



Alcohol Misuse and Illicit Drug Use Among Occupational Groups at High Risk of HIV in Sub-Saharan Africa: A Systematic Review

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Abstract

Key occupational groups in sub-Saharan Africa (SSA) are at increased risk of HIV, and may be at increased risk of substance use. In January 2018, we systematically searched for studies reporting prevalence of, and risk factors for alcohol misuse or illicit drug use and their association with HIV incidence or prevalence among fisherfolk, uniformed personnel, truckers, miners, motorcycle taxi riders and sex workers in SSA. Seventy-one studies published between 1983 and 2017 were included: 35 reported on alcohol misuse (19 using AUDIT, 5 using CAGE) and 44 on illicit drug use (eight reported both). Median prevalence of alcohol misuse based on AUDIT/CAGE was 32.8% (IQR 20.8–48.5%). Prevalence of illicit drug use ranged from 0.1% (95% CI: 0.0–0.2%) for injection drug use to 97.1% (95% CI: 85.1–99.9%) for khat (among uniformed personnel). Among papers examining associations between substance use and HIV incidence ($n=3$) or prevalence ($n=14$), nine papers (53%) reported a significant positive association (2 with incidence, 7 with prevalence). Harm reduction interventions in occupational settings are urgently required to prevent new HIV infections.

Keywords Alcohol misuse · Illicit drug use · HIV · Key populations · Sub-Saharan Africa

Introduction

HIV remains a major public health problem worldwide, despite substantial gains in sub-Saharan Africa (SSA), including a marked decline in incidence in Eastern and

Southern Africa since 2010 [1, 2]. Concurrent with the HIV epidemic, the SSA region also has the highest estimates of heavy episodic drinking per drinker globally, estimated at 25% [3]. The prevalence of alcohol use disorders (defined by an Alcohol Use Disorders Identification Test (AUDIT) score ≥ 8) in the general adult (≥ 15 years) population is estimated at 4% globally and 3% in Africa, with men disproportionately affected [3]. Our understanding of substance use in SSA remains limited, although there is some evidence that injection drug use may be increasing [4–6]. Recent research from SSA illustrates the potential for rapid expansion of the HIV epidemic through unsafe injection drug use [7–9].

There is extensive evidence that alcohol misuse and illicit drug use are associated with higher HIV risk at societal, community and individual levels, stemming mainly from relationships between substance use and unprotected sex, and sexual and gender-based violence [10, 11]. Alcohol misuse and illicit drug use impact clinical manifestation and management of HIV and may result in decreased retention in care [12], increased disease progression [13, 14], reduced antiretroviral treatment (ART) efficacy [11, 15], poor ART adherence [16] and mortality [11, 17, 18]. However, recent findings show that problem drinking has

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no short term direct biological impact on CD4+ cell count, in ART-naïve Ugandans [19].

Key occupational groups, specifically sex workers [20–22], fishing communities [22, 23], uniformed personnel [24], miners [25, 26], motorcycle taxi riders [27], and truckers [28] have been identified as being at increased risk of HIV and other sexually transmitted infections (STIs), and may be at increased risk of alcohol misuse and illicit drug use. Proven HIV prevention strategies or harm reduction services are often not accessible for these groups. Occupational groups at high risk of HIV constitute important sub-populations because they tend to have extensive sexual networks, bridging into the general population [29, 30]. Achieving the United Nations programme on HIV/AIDS 95-95-95 targets [31] will require prioritisation of harm reduction alongside other HIV prevention interventions, particularly among key population groups.

We hypothesise that occupation-related factors common to these high-risk groups might shape patterns of alcohol misuse and illicit drug use and other high-risk behaviour. Our conceptual framework (Fig. 1) builds upon Scribner and colleagues' ecological model [10]. At societal and community levels, substance use risk factors may include belonging to a community in which alcohol misuse and illicit drug use are normalised, and weak substance use control policies. At family and individual levels, potential risk factors include the increased functionality required for prolonged working hours and consequent perceived need for a performance enhancer; and real and perceived workplace hazards or vulnerabilities such as the likelihood of violence or death [32]. High mobility common to these populations could lead to prolonged separation from family and increased exposure to a flourishing sex

industry, around the occupational group, increasing risk for substance use and for HIV infection.

Limited attention has been paid to the burden of alcohol misuse and illicit drug use in low and middle-income countries. A descriptive systematic review of African studies broadly examined the association between alcohol use and HIV infection in the general population and found that use of alcohol in sexual contexts, and the frequency and quantity of alcohol use were all positively associated with HIV prevalence [33]. Another systematic review by Fisher et al. [34] demonstrated that alcohol use had a crude dose–response relationship with HIV prevalence: this pooled analysis of 11 studies found that, compared with non-drinkers, the adjusted odds ratio (aOR) for association with HIV was 1.57 (95% confidence interval (CI): 1.33–1.86) among non-problem alcohol drinkers and 2.04 (95% CI: 1.61–2.58) among problem drinkers. However, neither systematic review examined the burden of alcohol misuse or illicit drug use among high-risk occupational groups. Two recent reviews—one addressing alcohol use among young people in East Africa [35] and another examining HIV and related risk behaviour among fishermen in Africa and Asia [36] were limited in scope regarding participant age and illicit drug use, and focus on fishermen, respectively. A better understanding of the patterns of alcohol misuse and illicit drug use in these high-risk groups is needed.

The objectives of this review are to (1) determine the prevalence of, and risk factors for, alcohol misuse and illicit drug use in select high-risk occupational groups, namely fishing communities, sex workers, miners, truckers, motorcycle taxi riders and uniformed personnel, in sub-Saharan Africa, and (2) determine the association between HIV and alcohol misuse and illicit drug use in these groups. The

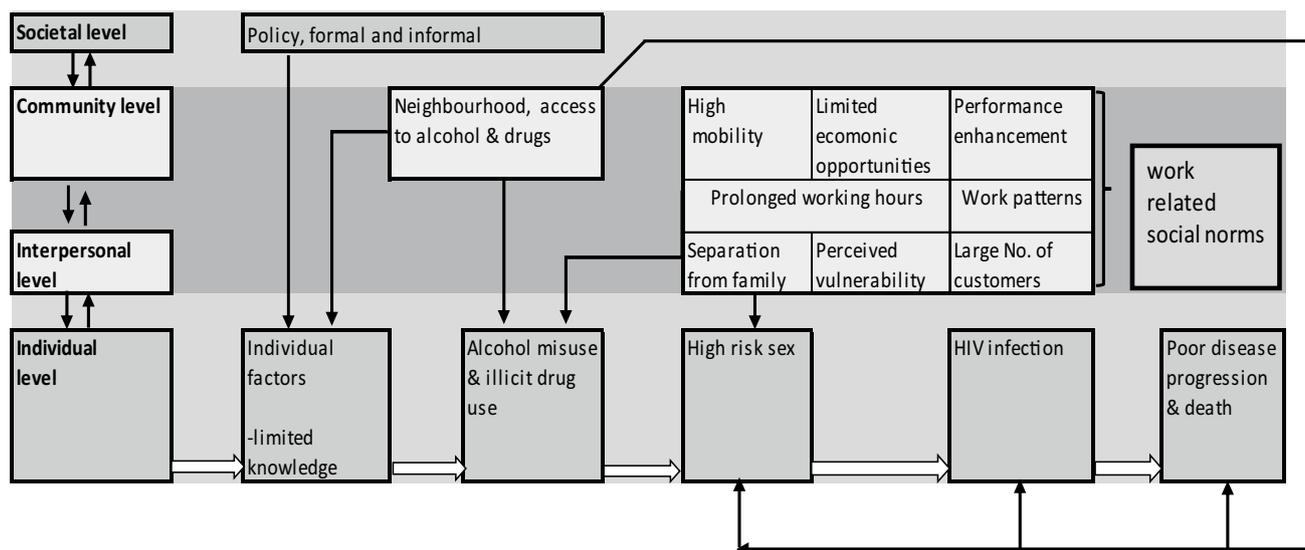


Fig. 1 Conceptual framework: The role of occupation-related factors in alcohol and illicit drugs in HIV/AIDS among high-risk groups

review will help to inform development of HIV prevention and substance use reduction policies that leverage occupational field elements to address the unique needs of ‘high-risk’ occupational groups.

Methods

We followed the Cochrane guidelines [37] to conduct the review and the PRISMA [38] reporting guidelines. The review protocol was registered (<http://www.crd.york.ac.uk/PROSPERO> CRD42016053495).

