are also more likely to engage in unprotected sero-discordant sex following binge alcohol consumption (Bouhnik et al., 2007). While protected sex is higher with casual partners than with regular partners for MSM, alcohol consumption further lowers the likelihood of protected sex with a casual partner Unprotected sex with casual partners is associated with a greater risk of frequent alcohol use before or during sex (OR 1.5, CI 1.03-2.24, p=0.037), (Folch et al., (2009))

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Prestage et al. 2009	Australia	Drugs and alcohol are used to enhance the sexual experience in more 'adventurous' gay community subcultures	Having more than five drinks (OR 2.41, CI 1.34-4.33, p=0.003) was associated with unprotected anal intercourse with non-HIV sero-concordant partners		MSM
Lambert et al. 2009	Montreal, Canada	Alcohol was used before sex 39.4% of the times when the partner was regular and 49.8% of the times when the partner was casual	Alcohol use was associated with unprotected anal sex at last sexual episode 12.2% of participants had unprotected anal sex at last sexual episode	Self-reported HIV-negative or HIV status-unknown	MSM
Tripathi et al. 2009	Tallinn, Estonia	Mean alcohol consumption was 7.1 standard alcoholic drinks per week in the week preceding the study	Over 50% of the sample did not use a condom regularly in the past 12 months Higher alcohol consumption was negatively associated with use of condom during the last intercourse		MSM
Bouhnik et al. 2007	France	Alcohol consumption at least once a month, is associated with unprotected sero-discordant sex (OR 2.4, CI 1.2-4.9, p=0.003)	Unprotected sex was more prevalent within sero-concordant couples than it was in sero-discordant couples	AIDS-positive	MSM
Tsui and Lau, 2010	Hong Kong	Only 13.3% of subjects reported that they drank alcohol before sex	MSM who chose their sexual partners from the internet are more likely to engage in unprotected sex		MSM
Mendoza-Pérez et al. 2009	Ciudad Juárez, Chihuahua, Mexico	29.6% report consuming alcohol more than twice a week	Alcohol consumption was associated with engaging in unprotected sex		MSM
Lane et al. 2009	Soweto, South Africa	87.9% report that they drank at least once per month 75.9% scored positive for problem drinking 54.5% of subjects report 10 or more drinks on a typical day of drinking	Unprotected anal intercourse predicts HIV-positive status (28.0%, CI 21.9%-33.6%)	HIV prevalence was estimated at 13.2% Problem drinking predicts HIV-positive status (75.9%, CI 70.0%-82.1%)	MSM

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Folch et al. 2009	Catalonia, Spain	19.6% of men were frequent users of alcohol 63.8% of men used alcohol and drugs at some time before or during sex	Unprotected sex with casual partners is associated with a greater risk of frequent alcohol use before or during sex (OR 1.5, CI 1.03-2.24, p=0.037)	24.3% of frequent alcohol users were HIV-positive	MSM
van Griensven et al. 2010	Bangkok, Thailand	80.2% of MSM report alcohol consumption in the past 4 months Of these, 11.5% binge drank	Always using a condom was reported by 43.7% of MSM, and this increased to 70.8% when the partner was paid	HIV-negative	MSM
Stein M. et al. 2005	Providence, Rhode Island	Alcohol use (OR 1.95, p<0.01) and hazardous alcohol use (OR 2.90, p<0.01) were associated with having sex	Alcohol use (OR 2.30, p<0.01) and hazardous alcohol use (OR 2.66, p<0.01) were associated with unsafe sex	HIV-positive	Heterosexual males and females and MSM
Koblin et al. 2006	Boston (Massachusetts), Chicago (Illinois), Denver (Colorado), New York (New York), Seattle (Washington), San Francisco (California)	72.1% of men reported using alcohol or drugs before having sex	69.1% report any unprotected anal intercourse	Initially HIV-negative, 29% of seroconversions in the cohort was attributed to alcohol use (odds ratio 2.54, CI 1.83 to 3.53)	MSM
Golin et al. 2009	Denver (Colorado), Kansas City (Missouri), Nashville (Tennessee), Brooklyn (New York), Chapel Hill (North Carolina) and Atlanta (Georgia)	26% of MSM report binge drinking at least once a week 51% of MSM report drugs or alcohol use before sex in the past 3 months	23.0% of MSM report unprotected sex	HIV-positive	MSM
Operario et al. 2009	Oakland, California	70.6% of subjects report alcohol use before sex in the past 30 days	33.8% to 51.5% had unprotected anal sex with a male Alcohol use was not linked to unprotected sex	17.6% reported being HIV-positive	MSM who report sexual relationships with females
Mackesy-Amity et al. 2010	Chicago, Illinois	93% individuals used alcohol 39% individuals showed signs of alcohol dependence Overall, 29% of the sample was found to abuse alcohol at the time of enrolment into the study	Between 28% and 35% of the sample report unprotected anal intercourse	HIV-negative	MSM
Reisner et al. 2010	Massachusetts		Problem drinking was linked to unprotected anal sex with a sero-discordant male partner (OR 3.22, CI 1.22-8.50, p<0.02)		MSM
Semple et al. 2010	San Diego, California	The average number of drinks in a typical drinking day was 3.5	The average number of unprotected anal sex acts in the past 2 months was 10	HIV-positive	MSM

