



Inconsistent Condom Use and Its Associations Among Individuals with Substance Use Disorders: A Systematic Review and Meta-analysis

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Abstract

Introduction The prevalence of risky sexual behaviors—especially inconsistent condom use (ICU)—is greater among individuals with substance use disorders (SUDs). ICU may lead to sexually transmitted diseases (STDs) and HIV infection among individuals with SUDs. The present study aimed to determine the prevalence, sociodemographic characteristics, risky behaviors, and type of psychoactive drug use associated with ICU among individuals with SUD.

Methods Papers published between January 1, 1990, and December 20, 2022, were reviewed and extracted from the *PubMed*, *Scopus*, *Web of Science*, and *Cochrane Library* databases. Two independent authors reviewed the full texts of the selected papers in accordance with the PECOS guidelines as well as the study's exclusion criteria. For detecting heterogeneity between the studies, several sub-group analyses were conducted. To perform sensitivity analyses, Baujat plots with random effect models were applied.

Results After initial assessment of 11,969 papers, a total of 117 studies met the eligibility criteria. Among individuals with SUD, the findings indicated lifetime pooled prevalence rates of ICU with any sexual partners to be 61% for vaginal sex (95% CI, 57–65%), 48% for anal sex (95% CI, 39–56%), and 81% for oral sex (95% CI, 68–93%). The findings indicated that individuals with SUD who report ICU with any sexual partners were more likely to be female, to have multiple sexual partners, to have a history of HIV testing, to have HIV-negative status, and to primarily use methamphetamine, cocaine, crack, ecstasy, or heroin (or engage in polysubstance use).

Conclusions Increasing awareness regarding the importance of consistent condom use, as well as HIV/AIDS at family, peer, and partner levels, would likely substantially help to improve safe sex among individuals with SUD.

Policy Implications These programs can include needle/syringe exchange programs, condom distribution, and opioid substitution interventions. Consequently, the likelihood of high-risk sexual activities and contracting STDs could be minimized among this vulnerable population.

Keywords Inconsistent condom use · Substance use disorders · Sexually transmitted diseases · HIV · Multiple sexual partners · HIV testing

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Introduction

The prevalence of risky sexual behaviors is greater among individuals with substance use disorders (SUD) relative to those without such conditions (Ritchwood et al., 2015). The *Diagnostic and Statistical Manual of Mental Disorders (DSM)-5* (American Psychiatric Association et al., 2013) delineate substance use disorders (SUDs) across a spectrum spanning from mild to moderate to severe, with the intensity of the disorder determined by the extent to which the 11 established diagnostic criteria are met. Compared to other populations, individuals with SUD have a significantly higher frequency of high-risk behaviors such as needle sharing, frequency of injection, injection by others, overdose, homelessness, and risky sexual behaviors (Armoon et al., 2022a; Armoon et al., 2022b; Rezaei et al., 2020). Also, compared to individuals who do not inject drugs, those who inject drugs are more likely to be arrested (Fischer et al., 2006), have more co-infection diseases such as HIV (human immunodeficiency virus) and HCV (hepatitis C virus) (Fischer et al., 2006; Keen et al., 2014), and experience poorer overall health, as well as greater use of treatment services such as methadone maintenance treatment (Fischer et al., 2006). Furthermore, the risks of developing sexually transmitted diseases (STDs) and HIV infection are

higher among individuals with SUD compared to those without SUD (Murali et al., 2018; Noroozi et al., 2019). Additionally, there is a robust association between SUD and early onset of sexual activity (Baldwin et al., 2013) and having multiple sexual partners (Ghiasvand et al., 2018; Murali et al., 2018). Consequently, not only are the health-concerned costs elevated, but also the lives of individuals with SUD (of any kind) are adversely impacted at social, professional, and personal levels (Dallelucchi et al., 2019). STDs increase as a consequence of sexual relationships without using contraceptives – mainly condoms – as a means of attempting unsafe sexual activities (Dallelucchi et al., 2019). Studies have demonstrated a robust association between inconsistent condom use (ICU) and drug use, supported by evidence concerning an individual’s capability of using or negotiating using condoms once under the influence of alcohol and/or other psychoactive substances (Armoon et al., 2023; Noroozi et al., 2020; Piersiala et al., 2020). ICU is prevalent among both those with or without SUD, possibly stemming from such reasons as limited awareness about HIV and the misconception that condom use diminishes sexual pleasure (Noroozi et al., 2018).

Psychoactive drugs and/or alcohol can increase alertness, energy, and self-esteem (Moradi et al., 2022). These substances can induce a state of euphoria characterized by increased energy, reduced fatigue, and heightened pleasure, often referred to as a “rush” or “flash”, accompanied by increased movement and concentration (Baldwin et al., 2018). Moreover, some psychoactive drugs such as stimulants have short-term effects including heightened alertness, reduced appetite, headaches, dizziness, fever, elevated heart rate, elevated blood pressure, and increased respiratory rate (Morgan et al., 2013). The use of psychoactive substances has been associated with various sexual behaviors and consequences, including heightened libido, increased sexual activity, prolonged sexual activity, greater sexual confidence, multiple sexual partners, casual sexual

encounters, anal intercourse, and engaging in sex trafficking either in exchange for drugs or money (Moradi et al., 2022; Morgan et al., 2013). Consequently, some individuals turn to such substances as a means to enhance sexual desire and prolong sexual intercourse, which in turn can lead to engaging in high-risk sexual behaviors such as ICU (McKetin et al., 2018).

Prior studies have highlighted a significant relationship between elevated ICU and sociodemographic features including male gender (Booth et al., 1993), low economic status or lack of constant accommodation (Armoon et al., 2018), and an early age initiation of drug use (Booth et al., 1993). Moreover, some studies have reported a significant association between enhanced ICU and practicing high-risk activities, (e.g., lack of awareness of injection drug use by sexual partner and oral sex (March et al., 2007)), a high perception of HIV risk (Noroozi et al., 2017), past experiences of using shared injection equipment (Narenjiha et al., 2014), and the use of some psychoactive substances, including methamphetamine (Armoon et al., 2018). Other studies have reported a significant association between reduced ICU and individuals who engage in drug injection at home, who have higher levels of education, and who have past experiences of drug treatment (e.g., methadone maintenance) (Narenjiha et al., 2014). However, it is unclear how failure to regularly use condoms might contribute to the features of SUD, including sociodemographic characteristics, high-risk behaviors, and type of psychoactive drug use.

Two previous meta-analyses have reported the relationship between alcohol consumption or substance use and risky sexual behaviors among adolescents and young adults (i.e., Cho et al., 2023; Ritchwood et al., 2015), but neither focused on individuals with SUDs. In addition these studies: (i) only included adolescents (12–17 years old) (Ritchwood et al., 2015) or adolescents and young adults (15–24 years old) (Cho et al., 2023); (ii) only investigated the association between alcohol consumption (Cho et al., 2023) or substance use (Ritchwood et al., 2015) with

risky sexual behaviors (i.e., they did not report the pooled prevalence rate of ICU in the past month, six months, or lifetime); (iii) did not compare SUD groups (those who inject drugs vs. those who do not inject drugs); (iv) did not compare groups based on sexual partners (regular sex partners, non-regular sex partners, and multiple sex partners); (v) did not conduct any sensitivity analyses; and (vi) did not investigate the risky determinants associated with ICU among individuals with SUDs.

To the best of the authors' knowledge, there is no meta-analysis study examining the prevalence of ICU and its associations with sociodemographic characteristics, high-risk behaviors, and type of drug use among individuals with SUD. Vulnerable populations may benefit from facilitated and accelerated services, such as distributing contraceptives (including condoms), needle and syringe exchange programs, and substance substitution therapies. Such services can be improved by an in-depth understanding of how decreased ICU as well as high-risk behaviors and type of drug use are associated with each other. Consequently, filling this knowledge gap could improve the management and prevention of HIV/AIDS. Furthermore, healthcare authorities and policymakers can use the data concerning the relationship between context-induced features and high-risk sexual behaviors among individuals with SUD to design better control strategies. Therefore, the present systematic review and meta-analysis study aimed to determine the prevalence, sociodemographic characteristics, risky behaviors and type of psychoactive drug use associated with ICU among individuals with SUD.

Methods

Search strategy

The present systematic review and meta-analysis research was performed according to the Protocols of Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021)

(Supplementary File 1). The papers published between January 1 1990 and December 20 2022 were reviewed by two independent authors (RM and BA). The reviewed studies were retrieved from the *PubMed*, *Scopus*, *Web of Science* and *Cochrane Library* databases. Every field within records and Medical Subject Headings (MeSH terms) were considered in these databases. The authors applied the following initial keywords respecting the search strategy: “(*inconsistent condom use*), (*sexual behavior*), (*unsafe sex*), (*condom less sex*), (*substance abuse, intravenous*), (*substance-related disorders*), (*substance use disorder*), (*drug abuse*)”. The authors also manually reviewed the bibliography lists of the selected papers for other possible studies for inclusion.