Search Criteria

We searched the following databases for publications prior to 16th January 2018: Medline, Embase, Global health, Web of Science, PsycINFO. No language restrictions were applied. The full database-specific search strategy is presented in the supplemental material, tables 1 and 2.

We searched additional sources including international organisation reports, country-level reports, and international conference abstracts including Conference on Retroviruses and Opportunistic infections (CROI), STD Prevention Conference, International AIDS Society Conference, International Conference on AIDS and STDs in Africa, Kettil Bruun Society, and the global state of harm reduction reports. We hand-searched reference lists of included papers and systematic reviews. We sent data requests to authors of studies for which relevant information might have been collected but not reported in their publications.

Screening and Selection

The search results were exported to Endnote reference management software (Thomson Reuters, version X7.5) where duplicates were removed. Titles and abstracts were screened by two independent authors (MK and EW) to identify studies meeting inclusion criteria. We sought help to translate papers written in French and German.

We included epidemiological studies among high-risk occupational groups in sub-Saharan Africa that estimated at least one of the following: prevalence or frequency of alcohol misuse or illicit drug use; risk factors for alcohol misuse or illicit drug use; association of alcohol misuse or illicit drug use with HIV. There were no restrictions on participants’ age, study sample size or year of publication. Alcohol misuse was defined as any reported measure that used specific patterns and amounts of reported alcohol use, and/or standard scoring systems to classify participants.

We excluded articles that did not clearly identify the population, did not provide separate results for high-risk occupational groups, or that reported data from the same

study participants as another included paper (with equivalent or less information included). We excluded studies where participants were selected for inclusion in the study on the basis of our outcomes of interest for this review i.e. studies where all participants were alcohol users, or drug users.

Data Extraction

Two authors (MK and EW) independently examined full-text articles of potentially relevant studies to assess if they met the inclusion criteria. Both authors independently extracted data from each article and independently performed quality assessment on each article. We used a data extraction form to collect the following information: (1) article publication characteristics; (2) country; (3) study population; (4) study design; (5) sample size; (6) participant socio-demographic characteristics; (7) measures for alcohol misuse; (8) measures for illicit drug use; (9) alcohol misuse prevalence; (10) prevalence of illicit drug use including drug types, quantity, frequency; (11) risk factors for alcohol misuse; (12) risk factors for illicit drug use; and (13) the association of alcohol misuse or illicit drug use, with HIV.

Discrepancies were discussed and consensus reached. Where confidence intervals (CIs) for prevalence estimates were not reported, we calculated them based on the figures provided (where possible) assuming simple random sampling. Inter-rater reliability between the two reviewers was assessed using the Kappa statistic. Differences of opinion were resolved and agreement reached.

Data Analysis

We used forest plots to display prevalence and 95% confidence interval estimates for alcohol misuse and illicit drug use. We calculated the median and interquartile range of prevalence estimates for alcohol misuse, by population group. We repeated these calculations, including only those studies that used validated and standardised measures, specifically AUDIT ≥ 7 in women or ≥ 8 in men [39, 40], AUDIT-C (first three AUDIT questions inquiring quantity-frequency) ≥ 4 [41] or CAGE (Cut down, Annoyed, Guilt, Eye-opener) tool ≥ 2 [42]. We also conducted meta-analysis of studies reporting alcohol misuse prevalence by standardised measures, assuming a random effects model, and report the pooled prevalence estimate with 95% CI, and heterogeneity I-square statistic. We did not conduct formal meta-analysis for alcohol misuse assessed by non-standardised measures, or for illicit drug use owing to the diversity in study methodologies, measures of alcohol misuse and illicit drug use, type of drugs reported, reporting timeframe for drug use, and source populations.

Quality Assessment

We assessed the quality of included papers, based on the following characteristics: probability sampling, response rate, use of validated or standardised measures for alcohol misuse or illicit drug use, detailed reporting on illicit drug use types, clarity on the timeframe for alcohol misuse or illicit drug use, HIV measure used, and use of adjusted analysis when assessing associations.

Results

We identified a total of 5692 papers from five databases (Fig. 2). After removing duplicates, we screened a total of 3155 unique titles and abstracts to identify potentially eligible studies. Of these, 228 papers were included in the full-text review. Inter-rater reliability for the full-text review indicated substantial agreement ($\kappa=0.74$).

After full-text review, 71 papers were included in the analysis. The primary reasons for exclusion were that papers did not report either alcohol misuse or illicit drug use ($n=60$) or did not include key occupational groups ($n=36$) (Fig. 2).

A summary of the studies included, together with their key characteristics, is shown in supplementary table 3. The 71 eligible studies were conducted in 23 countries, including multiple studies from Kenya ($n=15$), Uganda ($n=13$), Nigeria ($n=9$), Ethiopia ($n=9$), South Africa ($n=4$), Mozambique ($n=2$), Angola ($n=2$) and Ghana ($n=2$). Sample sizes ranged from a minimum of 16 among truckers to a maximum of 26,912 among miners.

The majority of studies were conducted among sex workers ($n=42$) and uniformed personnel ($n=14$, one of which also included data from truckers). Others were conducted among fishing communities ($n=6$), truckers ($n=6$), miners ($n=3$) and motorcycle taxi drivers ($n=1$). Most of the studies were cross-sectional ($n=62$), with 8 cohort studies and one case–control study.

Seventeen studies recruited men only (predominantly studies among truckers, uniformed personnel and miners), while 36 studies recruited women only (all among sex workers). Around half ($n=36$) of studies were published since 2014. Thirty-five papers reported data on alcohol misuse or problem drinking, and 44 reported data on illicit drug use (eight papers reported data on both). Full extracted data on alcohol misuse and illicit drug use are shown in Tables 1 and 2, respectively.

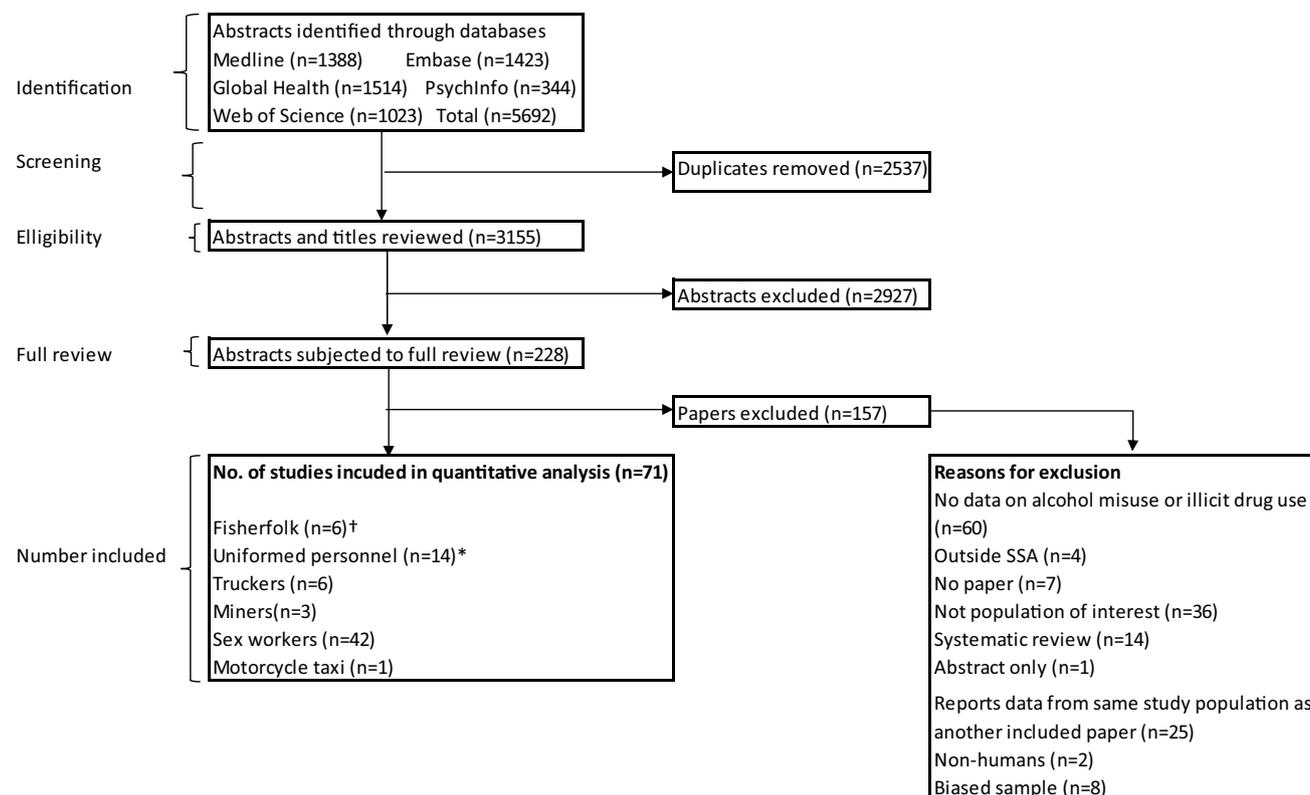


Fig. 2 Data extraction flow chart. *One of the papers appears twice, containing data from both uniformed personnel and truckers (Ihunwo), hence the total adds up to 72 but there were 71 papers. †We sourced a thesis on fishing communities from an author (Sileo [45])