Table 4. Men Who Have Sex with Men

4.7 Injecting Drug Users (IDUs) (Table 5)

For injecting drug users, alcohol consumption leads to needle sharing, unsafe sex and exchanging sex for money and drugs, opening the door for HIV transmission and re-infection. Nine studies were selected for this group with mixed HIV status. A study in

Nepal conducted by Poudel et al. 2010 reported that 44% of non-drinkers share needles, as opposed to 55% of alcohol drinkers (OR 0.63, CI 0.38-1.03). For IDUs, condom use was higher when both partners were sober and it was higher overall when the partner was a casual partner, as opposed to a main partner (Arasteh and Des Jarlais, 2009). There also seems to be an association between the severity of substance abuse and the degree of risk taking resulting in contracting STDs (Chan et al., 2010).

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern	HIV Status	Gender and Sexual Orientation of Subjects
Poudel et al. 2010	Kathmandu Valley, Nepal	44% of non-drinkers share needles, as opposed to 55% of alcohol drinkers (OR 0.63, CI 0.38-1.03)	Not discussed	21% of 202 participants who had taken an HIV test tested positive	Males
Matos et al. 2004	Vega Baja, greater San Juan, Puerto Rico	Alcohol intoxication during the last 30 days was reported by 18% of participants	Those reporting alcohol intoxication were also more likely to report unprotected sex with a paying partner and with a casual partner		Both males and females
Parry et al. 2008(a)	Cape Town, Durban and Pretoria, South Africa	Alcohol use is not mentioned	Being high was a reason to not think about safe (have unprotected sex)	28% of individuals who offered to be tested for HIV tested positive	Mostly heterosexual male and female
Parry et al. 2008(b)	Cape Town, Durban and Pretoria, South Africa	Alcohol is not mentioned	Drugs led to inconsistent condom use	Among MSM who agreed to HIV testing, one-third tested positive	Both heterosexual males and MSM
Stein MD. et al. 2000	Providence, Rhode Island	60% had used alcohol in the last month 14% were at-risk alcohol abusers	Not discussed	89% of subjects had been tested for HIV, and 4% of these subjects tested HIV-positive	Males and females
Arasteh and Des Jarlais, 2009	New York City, New York	35% of the sample were at-risk drinkers (defined as more than 14 drinks per week for males or 7 drinks per week for females)	At-risk drinkers report lower condom use than occasional or non-drinkers	HIV-positive	Both males and females
Chan et al. 2010	67 cities in 29 states across the United States	35.2% of males and 44.8% of females (37.9% average) had sex while high on alcohol or drugs (p<0.001)	33.3% of males and 44.3% of females (36.4% average) had sex without protection (p<0.001)		Heterosexual males and females
Jenness et al. 2010	New York City, New York	34.5% of participants binged on alcohol at least weekly in the past year	IDU partnerships were associated with risky unprotected sex	Overall, 7.0% tested positive for HIV	Heterosexual males and females
Sander et al, 2010	Baltimore, Maryland	At study entry, 36% of participants were binge drinkers	Not discussed	HIV-negative at the start of the study	Predominantly heterosexual males and females (MSM was reported at 1% of visits)

Table 5. Injecting Drug Users

4.8 Emerging adults

In emerging adult populations, alcohol is often consumed in the context of parties, with the potential for multiple sex partners, and unsafe sexual encounters.