Inclusion and exclusion criteria

The authors used the PECOS guidelines (population, exposures, comparison, outcome, and study design) to select relevant studies. Therefore, individuals with SUD includes alcohol and/or drug related disorders (either people who injected drugs or used drugs without injecting) who used drugs during sexual activity and engaged in ICU consisted of the “population”. Positive and protective contributors to the sociodemographic features, the type of psychoactive drug use, and high-risk behaviors among individuals with SUD regarding ICU comprised the “exposures”. Individuals with SUD who used condoms consistently comprised the “comparison” group. ICU was assessed in most (but not all) studies using the question: “What is the frequency of condom usage with any sexual partners (e.g., sex workers and casual partners)?” This included four potential responses: always, frequently, occasionally, and never. ICU was defined as irregular use (occasionally or never), comprising any type of sexual intercourse (oral, anal, or vaginal) (Armoon et al., 2023; Armoon et al., 2018; Diehl et al., 2014) with any sexual partners in life-time being the “outcomes”. Finally, integrated cross-sectional, cohort or case-control studies were considered as the “study design” since these studies are observational and provide prevalence rates or

associations between various variables of interest. Authors excluded qualitative studies, papers with secondary data lacking primary analyses, as well as systematic reviews, and meta-analytic studies. Moreover, studies were also excluded if there was substantial heterogeneity or outcome variations in the study groups.

Screening and data extraction

EndNote X7 software (*Thomson Reuters*) was implemented to manage the study references. Initially, authors removed the duplications (89% agreement). Then, the unweighted kappa (the level of agreement between reviewers) was examined. In sequence, the values 0, 0.01–0.02, 0.021–0.04, 0.041–0.06, 0.061–0.08, or 0.081–1.00 reflected poor, slight, fair, moderate, substantial, or almost perfect agreement between the paper reviewers (Landis et al., 1977). Next, the full texts of the obtained studies were reviewed by two independent authors (RM and BA), with respect to the PECOS guidelines and the exclusion criteria of the study. A third member of the research team (EA) resolved any disagreements in this respect. The authors utilized the *Covidence* software for conducting the study, which includes (i) imported references from *PubMed*, *Scopus*, etc., (ii) title and abstract screening, (iii) full-text review, and (iv) data extraction. *Microsoft Excel* software was applied to manage data. Consequently, the following data were extracted from each study: year of publication, name of first author, geographic location of study, study design, sample size, source of data collection, diagnostic measures used to evaluate the main variables, major statistical information, and all outcome measures.

Quality appraisal of studies

The research team implemented the Newcastle-Ottawa Scale (NOS) for assessing quality appraisal of the data (Peterson et al., 2011) (**Supplementary File 2**). The aspects of NOS consist of selection (three items respecting cross-sectional studies; four items respecting cohort and case

control studies), comparability (one item regarding both cross sectional as well as cohort and case control studies), and exposure/outcome (one item concerning cross-sectional studies and three items concerning cohort and case control studies). A star or score was dedicated to any study meeting each criterion. The maximum quality scores of 5 and 8 were obtainable regarding cross-sectional as well as cohort/case-control studies, respectively. In sequence, the total values of (i) 0–2, 3, 4, and 5 indicated “unsatisfactory,” “satisfactory,” “good,” or “very good” with respect to cross-sectional studies, and (ii) 0–3, 4, 5-6 and 7-8 orderly indicated “unsatisfactory,” “satisfactory,” “good,” or “very good” with respect to cohort and case-control studies.

Data synthesis and statistical analysis

Through the generation of pooled odds ratios (ORs) and 95% confidence intervals (CIs) on characteristics concerning ICU with any sexual partners among individuals with SUD, the meta-analysis was conducted. Using inverse variance weighting, the summary effect sizes were calculated (i.e., obtained from regression coefficients for the multivariate analyses).

Additionally, there were variations in actual effect sizes across papers with random effect patterns. Therefore, the analysis utilized a random-effects model with restricted maximum likelihood (REML) for selecting model and computing publication bias. Moreover, between-study variance and within-study sampling error were detected as the uncertainty sources. To observe heterogeneity in the true effect sizes among the papers, large Cochran's Q statistics, small p -values, and large I^2 statistics were applied. The authors employed subgroup analyses by country and sample size to determine heterogeneity sources (with ≥ 2 studies describing information regarding the examined variable per stratum). Moreover, Baujat plots were implemented concerning random effect models to run sensitivity analyses. These calculations helped determine impactful effects where investigations were excluded from the analysis to examine the influence of that study on

the estimate in total. Egger's and Begg's tests were used in graphical and statistical dimensions to identify any existing publication bias (Begg et al., 1994; Egger et al., 1997). Also, Rosenthal's fail-safe number trim-and-fill analysis, and funnel plots were applied. Finally, data analyses were conducted using R 3.5.1 software 'Meta' package.

Publication bias

To identify potential publication bias, the Egger's and Begg's tests were performed. Considering the symmetry assumption, there was no significant publication bias for almost of all variables which were examined (i.e., being female, multiple sex partners, methamphetamine use disorders). However, the publication bias test indicated considerable bias ($p < 0.05$) for other variables like cannabis and cocaine use disorders. Therefore, meta-trim analysis was performed in order to remove the effect of publication bias on the pooled OR. The meta-trim analysis showed that the pooled OR was 0.21 (95%CI: 0.16–0.25) in the random effect model (**Supplementary Files 3-8**).

Results

Initially, 11,969 papers were identified through the four database searches (**Supplementary File 9 and Table 1**). After paper duplicates were excluded ($n=7,348$), the title and abstracts of 4,621 papers were screened. Of these, 1113 were found relating to the aim of study. After a full text review, 996 papers were excluded. The main reasons for exclusion were as follows: 33 studies did not meet the quality appraisal score (3%), and 963 studies utilized a non-quantitative methodology or did not report parametric measurements such as coefficients, or odd ratios of relative risks in relation to the study outcomes (97%). Following exclusions, 117 studies (Anderson et al., 2011; Armoon et al., 2023; Armoon et al., 2018; Bailey et al., 1998; Bao et al.,

2015; Bellis et al., 2008; Boggiano et al., 2017; Booth et al., 1993; Bowen et al., 2006; Bradshaw et al., 2005; Brodbeck et al., 2006; Bryan et al., 2012; Cain et al., 2021; Castrucci et al., 2002; Celentano et al., 2006; Chavoshi et al., 2013; Cheng et al., 2016; Chikovani et al., 2011; Chikovani et al., 2013; Colfax et al., 2004; Daskalopoulou et al., 2014; de Carvalho et al., 2006; Decker et al., 2020; Decker et al., 2012; Desai et al., 2021; Diehl et al., 2018; Ding et al., 2013; Drumright et al., 2006; Ehrenstein et al., 2004; Falck et al., 1997; Fortenberry et al., 1997; Gálvez-Buccollini et al., 2009; Go et al., 2006; Guimarães et al., 2015; Guimarães et al., 2016; Gyarmathy et al., 2011; Gyarmathy et al., 2009; Hardy et al., 2022; Hensel et al., 2011; Hirshfield et al., 2004; Hops et al., 2011; Hudson et al., 2012; Janulis et al., 2018; Jones et al., 2019; Kahler et al., 2015; Kasirye et al., 2018; Kermode et al., 2015; Keshtkar et al., 2012; Khadr et al., 2016; Kingree et al., 2002; Kingree et al., 2003; Kingree et al., 2000; Lau et al., 2007; Leigh et al., 2008b; Li et al., 2014; Li et al., 2013; Lion et al., 2017; Liu et al., 2013; Ludford et al., 2013; Mansergh et al., 2006; March et al., 2007; Marshall et al., 2009; Mirabi et al., 2013; Mishra et al., 2014; Mitcheson et al., 2008; Morgan et al., 2016; Narenjiha et al., 2014; Neaigus et al., 2013; Newville et al., 2018; Niccolai et al., 2009; Nyamathi et al., 1995; Nydegger et al., 2014; Panda et al., 2005; Panda et al., 2007; Parkes et al., 2007; Patrick et al., 2012; Perngmark et al., 2004; Pilowsky et al., 2007; Pisani et al., 2003; Poulin et al., 2001; Prabhu et al., 2022; Rendina et al., 2015; Rhodes et al., 1994; Robbins T et al., 2020; Ross et al., 2002; Santa Maria et al., 2020; Saw et al., 2018; Schumacher et al., 2009; Scott-Sheldon et al., 2010; Scroggins et al., 2020; Semple et al., 2009; Shafer et al., 1993; Sharma et al., 2019; Shava et al., 2018; Sherman et al., 2001; Shimane et al., 2022; Siegal et al., 1999; Solomon et al., 2011; Song et al., 2009; Springer et al., 2007; Starks et al., 2020; Suohu et al., 2012; Thompson et al., 2005; Tran et al., 2018; Tross et al., 2009; Tun et al., 2014; Turner et al., 2011; Tyndall et al., 2002; van Empelen et al., 2001; Watkins et al., 1992; Wingood et al.,

1998; Yan et al., 2007; Zhang et al., 2016; Zhang et al., 2020; Zhao et al., 2006) remained for meta-analysis.