Table 1 Alcohol misuse prevalence, risk factors and association with HIV incidence or prevalence, by occupational group, among studies included in the systematic review

Author, year of publication	Country	Study year	Study design	Sex and age distribution	Sample size	Alcohol misuse		Association between HIV and substance use other associations	HIV test	HIV prevalence (95% CI)
						Measure	Prevalence (95% CI)			
<i>Fishing communities</i>										
Kebede, 2005 [58]	Ethiopia	1998	Cross-sectional	45% female; 70% < 40 years	1714	Alcohol dependence (CIDI F10.2)	1.5% (0.9–2.1%)			
	Uganda	Not given	Cross-sectional	44% male; age distribution not given	300	AUDIT	Not given	Positive association between higher AUDIT scores and HIV (OR 1.11; 95%CI: 1.04–1.18)	Self-report	23% positive, 10% unknown
Tumwesigye, 2012 [60]	Uganda	Not given	Cross-sectional	64% male; 91% < 40 years	475	AUDIT ≥ 8	32.2% (28.0–36.6%)			
Sileo, 2017 [45]	Uganda	2016–2017	Cross-sectional	100% male; mean age 37 (SD 8.6) years	200	AUDIT ≥ 8	30.7% (25.5–36.2%)			
<i>Uniformed personnel</i>										
Bing, 2008 [61]	Angola	2003–2004	Cross-sectional	All male; mean age 31.5 years	1710	AUDIT ≥ 8	42.4% (39.9–44.9%)			
Cheng, 2012 [62]	Angola	2008	Cross-sectional	All male; mean age 28.5 (SD 5.4) years	568	AUDIT ≥ 8; binge drinking in last year	AUDIT ≥ 8: 35% (31.1–39.1%) Binge drinking: 26.2% (22.7–30.0%)	AUDIT ≥ 8 positively associated with age, number of traumatic events, poor mental health, increased socialising with family and friends, and inversely associated with frequency of attending religious services	–	–
Courtney, 2017 [63]	South Sudan	2010, 2012	Cross-sectional	96.7% male; mean age 34.8 years	1063	RAPS4-QF	37.4% (30.9–44.4%)		Rapid test	5.0% (3.6–6.9%)
Djibo, 2013 [64]	Sierra Leone	2013	Cross-sectional	88.9% male; mean age 38.5 years	1157	AUDIT ≥ 8	15.3% (13.3–17.5%)	No association between AUDIT ≥ 8 and HIV [crude OR 1.33; 95% CI 0.52–3.43]	Rapid test	3.3% (2.3–4.3%)
Harbertson, 2011 [65]	Rwanda	2008–2010	Cross-sectional	All male; mean age 30.9 (SD 5.6) years	1307	AUDIT ≥ 8	10.2% (8.5–11.9%)	HIV positively associated with AUDIT ≥ 8 (p = 0.02)	Rapid test	2.6% (1.8–3.7%)

Table 1 (continued)

Author, year of publication	Country	Study year	Study design	Sex and age distribution	Sample size	Alcohol misuse		Association between HIV and substance use other associations	HIV test	HIV prevalence (95% CI)
						Measure	Prevalence (95% CI)			
Ijomanta, 2016 [66]	Nigeria	Not given	Cross-sectional	90.1% male; median age 32 years	223	DSM IV alcohol abuse and dependence	Lifetime abuse: 21.1% (15.7–26.4%) Lifetime dependence: 4.0% (1.9–7.5%) Lifetime ICD-10 harmful use: 16.6% (11.7–21.5%) Alcohol dependence: 2.7% (1.0–5.8%)	Predictors of lifetime alcohol abuse were Hausa/Fulani ethnicity (OR = 2.22, 95% CI: 1.03–6.99) and involvement in combat (OR = 2.04, 95% CI 1.12–6.81)	–	–
Ovuga, 2006 [67]	Uganda	2002	Cross-sectional	95.0% male; mean age 34.3 (SD 5.9) years	104	ICD-10 criteria	Alcohol use disorder: 19.2% (11.7–26.8%) Alcohol use psycho-social problems: 26.0% (17.5–34.4%) 58.9% (52.1–65.4%)	–	–	–
Tran, 2013 [68]	Botswana	Not given	Cross-sectional	All male; mean age 25.1 (SD 2.4) years	211	AUDIT ≥ 8				
Bello, 2010 [69]	Nigeria	2009	Cross-sectional	All male; mean age 38.5 (SD 9.5) years; 63.3% long-distance	360	AUDIT ≥ 8				

Table 1 (continued)

Author, year of publication	Country	Study year	Study design	Sex and age distribution	Sample size	Alcohol misuse		Association between HIV and substance use other associations	HIV test	HIV prevalence (95% CI)
						Measure	Prevalence (95% CI)			
Botao, 2016 [70]	Mozambique	2012	Cross-sectional	All male; aged (aged 31–40) years	322	AUDIT-C ≥ 4	33.3% (28.2–38.5%)	–	Rapid test + confirmatory test	15.4% (11.4–19.4%)
<i>Motorcycle taxi riders</i>										
Tumwesigye, 2016 [71]	Uganda	2014	Matched case control	All male; 56% aged 25–34	578	AUDIT ≥ 8	Controls: 6.2% (3.7–9.7%)	–	–	–
<i>Sex workers</i>										
Atalay, 2006 [72]	Ethiopia	2001–2002	Cross-sectional	All female; aged 15–49 years	2487	CAGE ≥ 2	31.4% (29.6–33.4%)	–	–	–
Augusto, 2016 [73]	Mozambique	2011–2012	Cross-sectional	All female; aged ≥ 15 years	1241	AUDIT-C ≥ 4	Maputo: 44.5% (38.0–51.9%) Beira: 50.0% (44.0–56.0%) Nampula: 41.3% (34.1–48.1%)	AUDIT-C ≥ 4 associated with HIV infection only in Nampula (OR 4.6, 95% CI: 2.7–8.0)	Rapid test + confirmatory testing	Maputo 31.2%, Beira 23.6%, Nampula 17.8%
Vandepitte, 2011 [29]	Uganda	2008–2009	Cross-sectional (cohort baseline)	All female; mean (SD) age 26 (5.7) years	1027	CAGE ≥ 2	55.7% (52.7–58.7%)	CAGE ≥ 2 associated with HIV (adjusted OR 1.64, 95% CI: 1.13–2.38, $p = 0.005$). From Weiss, CAGE ≥ 2 associated with being divorced/separated/widowed, less education, recruiting clients at bars/clubs, and forced sex at first sexual experience	Rapid test + confirmatory testing	37% (34–40%)

Table 1 (continued)