In United States (Table 6a) Ten studies showed that outcome variables of interest differed across race, age and sex. (Hou, 2009) established that Black students were less likely to use alcohol before any type of sexual activity. However this group was more likely to use a condom during sex of any kind. Adefuye et al, (2009) found that condom use was higher in younger individuals when compared with older individuals. Alleyne et al., (2010) noticed that alcohol use at last sex was 18.0% overall, with 15.0% in females and 21.1% in males. Also males were more likely to have used a condom during their last sexual episode.

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern
Sheer and Cline, 1995	A large South-Eastern University, United States	Alcohol is often consumed at parties	No significant association was found between the number of sex partners and condom use
Apostolopoulos et al. 2003	Sample was representative of university students, United States	Alcohol or drugs influenced decisions involving sex	31% of males and 32% of females report that alcohol use prior to sex had a negative influence on their decision to use a condom
Morrison et al. 2003	Seattle, Washington	Most subjects had been drinking more than one or two drinks per occasion and most have been getting drunk at least several times per week	The odds of condom use were not associated with whether or not alcohol was consumed before sex. Condom use was marginally lower for females than it was for males (OR 0.30, CI 0.11-1.06)
Adefuye et al. 2009	An urban Midwestern university, United States	14.6% of individuals below the age of 19 report alcohol use before sex	Condom use was higher in younger individuals
Hou, 2009	Southern universities, United States	Black students were less likely to use alcohol before any type of sexual activity	Black students were more likely to use a condom during sex of any kind
Murphy et al. 2009	Data collected from the National Longitudinal Survey of Youth	Males were found to consume higher levels of alcohol	The highest alcohol consumption was associated with the group that showed the highest sexual risk tendencies in both males and females
Randolph et al. 2009	A Southern University, United States	62.9% of participants reported binge drinking	Condom use was greater among older participants. Higher perceived risk of HIV was also associated with greater condom use
Alleyne et al. 2010	Youth Risk Behavior Survey, Illinois	Alcohol use at last sex was 18.0% overall, with 15.0% in females and 21.1% in males	Males were more likely to have used a condom during their last sexual episode.
Nkansah-Amankra et al. 2010	Colorado Youth Risk Behavioral Survey, Colorado	Alcohol consumption was found to lead to sexual risk taking and multiple sex partners	Not discussed
Wells et al. 2010	New York, New York	62.9% reported to sex after use of alcohol	Not discussed

Table 6a. Emerging Adults in the United States

Outside of the United States (Table 6b) HIV status is provided in two of the seven selected studies. Each of these seven studies provides valuable insight into the dynamics operating within this high-risk group relating to alcohol consumption and unsafe sex. A Chinese study (Xiao et al., 2010), showed that using alcohol diminished the likelihood of participants using condoms. In a South African study by McGrath et al., 2009, it was observed that for men, age at first sex was associated with having ever used alcohol (OR 1.89, CI 1.55-2.30, p<0.001).

Study	Study Settings	Alcohol Use Pattern	Condom Use Pattern
Tavares et al. 2009	Santiago Island, Cape Verde	Alcohol consumption was associated with sexual initiation in males	84.72% reported having used a condom in their first sexual intercourse
Xiao et al. 2010	Hunan Province, China	Using alcohol diminished the likelihood of participants using condoms	Impulsivity was shown to be negatively correlated with condom use
Campo-Arias et al. 2010	Santa Marta, Colombia	Of 804 students with a history of sexual relationships, 18.4% reported sexual intercourse after alcohol consumption	33.7% informed inconsistent condom use
Karnell et al. 2006	Pietermaritzburg area, KwaZulu-Natal, South Africa	At pre-test, almost half of the sample (both males and females) were using alcohol	A greater willingness to use a condom during the next 3 months was reported by students in the intervention group ($p<0.01$)
Morojele et al. 2006	Grade 8 and grade 11 students in Cape Town, South Africa	Some boys report that they supplied alcohol to girls in order to sleep with them. Some girls report that they consumed alcohol and other drugs voluntarily, and this made them more prone to engage in sexual acts	Some boys avoided condom use in order not to decrease sexual pleasure
McGrath et al., 2009	KwaZulu-Natal, South Africa	In men, age at first sex was associated with having ever used alcohol (OR 1.89, CI 1.55-2.30, $p<0.001$). The same trend was seen in women, although it was not statistically significant	Not discussed
Singh K et al., 2010	Hwange District, Zimbabwe	61% of individuals aged 15 to 19 that were found in nightlife/drinking venues report ever to have had sex – this was significantly higher than individuals in any other type of venue ($p<0.01$)	Condom use at last sex was 53.9% in the sample reporting the highest number of sexual partners