Study characteristics

The USA had the highest number of included studies, with 53 studies (n=181,331) (**Table 1**). By continent, 57 studies were conducted in North America (n=195,435), six studies were conducted in South America (n=7,147), 16 studies were conducted in Europe (n=23,667), 31 studies were conducted in Asia (n=51,932), two studies were conducted in Africa (n=563), and two were conducted in Australian continent (n=43,075). Regarding the country income level based on the (World Bank, 2021) criteria, 71 studies were conducted in high-income countries (n=259,186), 25 studies were conducted in upper-middle-income countries (25,757), 20 studies were conducted in lower-middle-income countries (36,703), and one study was conducted in a low-income country (n=203). The final study sample size had a mean of 2,750, with 82 being the lowest sample size (Fortenberry et al., 1997), and 65,707 being the largest sample size (Starks et al., 2020). Response rates between studies varied from 14% to 100%. Participants in the studies had a mean age of 28.74 years and were more likely to be male (mean 71.63%), varying from 0% to 100%. Most studies (n=99) were cross-sectional studies (85%). More than half were published between 2010 and 2021 (56%). Approximately three-quarters of the studies (n=86) comprised people who used drugs but did not inject them as participants (73%). Most studies (n=99) examined ICU in vaginal sex (85%), 16 studies examined ICU in anal sex (14%), and four studies examined ICU in oral sex (3%). Regarding type of sexual partners, 71 studies comprised multiple partners (61%), 27 studies comprised regular partners (23%), and 19 studies comprised non-regular partners (16%). Among the 117 studies included in the meta-analysis, 21 reported

sociodemographic variables among individuals with SUD, 16 reported risky behaviors, and 25 reported type of psychoactive drug use.

Table 1

Prevalence of inconsistent condom use among individuals with substance use disorders

Among individuals with SUD, the meta-analysis found that people did not use condoms consistently 61% (95% CI, 57%-65%) of the times they had vaginal sex, 48% (95% CI, 39%-56%) for anal sex, and 81% (95% CI, 68%-93%) for oral sex (**Figures 1, 2 and 3**). The lifetime pooled prevalence rate of ICU with any sexual partners was 60% (95% CI, 56%-64%) (**Figure 4**). With regard to other time periods, it was found that there was a pooled prevalence rate of 68% (95% CI, 53%-84%) for ICU in the past month, 53% (95% CI, 33%-73%) for ICU in past three months, 59% (95% CI, 49%-69%) for ICU in the past six months, 61% (95% CI, 52%-69%) for ICU in the past 12 months, and 50% (95% CI, 41%-59%) for ICU for the most recent sexual encounter with any sexual partners among individuals with SUD (**Figure 5**).

Figures 1-5 near here

Sociodemographic characteristics, risky behaviors and type of drug use associated with inconsistent condom use among individuals with substance use disorders

Females with SUD were 1.63 times more likely than males with SUD to report ICU with any sexual partners (OR=1.63, 95%CI=1.43-1.84) (**Figures 6, 7 and 8**). Additionally, individuals with SUD who had multiple sex partners were 2.34 times more likely than those who did not to report ICU (OR=2.34, 95%CI=1.67-3.29). Individuals with SUD who had a history of HIV testing were 1.55 times more likely than who did not to report ICU with any sexual partners (OR=1.55, 95%CI=1.17-2.05). Those who were HIV-negative were 1.95 times more likely than those who

were not to report ICU with any sexual partners (OR=1.95, 95%CI=1.44-2.64). Finally, individuals with SUD primarily using methamphetamine, cocaine, crack, ecstasy, or heroin (or engage in polysubstance use) (compared to individuals with SUD not primarily using these drugs) were 2.09 (OR=2.09, 95%CI=1.68-2.6), 1.68 (OR=1.68, 95%CI=1.41-2), 1.69 (OR=1.69, 95%CI=1.24-2.30), 1.41 (OR=1.41, 95%CI=1.01-1.96), 2.27 (OR=2.27, 95%CI=1.53-3.36) and 2.35 (OR=2.35, 95%CI=1.82-3.03) times more likely to report ICU with any sexual partners respectively.

Figures 6-8 near here

Sensitivity analysis

Sensitivity analysis and Baujat plots were performed to identify influential effects. Effects on the right-hand side showed studies with more heterogeneity (**Supplementary Files 10-17**). The studies that had the most contributions to heterogeneity were removed following the sensitivity analysis. The sensitivity analysis reduced heterogeneity among studies for all variables (i.e., having multiple sex partners, methamphetamine use disorders, cocaine use disorders) by identifying the studies that made the most significant contributions to the heterogeneity. It was found that two studies (i.e., Scroggins & Shacham [2021] and Decker et al. [2020]), had the most significant impact on the heterogeneity of having multiple sex partners associated with ICU. The studies by Cheng et al. (2016) and Saw et al. (2018) had the greatest impact on heterogeneity concerning methamphetamine use disorders associated with ICU. Two studies (i.e., Cheng et al. [2016] and Li & McDaid [2015]), made the most significant contributions to heterogeneity regarding cocaine use disorders associated with ICU. Finally, two studies (i.e., Starks et al. [2020] and Saw et al. [2018]), had the most significant contribution to heterogeneity concerning polysubstance use disorders associated with ICU.

Subgroup analysis

In the present study, several subgroup analyses were conducted to identify the main source of heterogeneity on pooled prevalence of ICU in both vaginal sex and anal sex taking into account age, study design, sample size, year of publication of studies, income level, type of SUD and type of partners (**Supplementary Files 18-27**). We also conducted another subgroup analysis based on the pooled prevalence of ICU with any sexual partners, considering the type of SUD and the type of partners. However, no heterogeneity was detected. Therefore, non-evaluated variables such as participants' gender and other variables may have been sources of heterogeneity.

Subgroup analysis of life-time pooled prevalence of inconsistent condom use with any type of sexual partners by type of patients with substance use disorders

A subgroup analysis was performed based on type of individuals with SUD categorizing the participants into two groups: (i) people who injected drugs, and (ii) people who used drugs but did not inject them (**Supplementary File 28**). The results confirmed that life-time prevalence of ICU with any sexual partners among people who injected drugs 66% (95% CI, 59%-73%) was higher than the 58% among people who used drugs but did not inject them (95% CI, 54%-63%).

Subgroup analysis of life-time pooled prevalence of inconsistent condom use by type of sexual partners among patients with substance use disorders

A subgroup analysis was also performed based on type of sexual partners among individuals with SUD categorizing the participants into three groups: (i) regular sex partners, (ii) non-regular sex partners, and (ii) multiple sex partners (**Supplementary File 29**). It was found that life-time prevalence of ICU with any sexual partners was higher among individuals with SUD

who had non-regular sex partners (65%; 95% CI, 53%-76%), followed by multiple sex partners (60%; 95% CI, 55%-65%), and regular sex partners (59%; 95% CI, 53%-66%).

Discussion

The present study attempted to determine pooled prevalence, sociodemographic characteristics, type of psychoactive drug use, and high-risk behaviors associated with ICU among individuals with SUD. The present findings indicated that individuals with SUD who report ICU with any sexual partners were more likely to (i) be female, (ii) have multiple sexual partners, (iii) have a history of HIV testing, (iv) have HIV-negative status, and (v) have methamphetamine, cocaine, crack, ecstasy, heroin or polysubstance use disorders. Among individuals with SUD, the high ICU rates for those engaged in vaginal sex (61%), anal sex (48%) and oral sex (81%) were consistent with previous research which reported rates from 10% (Vietnam) (Boggiano et al., 2017) to 93% (India) (Solomon et al., 2011). These high rates may be due to low knowledge of risky sexual behavior and HIV transmission methods or engaging in sexual behavior under the intoxicating influence of psychoactive drugs, which may interfere with individuals' decision-making regarding condom use (Armoon et al., 2018). The present study's finding confirmed that individuals with SUD may engage in some high-risk behaviors which may cause HIV/AIDS and various STDs. Such vulnerability is rooted in the concurrent use of psychoactive substances and practicing unprotected sex among this population (Ssekamatte et al., 2021).

The analysis found that the pooled prevalence rate of ICU with any sexual partners was 60%. No pooled prevalence for ICU with any sexual partners has ever previously been reported among individuals with SUD. However, the pooled prevalence of ICU was higher than the percentages reported in previous studies among general population in Spain (50%) (Ruiz-Palomino et al., 2020) and South Africa (39.98%) (Wet-Billings et al., 2020). The difference between ICU

among individuals with SUD and general population is unsurprising, and might be because individuals with SUD have more mental health issues and/or engage in more risky behaviors (e.g., needle sharing, polysubstance use) which lead them to engage in riskier sexual behaviors and greater ICU compared to general population.

Findings also indicated that ICU with any sexual partners was higher among people who injected drugs compared with people who used drugs but did not inject them. This finding has never been previously reported. It may be because people who inject drugs often have several mental health and co-occurring disorders (Novak et al., 2011) which may negatively effect on their decision-making including ICU with any sexual partners. Another possible explanation may be that people who inject drugs have lower HIV knowledge (Noroozi et al., 2018) and lower HIV risk perception compared to those who do not inject drugs (Armoon et al., 2024; Armoon et al., 2018) which may lead them to experience ICU with any sexual partners. A third possible explanation may be due to polydrug use which is prevalent among people who inject drugs. Studies have shown that people who inject drugs and who engaged in polydrug use in the past month (e.g., methadone 92%, cocaine 82%, heroin 92%) (Havinga et al., 2014) or were heavy users of drugs and used multiple drugs simultaneously which can impair judgements (Sharma et al., 2019), have a greater tendency to have unsafe sexual intercourse (i.e., not use a condom).