Author, year of publication	Country	Study year	Study design	Sex and age distribution	Sample size	Alcohol misuse		Association between HIV and substance use other associations	HIV test	HIV prevalence (95% CI)
						Measure	Prevalence (95% CI)			
Weiss, 2016 [20]	Uganda	2008–2013	Cohort	All female, mean (SD) age 25 (5.7) years	721	AUDIT ≥ 8	46.0% (42.4–49.8%)	Factors associated with AUDIT ≥ 8 : younger age, meeting clients in bars/clubs, number of clients, using drugs and HSV-2 infection	Rapid test + confirmatory testing	Prevalence 37% at enrolment; HIV incidence 2.77/100 pyr
							AUDIT 8–15: 27% (23.8–30.4%)			
Chersich, 2014 [28]	Kenya	2006–2007	Cohort	Not given	400	AUDIT ≥ 8	AUDIT ≥ 20 : 11% (8.8–13.5%)	AUDIT 8–15 positively associated with HIV acquisition ($p=0.04$)	Rapid test	
							AUDIT 8–15: 17.3% (13.5–21.0%)			
Chersich, 2007 [74]	Kenya	2005–2006	Cross-sectional	All female; mean (SD) age 30.4 (8.4) years	719	Binge drinking (5+ drinks in one occasion)	AUDIT ≥ 16 : 9.5% (6.6–12.4%) ^a	HIV prevalence was higher among women having ever drunk (39.9%) than lifetime abstainers (23.2%; $p < 0.001$), but was not associated with drinking patterns	Rapid test	37.3% in binge drinkers; 41.8% in non-binge drinkers; 23.2% in lifetime alcohol abstainers
							RDS sampling 33.0% (29.5–36.6%)			

Table 1 (continued)

Author, year of publication	Country	Study year	Study design	Sex and age distribution	Sample size	Alcohol misuse		Association between HIV and substance use other associations		HIV test	HIV prevalence (95% CI)
						Measure	Prevalence (95% CI)	Prevalence (95% CI)			
Lancaster, 2016 [75]	Malawi	Not given	Cross-sectional	All female; median age 26 (IQR 23–30) years	138	AUDIT ≥ 7	AUDIT ≥ 7: 55.1% (46.4–63.5%) AUDIT 7–15: 28.3% (20.9–36.5%) AUDIT 16–19: 12.3% (7.3–19.0%) AUDIT ≥ 20: 14.5% (9.1–21.5%)			Rapid test	69%
L’Engle, 2014 [52]	Kenya	Not given	Cross-sectional	All female; no information on age	818	AUDIT ≥ 7	89.0% (87.0–90.4%)				
Lemma, 2015 [76]	Ethiopia	2010	Cross-sectional	All female; mean (SD) age 21.9 (4.1) years	474	CAGE ≥ 1	24.3% (20.4–28.1%)				

Table 1 (continued)

Author, year of publication	Country	Study year	Study design	Sex and age distribution	Sample size	Alcohol misuse		Association between HIV and substance use other associations		HIV test	HIV prevalence (95% CI)
						Measure	Prevalence (95% CI)	Association between HIV and substance use other associations	Association between HIV and substance use other associations		
Luchters, 2011 [77]	Kenya	2008	Cross-sectional	All male; mean (SD) age 24.6 (5.2) years	442	AUDIT ≥ 8; binge drinking	AUDIT ≥ 8: 49.3% (44.6–54.1%) AUDIT 8–15: 24.0% (20.0–28.0%); AUDIT 16–19: 10.6% (7.8–13.5%); AUDIT 20–40: 14.7% (11.4–18.0%) Binge drinking: 38.9% (34.3–43.6%)	–	–	–	–
Magni, 2015 [78]	South Africa	2012	Cross-sectional	All female; 16–55 years	225	CAGE ≥ 2, binge drinking (≥ 4 drinks on one occasion)	CAGE ≥ 2: 9.6% (8.7–10.6%) Binge drinking: 14.9% (13.7–16.1%)	–	–	–	–
Muraguri, 2015 [79]	Kenya	2010	Cross-sectional	All male; 34.4% 18–24 years	273	AUDIT ≥ 20	22.7% (16.2–30.3%)	–	–	–	–
Mooney, 2013 [80]	Ethiopia	2009–2010	Cross-sectional	All female; 46.3% 20–25 years	311	CAGE ≥ 2	51.0% (45.2–56.4%)	–	–	–	–
Nouaman, 2015 [81]	D'Ivoire	2013	Cross-sectional	All female; median age 29 (IQR 23–36) years	249	AUDIT ≥ 8	19.7% (14.7–24.6%)	–	–	Routine testing	33.7% (27.8–39.6%)
Odukoya, 2013 [82]	Nigeria	2011	Cross-sectional	All female; mean (SD) age 28.1 (6.8) years	323	Weekly restrictions for women (14 pints/week)	89% (84.9–93.2%)	–	–	–	–

Table 1 (continued)

Author, year of publication	Country	Study year	Study design	Sex and age distribution	Sample size	Alcohol misuse		Association between HIV and substance use other associations	HIV test	HIV prevalence (95% CI)
						Measure	Prevalence (95% CI)			
Richter, 2013 [83]	South Africa	2010	Cross-sectional	91.9% female, 4.8% male, 3.3% transgender; mean (SD) age 29.7 (6.5)	1799	Binge drinking daily, weekly	Any binge drinking (daily or weekly): 45.9% (43.5–48.3%) Daily binge drinking 19.6% (17.8–21.6%) Weekly binge drinking 26.3% (24.2–28.4%)		Not clear	All participants living with HIV
Wilson, 2016 [84]	Kenya	2012–2013	Cross-sectional	All female; median age 39 (IQR 33–44) years	356	AUDIT ≥ 7	19.9% (15.9–24.4%)			
<i>Miners</i>										
Buchanan, 1988 [85]	Zambia	1983–1984	Cross-sectional	All male; no age information given	95	Alcohol blood level, measured by alcoholmeter AEDI ≥ 17.8 mmol/l	9.5% (4.4–17.2%)			
Clift, 2003 [86]	Ghana	1986, 1988	Cross-sectional	All male; mean age 33.9 years	117	GOT, GPT	GOT: 15% (8.7–22.2%) GPT: 17% (12.9–28.0%)			
Lewis, 2013 [87]	South Africa	2006 - 2009	Cross-sectional	95% male; 64% aged 35–54 years	26,912	> 28 units/week for men; > 21 units/week for women	1.6% (1.4–1.7%)			

CI confidence interval, *RAPSA-QF* rapid alcohol problems screen 4-quantity-frequency for alcohol dependence, *AUDIT* alcohol use disorder identification test, *CAGE* screening test for problem drinking, *GOT* glutamic oxaloacetic transaminase, *GPT* glutamic pyruvic transaminase, *RDS* respondent driven sampling, *CIDI* composite international diagnostic interview, *IQR* interquartile range, *SD* standard deviation

Table 2 Illicit drug use prevalence, risk factors and association with HIV incidence or prevalence, among studies included in the systematic review

Author, year of publication	Country	Year of study	Study design	Age and sex distribution	Sample size	Drug use prevalence (%), 95% CI By self-report	Associations of alcohol misuse or illicit drug use with HIV and other risk factors	HIV test	HIV prevalence (95% CI)
<i>Fishing communities</i>									
Kiwanuka, 2013 [88]	Uganda	2011–2013	Cross-sectional	51% male, mean (SD) age 29.7 (7.6) years	2191	Marijuana: 13.8% (12.3–15.2%)	Marijuana use positively associated with HIV (PPR 1.40 (1.1, 1.76))	Rapid test + ELISA confirmation	26.7%
Seeley, 2012 [89]	Uganda	2009	Cohort	54.4% male, median age 28 years (IQR 23–34)	919	–	Drug use positively associated with HIV acquisition (aHR 2.9 (1.0–8.0), $p=0.045$)	Rapid test + confirmatory testing	Incidence 4.9 (95% CI 3.8–6.3) per 100 pyr
Sileo, 2017 [45]	Uganda	2016–2017	Cross-sectional	100% male, mean age 37 (SD 8.6) years	300	Cannabis: 0.7% (0.1–2.4%); Kuber: 2.3% (0.9–4.7%); Sishat: 1.7% (0.5–3.8%); Khat: 1.0% (0.2–2.9%)	–	–	–
<i>Uniformed personnel</i>									
Essien, 2007 [90]	Nigeria	2003–2004	Cross-sectional	87% male, 55% 18–29 years	2213	Marijuana, last 6 weeks: 23.6% (21.8–25.3%)	–	–	–
Ihunwo, 2004 [46]	Uganda	Not given	Cross-sectional	71% male, 52% aged 21–25	35	Khat, ever: 97.1% (85.1–99.9%)	–	–	–
Mion, 1998 [91]	Djibouti	Not given	Cross-sectional	99% male, mean (SD) age 31 [1] years	100	Khat: 84.0% (75.3–90.6%)	–	–	–
Odenwald, 2009 [92]	Somalia	2003	Cross-sectional	89% male, mean (SD) age 37.3 (2.1) years	8124	Khat, last week: 36.4% (19.3–57.7%)	–	–	–
Argaw, 2012 [93]	Ethiopia	2010	Cross-sectional (mixed methods)	91.3% male, median (SD) age 29 (7.5) years	135	Khat: 66.7% (59.3–74.0%)	–	–	–
Okulate, 2008 [94]	Nigeria	1990–1994	Cross-sectional	All male; 46.6% <30 years of age	1131	Cannabis use: no data on prevalence	PTSD was associated with cannabis use Chi-Square 60.9, $p<0.000$	–	–