Table 6b. Emerging Adults Outside of the United States

4.9 Condom use

Not all studies have consistent findings with regard to condom use and alcohol consumption. The first important criterion may have to do with how they are used, rather than merely whether condoms are used. The fact that condom use is documented does not automatically imply that the condom was used effectively, i.e. there were no accidents including breakage and spillage, and that a condom was used for every separate act of sexual intercourse that took place during a particular sexual encounter.

Effective condom application for every act of sexual intercourse is a key means of limiting the spread of HIV. Condoms not only prevent HIV infection and other STIs but also prevent unplanned pregnancies. Condom use is recommended for monogamous couples if sero-discordant or both are infected. The number and sequencing of the sexual acts as well as the characteristics of the persons and nature of the sexual behaviour involved in the partnerships are not that relevant if there is adequate protection for contracting STIs.

Information concerning condom use for protection against contracting HIV is known but not necessarily acted upon. Hence an important focus of public health efforts should be on addressing other intermediary risk factors for sexual HIV risk behaviour, particularly those risk factors resulting from the use of alcohol.

Basic research on condom use and number of sexual partners is stymied by social desirability bias. The data obtained on safe-sex practices may be valid or there may be over-estimates on condom usage as well as under or over-estimates on the number of sexual partners. Furthermore, it is necessary to refer to the mechanics of condom use when

inebriated. A South African study by Townsend et al. (2010) attempted to answer the question: "Are condoms applied less effectively and consistently by men who drink heavily compared to those who do not?" The study replicated findings from other studies, (Kalichman et al, 2008; Simbayi et al. 2006) that heavy drinkers, if they use condoms, use them inconsistently.

4.10 Concurrency

Johnson et al. (2009) applied a mathematical model that demonstrated that concurrency is a major driver of the HIV/AIDS epidemic in SA. Concurrency in sexual relationships refers to sexual encounters that overlap in time with different partners, usually two or more simultaneous relationships. The role of concurrency in the spread of HIV is not straight forward. Concurrency subsumes various other factors such as the levels of infectiousness of HIV, so it may be particularly relevant to the spread of HIV, for instance early on in the epidemic or for a newly infected person. According to Morris 2010 concurrency increases the risk of transmitting HIV not acquiring it. One may debate whether long term polygamous relationships or several monogamous relationships in quick succession have a greater impact on HIV transmission. Morris argues that as the connectivity in sexual networks is non-linear a small behavioural change can result in significant HIV prevention. She suggests that if 5% of those individuals who are sexually active have their partners serially rather than concurrently, without reducing the number of partners, this will impact positively on the HIV epidemic.

The Townsend (2010) study referred to above showed high rates of problem drinking for men who have multiple, concurrent sexual partners (It should be noted that the figure from Townsend (2010) for problem-drinkers of 58.5% for men in urban contexts in the Western Cape (South Africa) is considerably higher than the 27.9 % of lifetime problem drinkers in the same region recorded in the first South African Demographic and Health Survey (Parry et al. 2005). Despite this finding, Townsend (2010) did not find that problem drinkers were more likely to have multiple partners than non-problem drinkers. Kalichman et al. (2007) however showed that greater frequency and quantities of alcohol use was related to a greater number of sexual partners. Furthermore, an interesting finding from the Townsend (2010) study is that the amount of alcohol consumed effects the choice of sexual partner, i.e. one who is more likely to drink alcohol and be unemployed; this in turn has additional implications for riskier sexual encounters. For example, with transactional sex there is less likelihood of condom use.

The link between alcohol use, condom use and concurrency is not clear-cut; no pattern is discernable both within and between groups. A somewhat counter intuitive finding is that condoms are more likely to be used for casual partners, i.e. conferring protection against HIV infection.