A fourth possible explanation may be due to the fact that using drugs before or during sex among sex workers may lead to ICU (Shannon et al., 2008). Previous studies have reported that drugs may enable individuals to undertake sex work which is intolerable for some without using drugs (Syvertsen et al., 2019). Moreover, using drugs to improve or prolong the sexual experience is associated with ICU (Parry et al., 2009). The fifth possible explanation may be due to the novel finding that the prevalence of ICU was higher among individuals with SUD who had non-regular

sexual partners compared with regular or multiple sexual partners. Here, individuals with SUD may increase ICU with non-regular partners since they may have less fidelity expectations of them (Hicks et al., 2016). However, increased fidelity among partners may result in the use of other types of birth control other than condoms because couples who are sexually monogamous cannot pass on STDs to each other and would only be using contraception for birth control rather than STD prevention (Manlove et al., 2003).

Regarding sociodemographic characteristics, previous studies have indicated a substantially greater risk of practicing harmful sexual activities (including ICU) among female individuals with SUD. Such behaviors might be explained by numerous socio-structural factors, such as inequities experienced by women (Higgins et al., 2010). One study suggested that a sexual division of labor extends to the domain of contraception and pregnancy prevention responsibilities (Fennell, 2011). It reported that men typically perceive themselves as responsible for condoms, while women are expected to manage hormonal contraception (Fennell, 2011). This assumption creates inequality because women are burdened with greater responsibilities, including the need to be knowledgeable about contraceptive methods, visit healthcare providers to access them, handle potential side effects, and negotiate condom use (Flanagan et al., 2021). As a result, it is essential to develop gender-specific health promotion programs to improve the regular use of condoms among individuals with SUD (Exner et al., 2003; Workowski et al., 2021).

Considering high-risk behaviors, ICU was more frequent among individuals with SUD who reported multiple drug use. Engaging in sexual activities with multiple sex partners simultaneously was strongly correlated with ICU, and consistent with the findings of previous research (Cheng et al., 2016). However, the exact mechanism underlying this association and ICU remains unclear (Cheng et al., 2016). Congruent with previous study results (Scroggins et al., 2020;

Sharma et al., 2019), it was found that previous HIV testing was associated with 55% higher odds of ICU, relative to those who had not previously undergone HIV testing. However, this finding is not consistent with previous studies conducted among the general population, where having been tested for HIV, accompanied by (i) greater HIV transmission and awareness knowledge and (ii) HIV prevention awareness, have been associated with lower chances of risky sexual behaviors (Scott-Sheldon et al., 2010). One plausible explanation might be that individuals with SUD who have previously tested negative for HIV may perceive themselves to be at low risk for the virus, leading them to engage in unprotected sexual behaviors. By providing educational interventions for people who use drugs and asking healthcare providers to explain it to them, increased knowledge concerning HIV transmission can be disseminated to this vulnerable group. The odds of reporting ICU were higher among the HIV-negative individuals compared with people with HIV. Therefore, individuals with a HIV-negative status were more engaged with risky sexual activities in comparison to people with HIV. Studies indicate that after receiving a negative test, individuals may increase their sexual risk behaviors. For example, several longitudinal studies have reported that after obtaining a negative HIV test, individuals tend to increase sexually risky behaviors twofold (Corbett et al., 2007; Matovu et al., 2007), increase having sex with multiple partners simultaneously (Shelton, 2008; Sherr et al., 2007), increase their sex frequency (Allen et al., 2003) have sex with a non-regular partners (Ndase et al., 2012) and/or do not perceive risky sexual behaviors as risky (Carlos et al., 2016).

In terms of type of drug use, the available data show a strong relationship between ICU and methamphetamine use disorders. This finding has also been supported by other studies, showing a robust association between amphetamine use and engaging in high-risk sexual behaviors (Moradi et al., 2022; Sharifi et al., 2017). Such a mechanism may be explained by the

effects of methamphetamine on sexual desire, arousal, and function, leading to seeking out high-risk sexual activities, including exchanging sex for money or substances, having multiple sexual partners, and increased ICU (McKetin et al., 2018). Generally, psychoactive substances like cocaine, crack, and ecstasy impact sexual functioning by elevating sexual desire and libido, decreasing social inhibitions (reducing self-consciousness and shyness), and causing physiological changes in the body that may heighten the subjective pleasure of sexual experiences (Halkitis et al., 2001). These may lead to an increase in risky and more ‘adventurous’ sexual behavior. Also drugs such as methamphetamine may lead to mucosa dryness and cause to genital tearing, which increases the likelihood of HIV transmission or other sexually transmitted infections (Hunter et al., 2012).

In other words, individuals are at greater risks of engaging in risky sexual behaviors under the influence of psychoactive substances, due to poor choice planning and decreased alertness (Dallelucchi et al., 2019; Patton et al., 2008). Prior research has identified an elevated health risk raised by the interaction of recreational drug use during sex concurrent hazardous activities (Dallelucchi et al., 2019; Jackson et al., 2012). Moreover, these high-risk behaviors may not solely be attributed to the effects of psychoactive drugs, because personal factors (e.g., personality traits, coping strategies) might explain these risks (Celentano et al., 2006; Marshall et al., 2009). More specifically, dose-dependently, cocaine enhances libido among users (Johnson et al., 2017). Typically, sexual libido and function decline under the effects of heroin (which has a sedative rather than a stimulant effect) (Keshtkar et al., 2012). One study concluded that reduced condom use elevated risky sexual activities, and that exchanging sex for psychoactive substances or money were significantly correlated with the severity of heroin use disorders (Jia et al., 2013). Moreover,

the association between specific drugs and reduced condom use may be attributed more to the characteristics of the individuals using them rather than the drugs themselves (Leigh et al., 2008a).

Limitations

The present study is the first meta-analysis to ever determine the pooled prevalence of ICU among individuals with SUD in relation to vaginal, anal, and oral sex. However, there are some methodological concerns regarding the studies examined in the meta-analysis. First, 85% of the papers were of a cross-sectional nature. Therefore, causal/temporal relationships between the study variables could not be determined. Second, some studies might have been subject to social desirability and recall biases, due to the use of self-report data collection (Latkin et al., 1998). Third, approximately 30% of the included studies used a snowball sampling method which limits the representativeness of their study population. In other words, the homophily and social networks considered in selecting the study participants might have impaired the collected data.

Fourth, given the sensitive socio-cultural barriers, there could have been some underreporting with respect to items assessing sexual behaviors, resulting in social desirability biases (e.g., under-reporting) due to the sensitive nature of the questions. Sixth, the present study did not consider the relationship status of participants because the included studies did not report any such information which could have affected the findings. For example, participants who are in an exclusive, monogamous relationship are less likely to use condoms which would likely increase the prevalence of ICU. Seventh, different studies had various definitions for risky sexual behaviors, with some studies not separating out risky sexual activities (e.g., including ICU and having multiple sexual partners together without differentiating specific risky sexual behavior). Therefore, studies which did not differentiate different types of risky sexual behavior were excluded from the current meta-analysis. Eighth, some characteristics were not included in the

meta-analysis, due to the fact that only one study examined the variable such as sociodemographic features (e.g., employment status, marital status, ethnicity) as well as some biopsychological markers (e.g., mental health care, HIV/AIDS knowledge, depression).

Ninth, the present study was unable to analyze multiple sub-groups with regards to significant variables, like HIV status and HIV testing. This was mainly due to included studies not documenting such data. Consequently, the key heterogeneity sources remained unrecognized in the present meta-analysis. As the number of studies was minimal in some cases (e.g., regarding HIV-negative status, heroin use disorder, ecstasy use disorder), it is suggested that future research includes large sample-size cohort studies exploring the accurate underlying mechanisms concerning HIV status. Finally, significant heterogeneity was observed across the studies. The present study explored various factors including age, study design, sample size, year of publication, income level, type of SUD, and type of partners. Despite this comprehensive analysis, no definitive sources of heterogeneity were identified. Consequently, unexamined variables such as participants' gender could potentially contribute to this heterogeneity. Although numerous subgroup analyses were conducted to mitigate the impact of heterogeneity, it was challenging to address all potential sources due to the reduction in the number of studies within each subgroup. Given the inability to pinpoint the root cause of heterogeneity and the inability to conduct subgroup analyses on variables such as gender, further cohort and case-control studies are warranted.

Conclusions

The findings of the present study suggest that promoting safe sexual behaviors (including regular condom use) and alleviating challenges can be achieved by facilitating safe sex training in substance use disorder treatment settings. Another significant finding of the meta-analysis was the high rate of ICU among female individuals with SUD. Therefore, policymakers and health

authorities are recommended to design healthcare programs tailored to this sub-group to facilitate the regular use of condoms among females with SUD. From a biopsychosocial perspective, increasing awareness regarding the importance of consistent condom use, as well as HIV/AIDS at family, peer, and partner levels, would likely substantially help improve safe sex among this vulnerable group. In this respect, individuals with SUD can learn to use condoms regularly following the receipt of education and counselling services, encouraging their sexual partners to use condoms, to increase HIV risk perception and decrease sexually transmitted infections. In addition, improving self-efficacy concerning condom use, HIV awareness and testing, and implementing pre-exposure prophylaxis by needle and syringe programs are among other necessary strategies in this area. Not only could STDs and HIV infection be substantially decreased using these preventive measures, but consistent condom use could be particularly promoted among individuals hesitating to demand condom use from their sexual partners.