Table 2 (continued)

Author, year of publication	Country	Year of study	Study design	Age and sex distribution	Sample size	Drug use prevalence (%), 95% CI By self-report	Associations of alcohol misuse or illicit drug use with HIV and other risk factors	HIV test	HIV prevalence (95% CI)
<i>Truckers</i>									
Adejughagbe, 2015 [95]	Nigeria	2013	Cross-sectional	All male, median age 42 years (range 22–73)	592	Kola nut: 38.5% (34.7–42.5%)	–	–	–
Adjei, 2016 [96]	Ghana	2013	Cross-sectional	All male, mean (SD) age 40.6 (11.6) years	106	Any illicit drug use: 5.7% (0.2–11.9%)	–	Rapid test + confirmatory testing	0.9% (0.02–5.1%)
Botao, 2016 [73]	Mozambique	2012	Cross-sectional	All male, 45.3% 31–40 years	322	Illicit drug (marijuana, cocaine and heroin) use, last year: 1.9% (0.4–3.3%)	–	Rapid test + confirmatory testing	15.4% (11.4–19.4%)
Ihunwo, 2004 [46]	Uganda	Not given	Cross-sectional	71% male, 52% aged 21–25	16	Khat, ever: 68.8% (41.3–89.0%)	–	–	–
Okpataku, 2016 [97]	Nigeria	2012	Cross-sectional	All male, mean (SD) age 43.4 (10.2) years	274	Cannabis: 9.4% (6.0–13.0%) Opioids 4.3% (2.3–7.5%) Anxiolytics 2.1% (0.8–4.7%) Kola nuts 50.0% (44.1–55.9%) Solvents 1.1% (0.2–3.2%) Cocaine 0.3% (0.01–2.0%)	Cannabis use predictors: not having a spouse, aged < 45 years	–	–
<i>Sex workers</i>									
Alemayehu, 2015 [98]	Ethiopia	2013	Cross-sectional	All female, mean (SD) age 24 (4.3) years	250	Khat: 45.6% (39.4–51.8%) Drug use: 32% (26.6–38.2%)	–	–	–
Atalay, 2006 [72]	Ethiopia	2001–2002	Cross-sectional	All female, 15–49 years	2487	Khat: 49.3% (47.2–51.4%) Any substances (including Khat): 58.6% (56.5–60.6%)	–	–	–

Table 2 (continued)

Author, year of publication	Country	Year of study	Study design	Age and sex distribution	Sample size	Drug use prevalence (%), 95% CI By self-report	Associations of alcohol misuse or illicit drug use with HIV and other risk factors	HIV test	HIV prevalence (95% CI)
Chersich, 2014	Kenya	2006–2007	Cohort	All female, mean (SD) age 25.1 (5.2) years	400	Cannabis, last week: 7.5% (5.1–10.6%) Khat, last week: 18.5% (14.9–22.7%)			
Cheuk, 2016 [99]	Kenya	Not given	Cross-sectional	All female, aged 14–24 years	408	Injection drug use: 1.5% (0.5–3.2%)			
Decker, 2016 [100]	Cameroon	Not given	Cross-sectional	All female, 39.6% 24–30 years	1817	Injection drug use ever 1.5% (0.9–2.1%)	–	Self-report	5.1% (4.0–6.2%)
Hladik, 2017 [101]	Uganda	2008–2009	Cross-sectional	All female, median age 26 years	942 ^(RDS)	Any drug use: 23.4% (20.8–26.3%) Injection drug use: 4.5% (3.3–6.1%)	No association with HIV prevalence for any drug use [OR 1.05 (0.82–1.34)] or IDU [OR 1.24 (0.80–1.91)]	Rapid test	33.0% (29.7–36.6%)
Kerrigan, 2017 [102]	Tanzania	Not given	Cross-sectional (baseline of cohort)	All female, median (SD) age 27 (6.7) years	496	Any illicit drug use: 6.9% (4.8–9.4%) Illicit drug use, past 6 months: 3.0% (1.7–4.9%)		Rapid test + confirmatory testing	40.9% (36.6–45.4%)
Niama, 2017 [103]	Congo	2011–2012	Cross-sectional	All female, mean (SD) age 28.3 (9.1) years	805	Any drug use: 15.2% (12.7–17.8%) Injection drug use: 3.4% (2.2–4.8%)	No association with HIV prevalence for any drug use OR 1.1 (0.5, 2.8) or IDU OR 0.5 (0.1, 3.5)	Rapid test + confirmatory testing	7.5%
Vandepitte, 2011 [29]	Uganda	2008–2009	Cross-sectional	All female, mean (SD) age 26 (5.7) years	1027	Marijuana and/or khat, ever: 8.2% (6.0–9.2%) Injected heroin, ever: 0.2% (0.02–0.7%)		Rapid test + confirmatory testing	37% (34–40%)

Table 2 (continued)

Author, year of publication	Country	Year of study	Study design	Age and sex distribution	Sample size	Drug use prevalence (%), 95% CI By self-report	Associations of alcohol misuse or illicit drug use with HIV and other risk factors	HIV test	HIV prevalence (95% CI)
Bukenya, 2013 [104]	Uganda	2008–2009	Cross-sectional	All female, median age 26 (IQR 22–30) years	905	Overall any use 21.2% (18.6–23.9%)	–	–	–
Francis, 2016 [105]	Uganda	2008–2011	Cohort - GHWP	All female, median age (baseline) 26 years	1027	Overall 23% illicit drug use in last 3 months ^b	–	–	–
Bugssa, 2015 [106]	Ethiopia	2013	Cross-sectional	All female, mean age 24 (SD 5.7) years	319	Any drug use: 16.6% (12.5–20.0%)	No association between HIV association and drug use, OR 0.8 (0.2, 2.5)	Rapid test	11.9%
Fawole, 2014 [107]	Nigeria	2009	Cross-sectional	All female, mean age 27.4 (SD 5.7) years	305	Cigarette or Indian hemp, before sex: 56.4% (53.3–64.6%)	–	–	–
Fonek, 2000 [108]	Kenya	1998	Cross-sectional (RCT baseline)	All female, mean age 32 (range 18–57) years	318	Intravenous drug use: 3.0% (1.5–5.7%)	Intravenous drug use not associated with HIV	Rapid test + confirmatory testing	27%
Gallo, 2011 [109]	Kenya	2004–2005	Cohort	All female, median age 30 years (range 18–55)	140	Bhang/cannabis during sex: 9.2% (5.03–15.4%)	–	–	–
Johnston, 2013 [47]	Mauritius	2010	Cross-sectional	All female, median (range) age 31 [16–56] years	299	Injection drug use, ever: 40% (29.6–45.8%)	IDUs (ever) more likely to be HIV positive: adjusted OR 5.3 (2.2–12.3)	Rapid test + confirmatory testing	–
Kayembe, 2008 [110]	DRC	2005–2006	Cross-sectional	All female, 76% aged between 20–44 years	2638	Marijuana, ever: 22.2% (22.6–23.8%) Cocaine, ever: 2.5% (1.9–3.1%)	–	–	–

Table 2 (continued)