4.11 Limitations of the study

Overall, this study has limitations in that only English language papers were considered and comprised mainly of those published between 2008 and 2010. Furthermore, HIV status of the subjects was not always provided in the papers and alcohol use patterns were often loosely defined. The emerging adult high risk group may also include some studies that can

be considered to constitute a separate high risk group, namely adolescents, for example, Morojele 2006b. Groups are not mutually exclusive, individuals within groups may also be part of other groups, for example men who classify themselves as heterosexual may also engage in sex with other men.

Katz (2008) highlights that there are significant risk factors that are not captured from standard behavioural indicators, Katz also suggests that cumulative risk, that is, risk over an extended period is not captured by annual measures of sexual risk, such as the number of sexual partners in the past 12 months. These concerns impact on the adequacy of the measures of sexual risk behaviour and may explain why the demonstrated behavioural changes (Shisana et al., 2009) have not lead to the expected declines in HIV measures in SA. For example, despite evidence showing increased condom use there is an indication that condoms are not used consistently.

4.12 Models

Epidemiological models combine epidemiological and statistical data, such as the probability of contracting HIV per sexual encounter, as well as behavioural data to help elucidate the spread and the control of HIV. Models are necessary to simulate complex sexual networks. For example, Wim Delva's SIMPACT is a modeling tool used to simulate HIV epidemics in complex sexual networks. SIMPACT can model the effect of concurrency on the pathogenesis of HIV/AIDS. For example by "capturing the formation and dissolution of sexual relationships between individuals" it can demonstrate the impact of this interpersonal behaviour on HIV transmission. (Delva thesis. Page 120). Wim Delva argues that "the potential for epidemiological models to improve our understanding of the determinants of HIV spread and control may only be fully unlocked when questions about the sexual network structure and partnership dynamics are adequately addressed both by empirical studies and ensuing advances in model development." (Delva thesis. Page 120)

"SIMPACT is a rather flexible tool, so in principle it is indeed possible to model the effect of alcohol (reduction) on the transmission of HIV in the population. However, the effect of alcohol works indirectly through behavioural choices (primarily formation of sexual relationships and condom use). If data are available describing how alcohol impacts on sexual risk behaviour, SIMPACT will be able to simulate what the implications of these effects are in terms of enhanced HIV transmission." (e-mail correspondence from Wim Delva)

5. Conclusion and recommendations

This literature review again demonstrated the strong association between alcohol consumption and HIV transmission via unsafe sex; broadly defined as unprotected sexual intercourse. This literature review examined two HIV prevention strategies, condom use and concurrency with the additional behavioural component, namely, alcohol consumption at time of sexual encounter in selected high risk sub-populations. It shows that the link between drinking and unsafe sex, that is, inconsistent condom use and multiple sexual partners, is influenced by diverse factors such as the amount of alcohol consumed (generally but not always), the setting and power relations, among other variables and that this holds across the risk groups studied and in different countries. To a large extent this literature

review substantiates the findings of previous reviews in this area. Although it does not close the question of whether alcohol use is causally related to unsafe sex, it does add more evidence to the established association. It extends the area of research in that it focuses on high risk groups globally. In so doing it indicates important future areas of research, namely a focus on vulnerable sub-populations and the necessity to intervene on alcohol consumption and its role in leading to risky sex and subsequent sero-conversion to HIV.

In Africa and other countries where the HIV epidemic is mainly driven by unprotected sexual intercourse, focusing on factors influencing sexual risk behaviour is paramount in preventing new and re-infections of HIV. The focus on high-risk groups is not to further stigmatise certain groups that include drug users, sex workers and MSM. The focus on high-risk behaviours in these groups is vital in order to pinpoint group specific HIV prevention interventions.

Specific recommendations for additional studies in SA in the identified high-risk groups from this review are the military and migrant workers in SA. The focus should be on alcohol consumption and risky sexual practices within these high-risk groups. The studies of the SA military should include SA peacekeepers in Africa on their return to SA. There is also a need for more studies on migrants to SA from the rest of Africa. Oscillating internal rural / urban migration was the cornerstone of Apartheid labour policies. Lurie (2010) suggests that labour migration early on in the HIV epidemic in SA, i.e. in the early 1990's, was critical to the dissemination of the virus from urban to rural areas. However, in the light of evidence of HIV transmission in rural areas he questions the uni-directionality of the spread of HIV and recommends interventions aimed at migrants and their partners to limit the transmission of HIV. Another mobile population to target for HIV prevention measures are truck drivers and the CSWs at truck stops, Ramjee and Gouws, 2002 conclude that truckers may have facilitated the spread of HIV infection in southern Africa.