ICU and contracting STDs are potentially associated with each other. Therefore, preventative and controlling interventions can be highly effective in reducing STI-related risks among this group. Such measures should specifically target individuals who use psychoactive drugs. These programs can include needle/syringe exchange programs, condom distribution, and opioid substitution interventions. Consequently, the likelihood of high-risk sexual activities and contracting STDs could be minimized among this vulnerable population.

Abbreviations

Confidence interval (CI)

Inconsistent condom use (ICU)

Odds ratio (OR)

PECOS guidelines (population, exposures, comparison, outcome, and study design)

Substance use disorders (SUD)

Sexually transmitted diseases (STDs)

The Newcastle-Ottawa Scale (NOS)

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Table 1 Characteristics of studies for inconsistent condom use with any sexual partners among individuals with substance use disorders

Authors (year)	Years (y.) of data collections (number)	Country	Sample at baseline	Final sample (response rate)	Study design	Age	Male %	Female %	Type of participants	Diagnostic criteria used	Prevalence of ICU ^a in vaginal sex	Prevalence of ICU ^a in anal sex	Prevalence of ICU ^a in oral sex	Type of partner
Hardy et al. (2022)	2011–2017 (7 y.)	Australia	42,761	42,761 (100)	Cohort	35.8	100	0	Non-IDUs ^c	DSM-IV ^e	37.9			Multiple
Prabhu et al. (2022)	2016–2017 (2y.)	India	21,723	21,723 (100)	Cross-section	28	100	0	Non-IDUs ^c	AUDIT ^f	46.9			Regular
Shimane et al. (2022)	2017 (1y.)	Japan	806	699 (87)	Cross-section	43.5	66	44	Non-IDUs ^c	DAST ^g and AUDIT ^f	79.6			Multiple
Armoon et al. (2022a, b)	2020–2021 (2y.)	Iran	292	272 (93)	Cross-section	41.5	93	7	IDUs ^d	ICD-9 ^h	59			Multiple
Castrucci and Martin (2002)	2002 (1y.)	USA	295	210 (71)	Cross-section	12.5	NR ^b	NR ^b	Non-IDUs ^c	DSM-IV ^e	70			Multiple
Cain et al. (2021)	2018–2020 (3 y.)	USA	579	578 (99)	Cross-section	20.8	100	0	Non-IDUs ^c	NR ^b	58.1			Regular
Desai et al. (2021)	2019 (1y.)	USA	11,919	11,919 (100)	Cohort	17	50	50	Non-IDUs ^c	YRBSS database	3.9			Multiple
Scroggins and Shacham (2020)	2017 (1y.)	USA	3732	3628 (97)	Cross-section	NR ^b	49	51	Non-IDUs ^c	NR ^b	46.2			Multiple
Starks et al. (2020)	2017–2019 (3y.)	USA	65,707	65,707 (100)	Cross-section	36.3	100	0	Non-IDUs ^c	NR ^b	15.5			Regular
Zhang et al. (2020)	2012–2013 (2y.)	China	378	342 (90)	Cross-section	19	0	100	Non-IDUs ^c	ICD-9 ^h	72			Regular
Robbins et al. (2020)	2016 (1y.)	USA	488	488 (100)	Cross-section	16	100	0	Non-IDUs ^c	DSM-IV ^e	77			Regular
Decker et al. (2020)	2016–2017 (2y.)	USA	250	250 (100)	Cross-section	NR ^b	0	100	Non-IDUs ^c	NR ^b	41.8			Regular
Santa Maria et al. (2020)	2014 (1y.)	USA	850	434 (51)	Cross-section	20	54	46	Non-IDUs ^c	MFNSRDUI ⁱ	46			Multiple
Jones et al. (2019)	2005–2008 (4y.)	USA	269	266 (98)	Cross-section	NR ^b	0	100	Non-IDUs ^c	DSM-IV ^e	91			Multiple

Table 1 (continued)

Authors (year)	Years (y) of data collections (number)	Country	Sample at baseline	Final sample (response rate)	Study design	Age	Male %	Female %	Type of participants	Diagnostic criteria used	Prevalence of ICU ^a in vaginal sex	Prevalence of ICU ^a in anal sex	Prevalence of ICU ^a in oral sex	Type of partner
Kasirye and Mutaawe (2018)	2018 (1y.)	Uganda	203	203 (100)	Cross-section	18	30	70	Non-IDUs ^c	NR ^b	66			Multiple
Newville et al. (2018)	2018 (1y.)	USA	590	359 (61)	Cross-section	40.3	100	0	Non-IDUs ^c	ASI ^j	88.4			Non-regular ⁱ
Sharma et al. (2019)	2018 (1y.)	India	1365	916 (67)	Cohort	18–45	NR	NR ^b	IDUs ^d	NR ^b	46			Regular
Shava et al. (2018)	2007–2011 (5 y.)	China and Thailand	1250	1250 (100)	Cross-section	34	92	8	Non-IDUs ^c	DSM-IV ^e	36			Regular
Janulis et al. (2018)	2015 (1y.)	USA	540	469 (87)	Cohort	22.5	100	0	Non-IDUs ^c	NR ^b		34.5		Multiple
Saw et al. (2018)	2013 (1y.)	Myanmar	1183	1183 (100)	Cross-section	NR ^b	65	35	Non-IDUs ^c	NR ^b	85			Multiple
Norozi et al. (2018)	2013–2014 (2y.)	Iran	530	510 (96)	Cross-section	31	100	0	IDUs ^d	NR ^b	26			Multiple
Su et al. (2018)	2015 (1y.)	China	848	610 (71.9)	Cross-section	34.4	90.3	9.7	Non-IDUs ^c	DSM-5 ^k	54.5			Regular
Tran et al. (2018)	2014–2015 (2y.)	Vietnam	300	300 (100)	Cross-section	39.5	100	0	Non-IDUs ^c	NR ^b	69			Multiple
Diehl et al. (2018)	2013–2014 (2y.)	Brazil	134	134 (100)	Cross-section	34	NR ^b	NR ^b	Non-IDUs ^c	NR ^b	61.3			Non-regular ⁱ
Boggiano et al. (2017)	2016 (1y.)	Vietnam	274	241 (88)	Cross-section	19.3	100	0	Non-IDUs ^c	NR ^b	10			Multiple
Lion et al. (2017)	2107 (1y.)	South Africa	360	360 (100)	Cross-section	29	56	44	Non-IDUs ^c	ASI ^j	73			Multiple
Khadr et al. (2016)	2010–2012 (3y.)	UK	15,162	8643 (58)	Cross-section	20	NR ^b	NR ^b	Non-IDUs ^c	NR ^b	46.4			Multiple
Morgan et al. (2016)	2002 (1y.)	USA	202	202 (100)	Cross-section	30	100	0	Non-IDUs ^c	DSM-IV ^e				Multiple
Guimarães et al. (2016)	2014–2015 (2y.)	Brazil	323	323 (100)	Cross-section	32.4	83	17	Non-IDUs ^c	BDUT ^l	83.5	37.5	72.2	Regular
Cheng et al. (2016)	2005–2013 (9y.)	Canada	1026	1026 (100)	Cohort	21	68	32	Non-IDUs ^c	NR ^b	75			Multiple

Table 1 (continued)