Author, year of publication	Country	Year of study	Study design	Age and sex distribution	Sample size	Drug use prevalence (%), 95% CI By self-report	Associations of alcohol misuse or illicit drug use with HIV and other risk factors	HIV test	HIV prevalence (95% CI)
Lancaster, 2016 [111]	Malawi	2014	Cross-sectional	All female, median age 26 years (IQR 23–30). Data on drug use for HIV + only	200	Cannabis: 20.8% (13.2–30.3%)	–	Rapid test	69%
Longo, 2017 [112]	Central African Republic	2013	Cross-sectional	All female, median age 21 years (range 14–36 years)	112	Cannabis, every day: 8.9% (4.4–15.8%) Glue, every day: 9.8% (5.0–16.8%)	–	Rapid test	–
McKinnon, 2014 [113]	Kenya	Not given	Prospective cohort	All male, median age 27 years (IQR 24–31)	507	Marijuana current use 11.8% (9.0–14.6%)	Marijuana use associated with reduced HIV prevalence (OR = 0.40 (95% CI: 0.18, 0.90), $p = 0.027$); not associated with HIV acquisition	Not clear	–
Micheni, 2015 [114]	Kenya	2005–2014	cohort	All female, median age 26 years	367	0.05% (0.0–0.2%)	–	–	–
Cheuk, 2016 [115]	Kenya		Cross-sectional	All female, 14–24 years	408	Injection drug use 1.5% (0.3–4.9%)	–	–	–
Muraguri, 2015 [79]	Kenya	2010	Cross-sectional	Male, 34.4% 18–24 years	273 ^(RDS)	Illicit drug use, past 12 months: 77.5% (68.5–85.0%)	–	–	–
Nouaman, 2015 [8]	Cote D'ivoire	2013	Cross-sectional	All female, median age 29 years (IQR 23–36)	249	Marijuana, past 12 months: 2.4% (0.9–5.2%)	–	Routine testing	33.7% (27.8%–39.6%)
Okafor, 2017 [116]	Nigeria	2010	Cross-sectional	All female, aged 15–24 years	1796	Injection drug use: 7.8% (6.50–9.1%)	–	–	–

Table 2 (continued)

Author, year of publication	Country	Year of study	Study design	Age and sex distribution	Sample size	Drug use prevalence (%), 95% CI By self-report	Associations of alcohol misuse or illicit drug use with HIV and other risk factors	HIV test	HIV prevalence (95% CI)
Peltzer, 2004 [117]	South Africa	2003–2004	Cross-sectional	All female, mean (SD) age 26.6 (5.5) years	70	Cannabis, past 12 months: 10% (4.1–19.5%) Injected drugs, past 12 months: 2.9% (0.3–9.9%)	–	–	–
Rishan, 2015 [118]	Mekelle	2014	Cross-sectional	all female, mean age 22.6 years (SD 4.98)	346	Drug use, last 2 years 23.7% (19.2–28.2%)	–	–	–
Tegang, 2010 [119]	Kenya	2007	Cross-sectional	All female, median age 25 years (IQR 21–29)	297	Khat, ever use: 71% (65.9–76.2%), Marijuana, ever use: 34% (28.6–39.4%) Heroin, cocaine, glue or petrol: 6% (3.3–8.8%)	Marijuana positively associated with age ($p < 0.01$, OR = 2.10 (1.28, 3.45). Khat users more likely to have younger age at first paid sex. Coke/heroin/glue users more likely to have 2+ sex partners in last working day	–	–
Van der Elst, 2009 [120]	Kenya	2008	Cross-sectional	65% male. Male median age 27 (IQR 23–43), female median age 28 years [24–32]	398	WOMEN: Marijuana, daily: 12.3% (6.8–17.7%) IV drugs, past 3 months 4.4% (1.6–9.2%) MEN: Marijuana, daily: 23.2% (18.0–28.3%) IV drugs in past 3 months 10.8% (7.0–14.6%)	–	–	–

Table 2 (continued)

Author, year of publication	Country	Year of study	Study design	Age and sex distribution	Sample size	Drug use prevalence (%), 95% CI By self-report	Associations of alcohol misuse or illicit drug use with HIV and other risk factors	HIV test	HIV prevalence (95% CI)
Vandenhoudt, 2013 [121]	Kenya	2008	Cross-sectional	All female, median age 26 years (IQR 20–30)	481	IDU ever use 7.3% (5.0–9.6%)	No association with HIV prevalence: OR 1.1 (0.5–2.3), $p=0.78$	Confirmatory test	56.5% (52–61.6)
Wilson, 2014 [122]	Kenya	2006–2011	Cross-sectional	All female, median age 29 years (IQR 25–35)	474	Marijuana: 3.4% (1.9–5.4%) Cocaine: 0.3% (0.05–1.5%)	–	Rapid and confirmatory test	29.3% (26.3–33.6%)
Tadesse, 2016 [123]	Ethiopia	2015	Cross-sectional	All female, mean age 23.4 years (SD 6.4)	380	Any substance use: 58.2% (53.0–63.2%) Khat: 51.8% (46.7–57.0%) Shisha: 25.8% (21.5–30.5%)	Substance use among female sex workers was significantly associated with marital status, educational status, monthly income, and risky sexual behaviour		

Alcohol Misuse

The 35 papers reporting data on alcohol misuse were distributed as follows: fishing communities (n = 4), uniformed personnel (n = 8), truckers (n = 2), sex workers (n = 17), miners (n = 3) and motorcycle taxi riders (n = 1) (Table 1). Of the 34 papers estimating alcohol misuse prevalence, 17 screened for alcohol misuse using AUDIT; however, cut-offs for alcohol misuse varied between AUDIT ≥ 8 (n = 13), AUDIT ≥ 7 (n = 3, all among women), AUDIT ≥ 20 (n = 1). Two papers used the shortened AUDIT-C with a cut-off of ≥ 4. Five papers used the CAGE tool, with four of these using a cut-off of ≥ 2 while one used a cut-off of ≥ 1. One study reported both AUDIT and CAGE (Table 2).

Other measures used included the CIDI F10.2 [43] (n = 1), Rapid Alcohol Problems Screen 4-Quantity-Frequency (RAPS4-QF) for alcohol dependence [40] (n = 1), DSM IV alcohol abuse and dependence [44] (n = 1), ICD-10 criteria for alcohol dependence, and psychosocial problems in alcohol dependence [42] (n = 1), binge drinking 5 + drinks on one occasion (n = 5), weekly restrictions in units/week (n = 2), alcohol blood levels by alcometer AEDI (n = 1), and Glutamic Oxaloacetic transaminase (GOT) reference interval ≤ 45 U/L or Glutamic Pyruvic Transaminase (GPT) reference interval 8–40 IU/L (n = 1) (Table 1).

Figure 3 displays study-specific prevalence and 95% CIs for those studies using CAGE ≥ 2, AUDIT-C ≥ 4, AUDIT ≥ 7 or AUDIT ≥ 8, by occupation group, and demonstrates the marked heterogeneity in prevalence estimates, both overall