Using condoms, HIV counselling and testing, and needle and syringe programs were all found to be effective and cost-effective techniques to prevent HIV infection among IDUs in a review of Thai literature (Pattanaphesaj and Teerawattananon, 2010). As for IDUs in SA, Parry (2010a) examines risk behaviour in both IDUs and non-injection drug use (NIDU), vulnerable populations at risk for HIV, to inform service delivery that includes prevention and harm reduction. Although the focus of this study is substance abuse that does not include alcohol, many of the recommendations apply equally to alcohol abuse. These include a specific recommendation that service delivery be more integrated, with HIV counselling and testing be provided at substance abuse centres, and that VCT address both substance abuse and sexual risk behaviours. An important recommendation that is pertinent to the current review is that VCT be more specific to sub-populations. In South Africa, sex work is illegal and this adds to the challenge of identifying and implementing HIV prevention interventions.

It is important to identify places for HIV prevention programmes to be developed and implemented. For example, shebeens or township taverns are generally frequented by mixed social networks of mainly men who congregate to drink, socialise and find new, usually casual sexual partners (Morojele 2006a). An intervention in a bar with peer leaders has been shown to reduce risky sex for patrons in gay bars (Kelly et al. 1997). Furthermore, the type of research on reduced HIV risk needs to encompass alcohol and other substance

abuse as well as poor mental health and social problems; particularly in vulnerable sub-populations. (Jewkes 2010a; Jewkes 2010b; Sikkema 2011).

Parry et al. (2010b) states that in order to address poor health outcomes resulting from alcohol-related risky sex or non-adherence to antiretroviral regimens resulting from alcohol misuse, primary health care level personnel should use appropriate instruments to screen for problem alcohol use and if necessary provide brief interventions for substance abuse and VCT for HIV. The latter includes proper training of health and social services workers. Overall there should be greater emphasis on advocacy concerning the negative health outcomes from alcohol misuse. This includes educating people on the link of alcohol to unsafe sexual practices and the re-infection/infection with, transmission and progression of HIV/AIDS.

Intervention research should include an examination of the efficacy and cost-effectiveness of Brief Interventions for problem alcohol use as HIV prevention. Epidemiological and operational research is needed specifically on the prevalence of alcohol problems in patients with HIV and the integration of alcohol and HIV services in the public health sector at primary health care level (Parry 2010b).

The present review clearly shows that there are specific groups at higher risk of contracting HIV. These groups would benefit from improved risk-assessment information. To this end we suggest additional studies in this domain utilising meta-analyses and the modelling of data obtained for the specific groups to better summarise and utilise the information obtained. The statistical data from this review can be utilised as parameter values for modeling the spread of HIV in these sub-populations. In addition to the SIMPACT model there are others, including the STDSIM model (Habbema, 1996) that utilises different data sources to determine which prevention and intervention programmes for STIs are most cost effective.

Evidence-based, cost effective HIV interventions for specific high risk groups are a priority. In order to be optimally effective these should take into account the norms and practices central to the particular sub-population. Broader structural problems, outside the public health ambit, such as gender inequality and poverty need to be addressed in the longer term, as they are the underlying, albeit more distal risks factors resulting in the spread of HIV in SA.

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7. Abbreviations

AIDS - acquired immune deficiency syndrome
ARV - antiretroviral drugs

CSW - commercial sex workers
DALYs - disability adjusted life years
FSW - female sex workers
HIV - human immunodeficiency virus
IDU - Injecting Drug Users
MARPs- most at-risk populations
MSM - men having sex with men
SA - South Africa
SSA - sub-Saharan Africa
STDs -sexually transmitted disease
STIs - sexually transmitted infections
US - United States of America

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Human behavior accounts for the majority of morbidity and premature mortality throughout the world. This book explores several areas of human behavior including physical activity, nutrition and food, addictive substances, gun violence, sexual transmitted diseases and more. Several cutting edge methods are also examined including empowering nurses, community based participatory research and nature therapy. Less well known public health topics including human trafficking, tuberculosis control in prisons and public health issues in the deaf community are also covered. The authors come from around the world to describe issues that are both of local and worldwide importance to protect and preserve the health of populations. This book demonstrates the scope and some of the solutions to addressing today's most pressing public health issues.

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