Authors (year)	Years (y.) of data collections (number)	Country	Sample at baseline	Final sample (response rate)	Study design	Age	Male %	Female %	Type of participants	Diagnostic criteria used	Prevalence of ICU ^a in vaginal sex	Prevalence of ICU ^a in anal sex	Prevalence of ICU ^a in oral sex	Type of partner
Zhang et al. (2016)	2013–2015 (2y.)	China	3588	3588 (100)	Cross-section	29.9	100	0	Non-IDUs ^c	ICD-9 ^h	6.6	21.9		Multiple
Bradshaw et al. (2005)	1999–2002 (3y.)	Australia	314	314 (100)	Cross-section	24	63	37	IDUs ^d	NR ^b	65			Non-regular ⁱ
Li and McDavid (2014)	2011 (1y.)	Scotland	2323	1515 (62)	Cross-section	31	100	0	Non-IDUs ^c	NR ^b		42		Regular
Rendina et al. (2015)	2015 (1y.)	USA	376	371 (98)	Cross-section	37	100	0	Non-IDUs ^c	TLFB ^m				Regular
Bao et al. (2015)	2009–2010 (2y.)	China	1434	1434 (100)	Cross-section	32.85	62	38	Non-IDUs ^c	DSM-IV ^e	79.8			Multiple
Decker et al. (2015)	2005 (1y.)	Russia	147	147 (100)	Cross-section	28.5	NR ^b	NR ^b	IDUs ^d	NR ^b	21.1			Regular
Guimarães et al. (2015)	2012–2013 (2y.)	Brazil	588	588 (100)	Cross-section	30.5	84	16	Non-IDUs ^c	BDUT ^l	52			Non-regular ⁱ
Kermode et al. (2015)	2009 (1y.)	India	3362	3362 (100)	Cross-section	27.8	100	0	IDUs ^d	NR ^b	89			Regular
Li et al. (2013)	2015 (1y.)	China	426	426 (100)	Cross-section	NR ^b	30	70	Non-IDUs ^c	ICD-9 ^h	69.8			Non-regular ⁱ
Kahler et al. (2015)	2011–2013 (2y.)	USA	142	109 (77)	Cross-section	42.5	100	0	Non-IDUs ^c	TLFB ^m		62.1	96	Multiple
Daskalopoulou et al. (2014)	2011–2012 (2y.)	UK	2248	2248 (100)	Cross-section	NR ^b	100	0	Non-IDUs ^c	AUDIT ^f	38			Multiple
Gyarmathy et al. (2011)	2004–2008 (5y.)	Russia	661	535 (80)	RCT	30	65	35	IDUs ^d	NR ^b	74.4			Regular
Tun et al. (2014)	2006 (1y.)	India	850	850 (100)	Cross-section	NR ^b	100	0	IDUs ^d	NR ^b	84			Regular
Assari et al. (2014)	2007 (1y.)	Iran	1131	1131 (100)	Cross-section	31.3	100	0	IDUs ^d	DSM-IV ^e	83.3			Multiple

Table 1 (continued)

Authors (year)	Years (y.) of data collections (number)	Country	Sample at baseline	Final sample (response rate)	Study design	Age	Male %	Female %	Type of participants	Diagnostic criteria used	Prevalence of ICU ^a in vaginal sex	Prevalence of ICU ^a in anal sex	Prevalence of ICU ^a in oral sex	Type of partner
Mishra et al. (2014)	2009 (1y.)	India	1712	1712 (100)	Cross-section	NR ^b	100	0	IDUs ^d	NR ^b	64.5			Regular
Nydegger et al. (2014)	2009–2010 (2y.)	USA	196	196 (100)	Cross-section	31.26	67	33	Non-IDUs ^c	DAST ^g	15.0			Multiple
Neaigus et al. (2013)	2009 (1y.)	USA	511	439 (86)	Cross-section	40	78	22	IDUs ^d	NR ^b	75.6			Multiple
Mirabi et al. (2013)	2009 (1y.)	Iran	360	360 (100)	Cross-section	NR ^b	100	0	IDUs ^d	ICD-9 ^h		20.8		Multiple
Li et al. (2013)	2008 (1y.)	China	2995	2688 (89.1)	Cross-section	17.7	49.9	50.1	Non-IDUs ^c	NR ^b	42.2			Multiple
Chikovani et al. (2013)	2008–2009 (2y.)	Georgia	1127	1127 (100)	Cross-section	88	99	1	IDUs ^d	NR ^b	64.3			Non-regular ⁱ
Ludford et al. (2013)	2011 (1y.)	Peru	5575	5148 (92)	Cross-section	29.5	100	0	Non-IDUs ^c	AUDIT ^f	46.2			Multiple
Ding et al. (2013)	2013 (1y.)	China	276	276 (100)	Cross-section	28.6	72	28	Non-IDUs ^c	NR ^b	67.4			Non-regular ⁱ
Chavoshi et al. (2013)	2013 (1y.)	Canada	605	594 (98)	Cross-section	23.5	52	48	Non-IDUs ^c	NR ^b				Regular
Liu et al. (2013)	2013 (1y.)	China	398	398 (100)	Cross-section	30.6	72	28	Non-IDUs ^c	NR ^b	93.1			Multiple
Keshkar et al. (2012)	2008–2009 (2y.)	Iran	400	400 (100)	Cross-section	34.4	87	13	Non-IDUs ^c	AUDIT ^f	47			Non-regular ⁱ
Suohu et al. (2012)	2009 (1y.)	India	1712	1712 (100)	Cross-section	NR ^b	100	0	IDUs ^d	NR ^b	85			Multiple
Bryan et al. (2012)	2012 (1y.)	USA	728	656 (90)	Cross-section	15.71	69	31	Non-IDUs ^c	DSM-IV ^e	66.6			Multiple
Hudson and Nandy (2012)	2009 (1y.)	USA	156	156 (100)	Cross-section	20	73	27	Non-IDUs ^c	TCUDS ⁿ	80			Regular
Patrick et al. (2012)	2004–2009 (5y.)	USA	7595	7595 (100)	Cohort	26	48	52	Non-IDUs ^c	DSM-IV ^e	82.2			Multiple

Table 1 (continued)

Authors (year)	Years (y.) of data collections (number)	Country	Sample at baseline	Final sample (response rate)	Study design	Age	Male %	Female %	Type of participants	Diagnostic criteria used	Prevalence of ICU ^a in vaginal sex	Prevalence of ICU ^a in anal sex	Prevalence of ICU ^a in oral sex	Type of partner
Anderson and Stein (2011)	2011 (1 y.)	USA	513	308 (69)	Cross-section	21	0	100	Non-IDUs ^c	TLFB ^m	71.7			Multiple
Chikovani et al. (2011)	2009 (1y.)	Georgia	1127	1127 (100)	Cross-section	NR ^b	98	2	IDUs ^d	NR ^b	69.1			Non-regular ⁱ
Solomon et al. (2011)	2009 (1y.)	India	433	400 (92.4)	Cross-section	31	0	100	IDUs ^d	NR ^b	93.2			Non-regular ⁱ
Turner et al. (2011)	2006–2008 (3y.)	USA	680	616 (90)	Cross-section	18.7	50	50	Non-IDUs ^c	YRBSS ^o	42			Multiple
Hensel et al. (2011)	1999–202,009 (2011)	USA	387	387 (100)	Cohort	15.33	0	100	Non-IDUs ^c	ASU ^j	70			Multiple
Hops et al. (2011)	2011 (1y.)	USA	263	225 (85)	RCT	15.8	83	17	Non-IDUs ^c	DSM-IV ^e	46.2			Multiple
Scott-Sheldon et al. (2010)	2010 (1y.)	USA	177	177 (100)	Cross-section	19	33	67	Non-IDUs ^c	TLFB ^m	55	55		Non-regular ⁱ
Gálvez-Buccollini et al. (2009)	2000 (1y.)	Peru	968	793 (82)	Cross-section	18–30	NR ^b	NR ^b	Non-IDUs ^c	NR ^b	62	40		Regular
Schumacher et al. (2009)	2003 (1y.)	Vietnam	309	216 (70)	Cross-section	28.5	100	0	IDUs ^d	NR ^b	33			Multiple
Marshall et al. (2009)	2003–2005 (3y.)	Canada	1090	1090 (100)	Cohort	38.4	78	22	IDUs ^d	PBDS ^p	74.7			Non-regular ⁱ
Tross et al. (2009)	2004–2006 (3y.)	USA	515	515 (100)	Cross-section	40	0	100	Non-IDUs ^c	DSM-IV ^e	80			Multiple
Gyarmathy and Neaigus (2009)	1999–2003 (5y.)	USA	254	235 (92)	Cohort	24.1	57	43	IDUs ^d	NR ^b	66.8			Regular
Niccolai et al. (2009)	2005–2008 (4y.)	Russia	684	631 (92)	Cross-section	29	72	28	Non-IDUs ^c	ICD-9 ^h	60			Multiple

Table 1 (continued)

Authors (year)	Years of data collections (number)	Country	Sample at baseline	Final sample (response rate)	Study design	Age	Male %	Female %	Type of participants	Diagnostic criteria used	Prevalence of ICU ^a in vaginal sex	Prevalence of ICU ^a in anal sex	Prevalence of ICU ^a in oral sex	Type of partner
Song et al. (2009)	2009 (1y.)	USA	520	324 (62)	Cross-section	39.71	100	0	Non-IDUs ^c	ASI ^j	39.5			Non-regular ⁱ
Seiple et al. (2009)	1999–2004 (5y.)	USA	341	341 (100)	Cross-section	37.3	100	0	Non-IDUs ^c	SSAGA ^q	65			Non-regular ⁱ
Bellis et al. (2008)	2008 (1y.)	Multicountry	1363	1341 (98)	Cross-section	21	48	52	Non-IDUs ^c	NR ^b	66			Multiple
Howard and Wang (2008)	1999 (1y.)	USA	15,349	7669 (66)	Cross-section	NR ^b	51.5	48.5	Non-IDUs ^c	DSM-IV ^e				Multiple
Mitcheson et al. (2008)	2000 (1y.)	UK	1105	1105 (100)	Cross-section	24.1	63	34	Non-IDUs ^c	DSM-IV ^e	83.5			Multiple
Leigh et al., (2008a, 2008b)	2008 (1y.)	USA	312	312 (100)	Cross-section	13.2	49	51	Non-IDUs ^c	NR ^b	60			Non-regular ⁱ
Parke et al. (2007)	2007 (1y.)	Scotland	1322	1322 (100)	Cross-section	15	49	51	Non-IDUs ^c	NR ^b	38.6			Multiple
March et al. (2007)	2000 (1y.)	Spain	391	391 (100)	Cross-section	NR ^b	83	17	Non-IDUs ^c	NR ^b	77	80	85	Regular
Springer et al. (2007)	2003 (1y.)	USA	15,240	15,240 (100)	Cross-section	NR ^b	51.4	48.6	Non-IDUs ^c	NR ^b				Multiple
Lau et al. (2007)	2003–2004 (2y.)	China	3105	3105 (100)	Cross-section	27.5	100	0	IDUs ^d	DSM-IV ^e	73.6			Non-regular ⁱ
Pilowsky et al. (2007)	2002–2005 (3y.)	USA	264	264 (100)	Cross-section	31.9	NR ^b	NR ^b	Non-IDUs ^c	NR ^b	75.4			Multiple
Panda et al. (2007)	2003 (1y.)	India	211	226 (93)	Cross-section	36	100	0	Non-IDUs ^c	NR ^b	91			Regular
Mansergh et al. (2006)	2001 (1y.)	USA	388	388 (100)	Cross-section	34.5	100	0	Non-IDUs ^c	ICD-9 ^h		53		Multiple
Brodbeck et al. (2006)	2003 (1y.)	Switzerland	4031	2790 (69)	Cross-section	20	48	52	Non-IDUs ^c	DSM-IV ^e	21			Regular
Celentano et al. (2006)	1994–1998 (5y.)	USA	3492	3492 (100)	Cohort	18.5	100	0	Non-IDUs ^c	NR ^b		40	69	Multiple