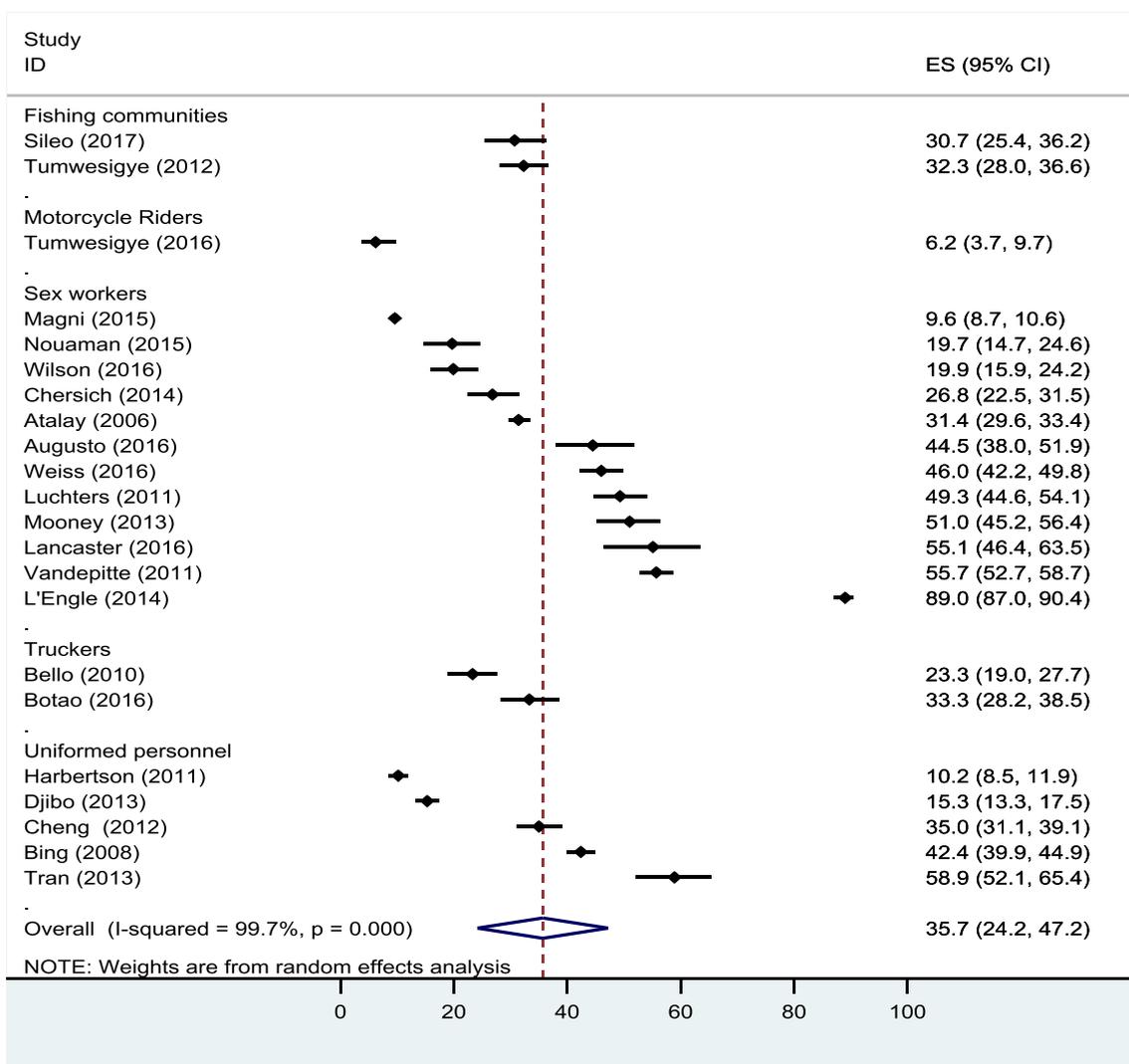


Fig. 3 Prevalence of alcohol misuse among high-risk occupational groups, among studies using validated measures [AUDIT (18 studies), CAGE (5 studies)]

and within occupational groups. The median prevalence of alcohol misuse based on these standardised measures was 32.8% (interquartile range (IQR) 20.8–48.5%). From meta-analysis, the overall pooled estimate of alcohol misuse prevalence based on these standardised measures was 35.7% (95% confidence interval: 24.2%, 47.2%), I-square 99.7%. Prevalence of alcohol misuse tended to be highest in sex workers (median prevalence 45.3%, IQR 25.1–52.0%, 12 studies), and lowest in motorcycle taxi riders population (prevalence 6.2%, one study). Overall the median prevalence

of alcohol misuse, regardless of the measure used, was 31.1% (IQR 19.3–45.6%).

Seven papers reported on associations between alcohol misuse and HIV incidence (n=2) or HIV prevalence (n=5) (Table 1, Supplementary table 3). Of these, five reported a statistically significant positive association (OR/RR > 1 with *p* value < 0.05), and two showed no evidence of association. Five papers reported significant positive associations between alcohol misuse and other factors, including age, number of traumatic events, involvement in combat, recruiting clients from bars, clubs or several sites; reporting rape

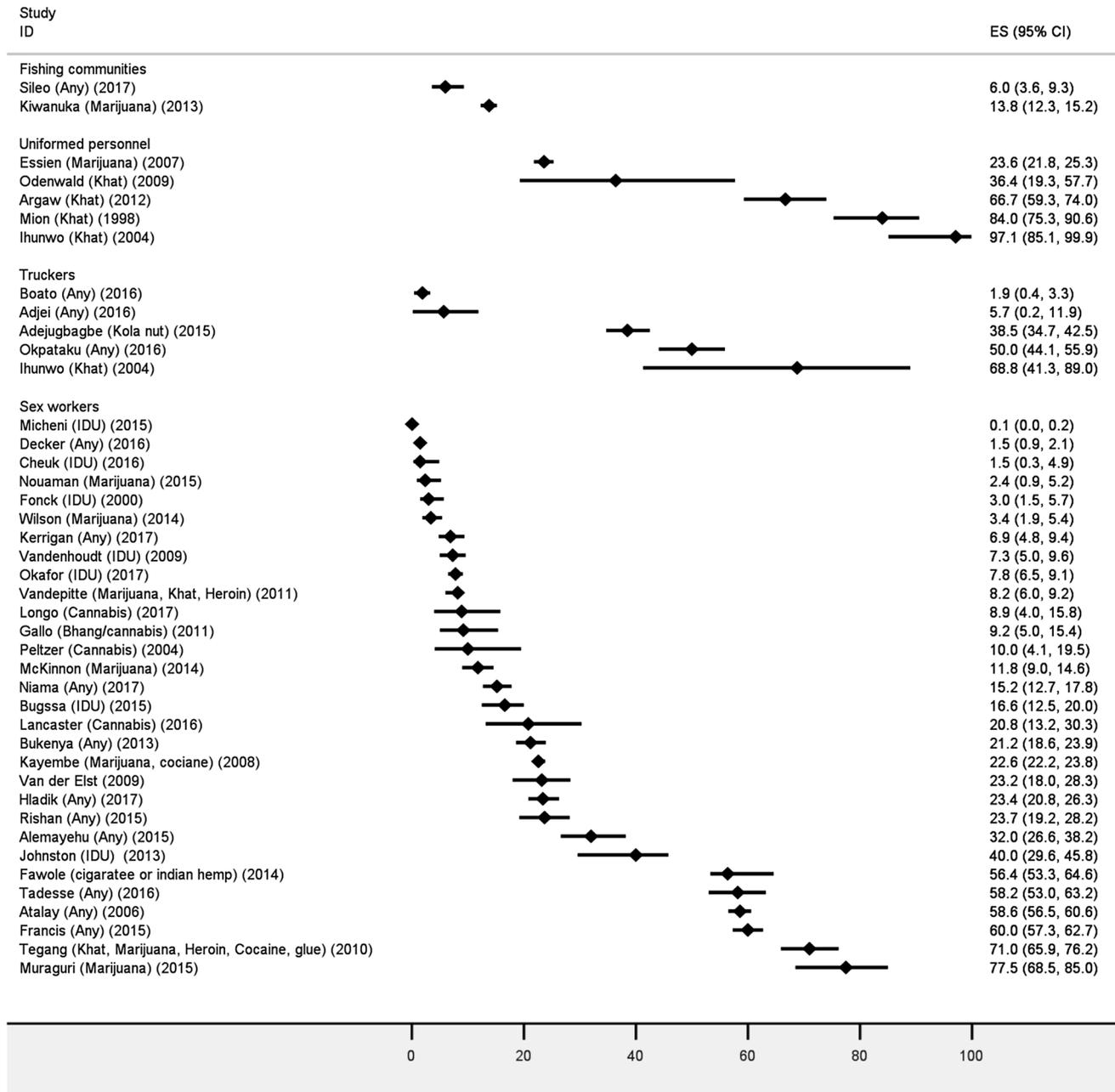


Fig. 4 Prevalence of self-reported illicit drug use among high-risk occupational groups

as the first sex act; drug use; and intimate partner violence, among others.

Illicit Drug Use

Forty-four papers reported data on illicit drug use among fishing communities ($n=3$), uniformed personnel ($n=6$; one paper also reported data from truckers), truckers ($n=5$), and sex workers ($n=31$) (Table 2, Fig. 4). Reported study sizes ranged from 16 to 2638 participants. Forty-two papers estimated prevalence, while two reported only associations with drug use. All prevalence estimates were based on self-report, and did not use validated measures except for one study that used the ASSIST tool [45]. The reporting time-period for drug use was variable, ranging from current daily use to ever use. Time-periods for drug use were not reported or were unclear in 21 (50%) papers.

A quarter of studies giving data on illicit drug use did not present substance-specific estimates, instead reporting data only on “any drug use”. Marijuana, khat and injection drugs were the substances most commonly reported. Prevalence of any drug use was generally highest among uniformed personnel (mainly khat and marijuana), followed by sex workers. The highest prevalence of any illicit drug use reported

was 97% for khat use among uniformed personnel in Uganda [46], with the highest single-study estimated prevalence of injection drug use (ever) reported as 40% among sex workers in Mauritius [47]. Since the drug types and reporting timeframes were extremely variable, we did not combine estimates into a single summary measure.

Fourteen studies examined correlates of drug use (Table 2). Ten reported associations between illicit drug use and HIV, of which five reported no evidence of association, four reported a positive association i.e. OR/RR > 1 with p value < 0.05 (three with marijuana use, one with IDU), and one reported an inverse association (with marijuana use) (Table 2). Other factors identified as being significantly positively associated with illicit drug use included being single; younger age at first sex and larger number of clients (for sex workers); low educational attainment; and post-traumatic stress disorder (Table 2).