Table 1 (continued)

Authors (year)	Years (y.) of data collections (number)	Country	Sample at baseline	Final sample (response rate)	Study design	Age	Male %	Female %	Type of participants	Diagnostic criteria used	Prevalence of ICU ^a in vaginal sex	Prevalence of ICU ^a in anal sex	Prevalence of ICU ^a in oral sex	Type of partner
Drumright et al. (2006)	2002–2005 (4y.)	USA	211	207 (98)	Cohort	35	100	0	Non-IDUs ^c	DSM-IV ^e	60			Multiple
Torres de Carvalho et al. (2006)	2004–2005 (2y.)	Brazil	161	161 (100)	Cross-section	14	79	21	Non-IDUs ^c	WHO and BST ^r	73.7			Multiple
Zhao et al. (2006)	2004–2005 (2y.)	China	168	141 (84)	Cross-section	30.1	72	28	IDUs ^d	DSM-IV ^e	77			Multiple
Bowen et al. (2006)	2006 (1y.)	USA	1110	514 (41)	Cross-section	35.5	NR ^b	NR ^b	Non-IDUs ^c	Roche ONTRAK	68			Multiple
Go et al. (2006)	2006 (1y.)	Vietnam	393	313 (80)	Cross-section	28.1	97	3	IDUs ^d	NR ^b	76			Multiple
Thompson et al. (2005)	1998 (1y.)	USA	29,261	17,264 (59)	Cross-section	NR ^b	86	14	Non-IDUs ^c	NR ^b	66			Multiple
Panda et al. (2005)	2003 (1y.)	India	226	226 (100)	Cross-section	36	25	75	IDUs ^d	NR ^b	49			Regular
Cofax et al. (2004)	1999–2001 (3y.)	USA	4295	4295 (100)	Cohort	34	100	0	Non-IDUs ^c	NR ^b				Multiple
Hirshfield et al. (2004)	2001 (1y.)	USA	3697	2949 (79)	Cross-section	39	100	0	Non-IDUs ^c	NR ^b		56		Multiple
Ehrenstein et al. (2004)	1997–2001 (5y.)	USA	349	345 (99)	Cohort	40.4	79	21	Non-IDUs ^c	ASPI ^j	38			Multiple
Perngmark et al. (2004)	1999–2002 (4y.)	Thailand	285	272 (95)	Cross-section	30	100	0	Non-IDUs ^c	Standard Thai test	62.7			Regular
Pisani et al. (2003)	2002 (1y.)	Indonesia	650	650 (100)	Cross-section	23	100	0	IDUs ^d	NR ^b	90			Multiple
Kingree and Betz (2003)	2000–2001 (2y.)	USA	243	210 (86)	Cross-section	15.43	100	0	Non-IDUs ^c	NR ^b				Multiple
Ross et al. (2002)	1998–1999 (2y.)	USA	407	407 (100)	Cross-section	34.5	72	28	Non-IDUs ^c	NR ^b	62.7			Regular
Kingree and Phan (2002)	2002 (1y.)	USA	282	272 (96)	Cross-section	14.82	62	38	Non-IDUs ^c	NR ^b	27			Multiple

Table 1 (continued)

Authors (year)	Years (y.) of data collections (number)	Country	Sample at baseline	Final sample (response rate)	Study design	Age	Male %	Female %	Type of participants	Diagnostic criteria used	Prevalence of ICU ^a in vaginal sex	Prevalence of ICU ^a in anal sex	Prevalence of ICU ^a in partner	Type of partner
Poulin and Graham (2001)	1998 (1y.)	Canada	9997	9997 (100)	Cross-section	16	50	50	Non-IDUs ^c	NR ^b	49.9			Multiple
Sherman and Latkin (2001)	1997–1999 (3y.)	USA	1003	1003 (100)	Cross-section	38	63	37	IDUs ^d	NR ^b	60			Multiple
Tyndall et al. (2002)	1996 (1y.)	Canada	1400	1400 (100)	Cohort	33.35	66	34	IDUs ^d	NR ^b	65			Non-regular ⁱ
Van Empelen et al. (2001)	2001 (1y.)	Netherlands	103	103 (100)	Cross-section	NR ^b	NR	NR	IDUs ^d	NR ^b	69.2			Non-regular ⁱ
Kingree et al. (2000)	1998 (1y.)	Georgia	153	153 (100)	Cross-section	NR ^b	63	37	Non-IDUs ^c	NR ^b	31			Multiple
Booth et al. (1993)	1992–1997 (6y.)	USA	26,982	26,982 (100)	Cohort	37	70	30	IDUs ^d	Roche ONTRAK	80			Multiple
Siegal et al. (1999)	1996 (1y.)	USA	366	366 (100)	Cross-section	33	80	20	Non-IDUs ^c	CANAI ^e	54			Multiple
Bailey et al. (1998)	1998 (1y.)	USA	327	327 (100)	Cross-section	17.5	NR ^b	NR ^b	Non-IDUs ^c	NR ^b	35			Multiple
Wingood and DiClemente (1998)	1996 (1y.)	USA	180	180 (100)	Cross-section	33	0	100	Non-IDUs ^c	NR ^b	42.7			Multiple
Falk et al. (1997)	1994–1995 (2y.)	USA	354	354 (100)	Cross-section	37.7	70	30	Non-IDUs ^c	NR ^b	86.5			Multiple
Fortenberry et al. (1997)	1997 (1y.)	USA	574	82 (14.3)	Cross-section	17.4	0	100	Non-IDUs ^c	NR ^b	53			Multiple
Nyamathi et al. (1995)	1989–1992 (4y.)	USA	378	378 (100)	Cross-section	33.8	0	100	IDUs ^d	NR ^b	84.9			Multiple
Rhodes et al. (1994)	1991 (1y.)	UK	516	516 (100)	Cross-section	30.7	75	25	IDUs ^d	NR ^b	68			Non-regular ⁱ

Table 1 (continued)

Authors (year)	Years (y.) of data collections (number)	Country	Sample at baseline	Final sample (response rate)	Study design	Age	Male %	Female %	Type of participants	Diagnostic criteria used	Prevalence of ICU ^a in vaginal sex	Prevalence of ICU ^a in anal sex	Prevalence of ICU ^a in oral sex	Type of partner
Shafer et al. (1993)	1993 (1 y.)	USA	458	414 (90)	Cross-section	16	100	0	Non-IDUs ^c	NR ^b	79			Multiple
Watkins et al. (1992)	1988–1989 (2y.)	USA	379	255 (67)	Cohort	39	75	25	IDUs ^d	NR ^b	53			Multiple