Quality Assessment

All included studies were administered face-to-face, except for one study that was administered using audio computer assisted technology. Table 3 summarises quality assessment metrics for included studies. Included papers were often of

Table 3 Quality assessment of included papers

Quality measure	Category	N (%)
Probability sample	Yes	26 (37%)
	No	45 (63%)
Response rate reported	Yes	27 (38%) ^a
	No	44 (62%)
Alcohol misuse measure ^b	Standardised questionnaire tool	29 (83%)
	Objective measure	6 (17%)
Alcohol misuse timeframe ^b	Described	30 (86%)
	Not described	5 (14%)
Illicit drug use measure ^c	Self-report	43 (98%)
	Objective measure	1 (2%)
Illicit drug use reporting ^c	Individual drugs reported	29 (66%)
	Some individual and some grouped drugs reported	4 (9%)
	Drugs grouped (no individual drug information given)	11 (25%)
Illicit drug use timeframe ^c	Described	23 (52%)
	Not described or unclear	21 (48%)
HIV measure ^d	Objective	17 (94%)
	Self-report	1 (6%)
Adjustment for confounders	Fully adjusted	13 (48%)
	Partially adjusted	3 (11%)
	Not adjusted or unclear	11 (41%)

^aResponse rate > 90% for 19 (70%) studies where response rate was reported

^b35 studies reported alcohol misuse

^c44 studies reported illicit drug use

^d18 studies reported HIV

^e27 studies reported associations with HIV or with risk factors

poor quality, with common methodological issues including small sample sizes and use of non-probability sampling in over half of studies ($n = 45$, 63%). Only 27 (38%) papers reported a response rate, although this was over 90% for two thirds of these papers. Most studies reporting alcohol misuse used questionnaire tools with a small number (17%) using an objective measurement (AUDIT, CAGE). As noted above, 98% of studies reporting illicit drug use did not use validated tools, and 48% did not give a clear timeframe. Twenty-five papers reported on any association between either alcohol misuse or illicit drug use and HIV, or risk factors for alcohol misuse or illicit drug use, of which, 52% adjusted fully for confounders.

Discussion

Data from 71 studies, conducted in 23 countries in sub-Saharan Africa between 1983 and 2017, show that despite substantial growth in research examining substance use among occupational groups at high-risk of HIV in sub-Saharan Africa, the body of evidence remains limited. We found substantial variability in prevalence and patterns of alcohol misuse and illicit drug use, across and within occupational groups. The pooled estimate of alcohol misuse prevalence assessed using standardised tools was 35.7% (95% CI: 24.2%, 47.2%). Substance use was positively associated with HIV in the majority of studies that examined this relationship.

In studies using validated measures, the prevalence of alcohol misuse ranged from 6.2% (motorcycle taxi riders) to 89.0% (sex workers), and illicit drug use prevalence ranged from 0.1% (sex workers) to 97.1% (uniformed personnel). The heterogeneity in findings likely reflects regional and population level differences in patterns of substance use, which may be influenced by local contextual factors such as government policies, availability of substances and social norms.

Our random effects meta-analysis of alcohol misuse including only studies that used standardised measures, estimated a heterogeneity I-square statistic close to 100%. This level of heterogeneity limits the inference one can make from the pooled estimate. We did not conduct a meta-analysis or report a pooled prevalence estimate for illicit drug use given the heterogeneity of methods, tools, the drug types assessed for, and time periods over which drug use was reported—ranging from self-reported use in previous days to ever use. This level of heterogeneity makes it challenging to draw definitive conclusions.

Prevalence of reported alcohol misuse was, on average, highest among sex workers, and lowest among motorcycle taxi riders, while prevalence of any drug use was highest among uniformed personnel, followed by sex workers,

suggesting that these occupational settings may present particularly vulnerable risk environments for substance use. These findings emphasise a need to integrate substance use prevention and treatment into health care services offered to these key population groups.

Our pooled estimate of alcohol misuse prevalence in these key occupational groups is substantially higher than the general African adult population estimate of 4%, although participants included in reviewed studies were often younger than the general adult population. Sexual bridging between certain occupations, such as truckers, uniformed personnel, female sex workers and the general population is common [48], and may occur because of shared risk environments such as bars and brothels [49, 50] or because of migration that might shape patterns of substance use, and other high-risk behaviour [51].

The high pooled prevalence estimate (with wide confidence interval) may be partially driven by some outlier estimates of prevalence, for example one study reported a particularly high alcohol misuse prevalence (89%) among sex workers [52]. While it is possible that this is an accurate estimate for this sub-population in this setting, it was not clear how screening for the study was conducted; it might have been biased towards women at risk of problem drinking, who were the trial's target population.

The prevalence of reported injection drug use was generally much lower than for oral illicit drug use, but was not negligible. Unsafe injecting practises remain an important route for HIV and Hepatitis C transmission, further justifying the need for harm reduction services among high HIV risk occupation groups.

The variability in measuring tools mirrors the findings of a systematic review of alcohol misuse in young people in Africa [35]. Use of standardised and validated tools and or biomarkers is critical for assessing substance use, for monitoring and evaluation of harm reduction interventions, and for facilitating comparison of prevalence across populations. Future research should consider using Phosphatidyl ethanol (PEth), a highly specific and reasonably sensitive biomarker for heavy alcohol consumption within the past 2–3 weeks. [53, 54]. PEth levels vary depending on the amount and number of days or duration of alcohol consumption [55, 56]. Screening for illicit drug use could benefit from use of drug-screening kits to assess current or recent drug use.

The review highlights the lack of literature about correlates of substance use among occupational groups at high risk of HIV in sub-Saharan Africa. Around a quarter of studies reviewed examined associations between substance use and HIV, and among these positive associations were frequently seen, particularly for alcohol misuse and marijuana use. Only 9 papers reported on risk factors and the range of factors considered or reported was quite limited

and mostly inconsistent across papers. A consistently positive association with alcohol misuse and illicit drug use was seen for intimate partner violence, supporting results reported elsewhere in general population settings [57]. Our review included papers from the 1980s onwards, a period during which the HIV epidemic and HIV treatment options have constantly evolved, and this may have impacted our findings on association with HIV incidence or prevalence. In the future, any association between HIV and substance use may be mitigated by the advent of increased HIV testing and treatment coverage, although to date coverage in most SSA countries remains suboptimal.

Strengths of our review include its wide-ranging and comprehensive literature search, using data from a broad range of high-risk population groups in sub-Saharan Africa; who have important social interactions as far as HIV-related risky behaviour is concerned. One limitation is that our search deliberately excluded terms for certain vulnerable groups such as facility workers, patrons, bar workers and women or men engaging in transactional sex (apart from sex work) because they are not recognised as key population groups. Thus, our review may have missed some studies on populations with similar characteristics to those included. The different tools or cut-offs might have affected the generalisability of our findings.

Ideally, the data presented for purposes of comparison would have included the general population of the countries where the studies on key populations were conducted, disaggregated by gender; however, most countries only had a small number of papers included and often, general population data were not found. Nevertheless, our review is helpful for understanding differences in dynamics between various settings, and highlights substantial gaps in evidence.

Conclusions

The studies reviewed demonstrate a high prevalence of alcohol misuse and illicit drug in high HIV risk occupational groups in sub-Saharan Africa. There was some evidence for positive associations between substance use and HIV infection.

Recommendations

Future epidemiological and ethnographic research should (1) explore substance use in these groups, using standardised and validated tools such as AUDIT, and biomarkers such as PEth and drug testing kits; (2) explore occupational related factors, including factors common to different occupational groups, and how they influence substance use. This work should be done not only within specific high-risk occupational groups but also for general population comparison

groups, to inform implementation of interventions that are responsive to the common occupation-related risk factors.

As the bulk of existing research has focused on prevalence, future work should examine correlates of substance use more broadly. Illicit drug use measures should be specific to individual drug types rather than unspecified drug use. Longitudinal studies or repeat cross-sectional studies could be beneficial, and could examine population level patterns and trends of substance use including different drug types, and routes of drug administration, over time.

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Compliance with Ethical Standards

The review protocol was registered at: (<http://www.crd.york.ac.uk/PROSPERO> CRD42016053495).

Conflict of interest The authors have declared that no competing interests exist.

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