^aICU = inconsistent condom use

^bNR = not reported

^cNon-IDUs = non-injection drug users

^dIDUs = injection drug users

^eDiagnostic and Statistical Manual of Mental Disorders, Fourth Edition

^fAlcohol Use Disorders Identification Test

^gDrug Abuse Screening Test

^hInternational Classification of Diseases, Ninth Revision

ⁱMonitoring the future national survey results on drug use

^jAddiction Severity Index

^kDiagnostic and Statistical Manual of Mental Disorders, Fifth Edition

^lBrazilian Drug Use Test

^mThe Timeline Follow Back Interview

ⁿThe Texas Christian University Drug Screener

^oYouth Risk Behavior Surveillance Survey

^pPerceived-Benefit-of-Drinking Scale

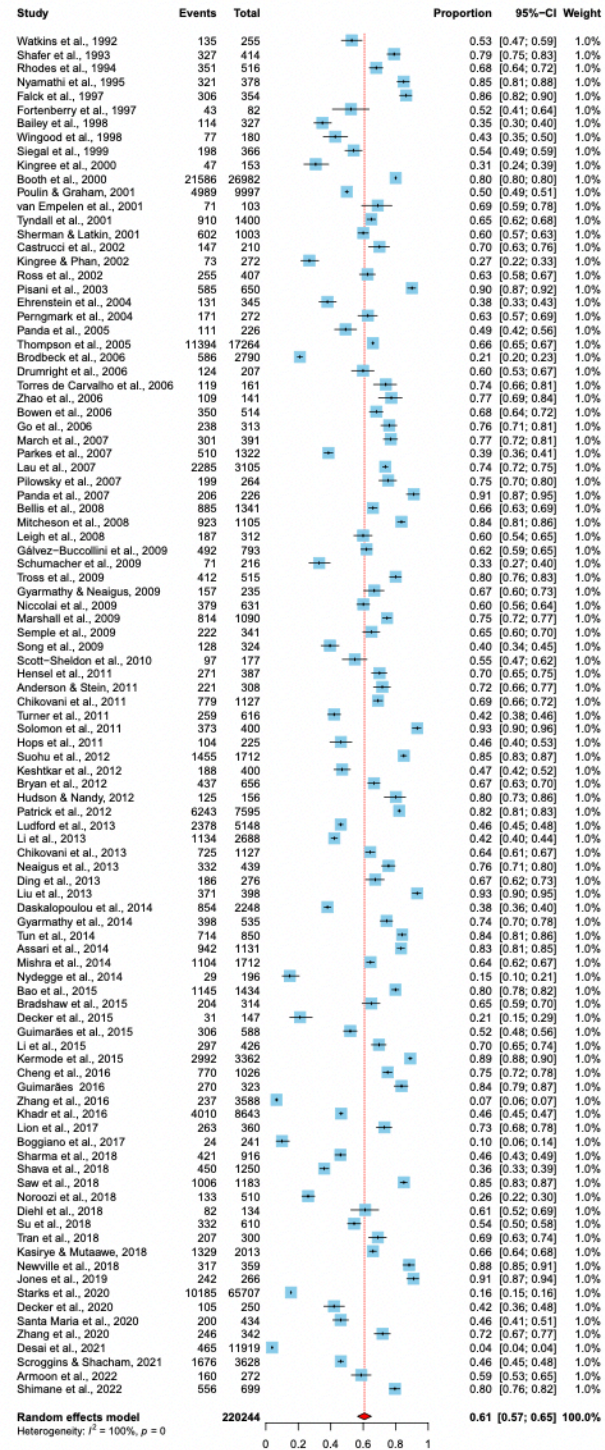
^qThe Semi-Structured Assessment for the Genetics of Alcoholism

^rWorld Health Organization and Brazilian Surveys Test

^sComputer-Assisted Needs Assessment Instrument

^tNon-regular partners: occasional, commercial and casual sex partners

Fig. 1 Pooled prevalence of inconsistent condom use in vaginal sex with any sexual partners among individuals with substance use disorders



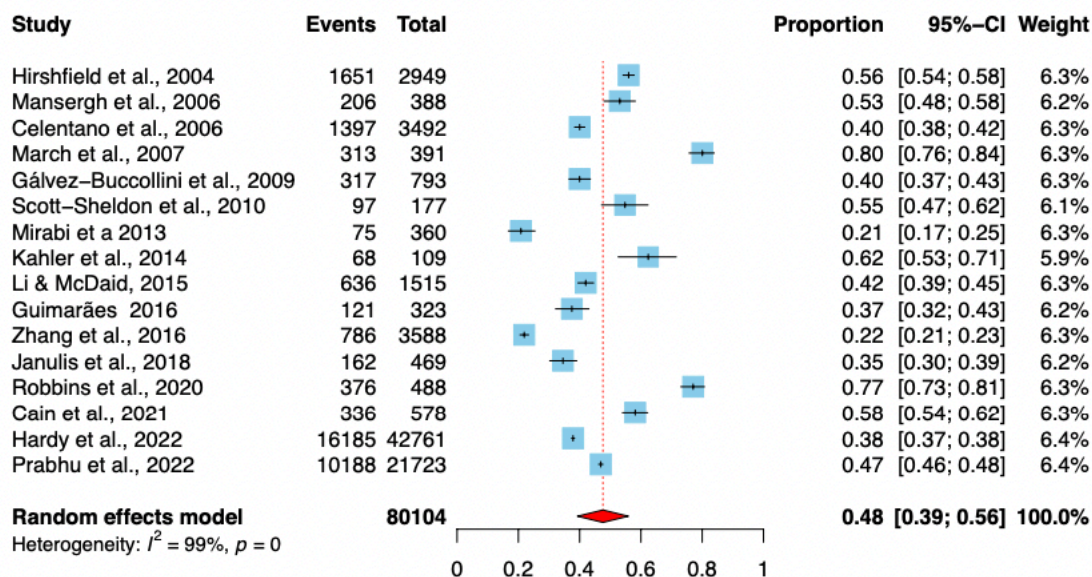


Fig. 2 Pooled prevalence of inconsistent condom use in anal sex with any sexual partners among individuals with substance use disorders

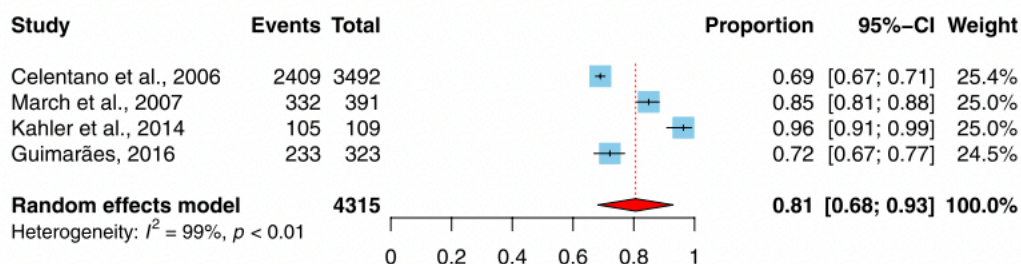


Fig. 3 Pooled prevalence of inconsistent condom use in oral sex with any sexual partners among individuals with substance use disorders

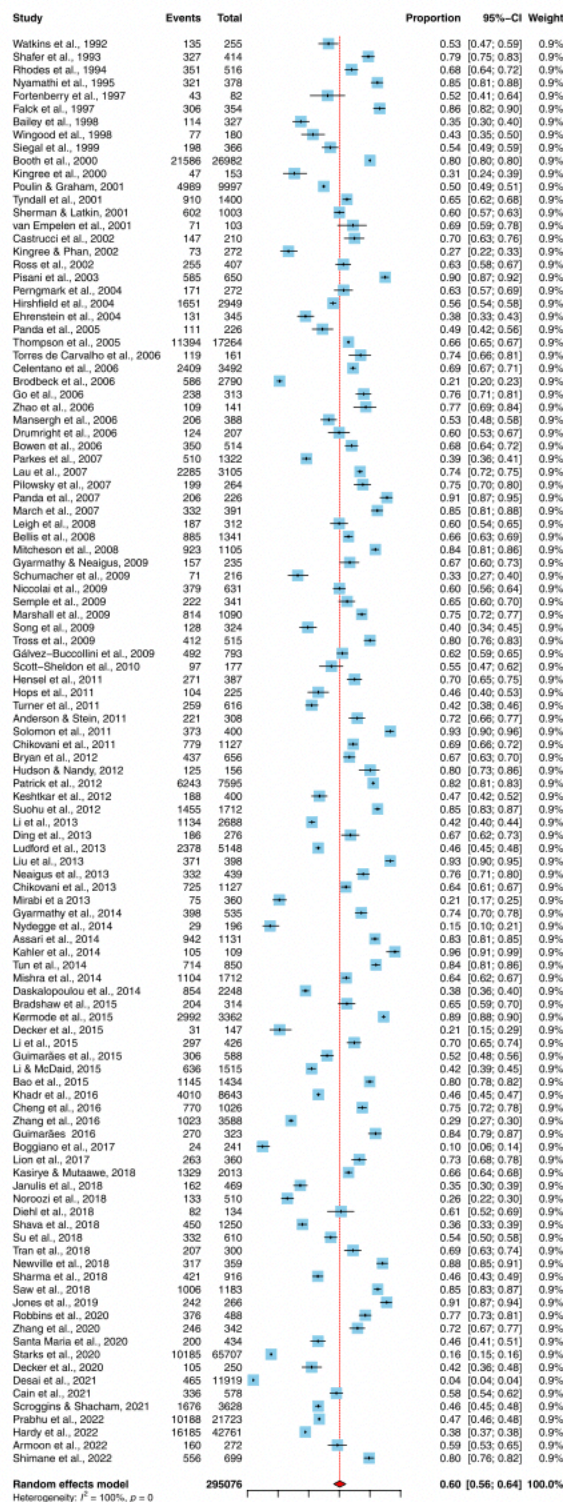


Fig. 4 Pooled prevalence rate of inconsistent condom use with any sexual partners among patients with substance use disorders

Fig. 5 Pooled prevalence rate of inconsistent condom use with any sexual partners in the most recent sexual encounter, past 1, 3, 6, and 12 months among patients with substance use disorders

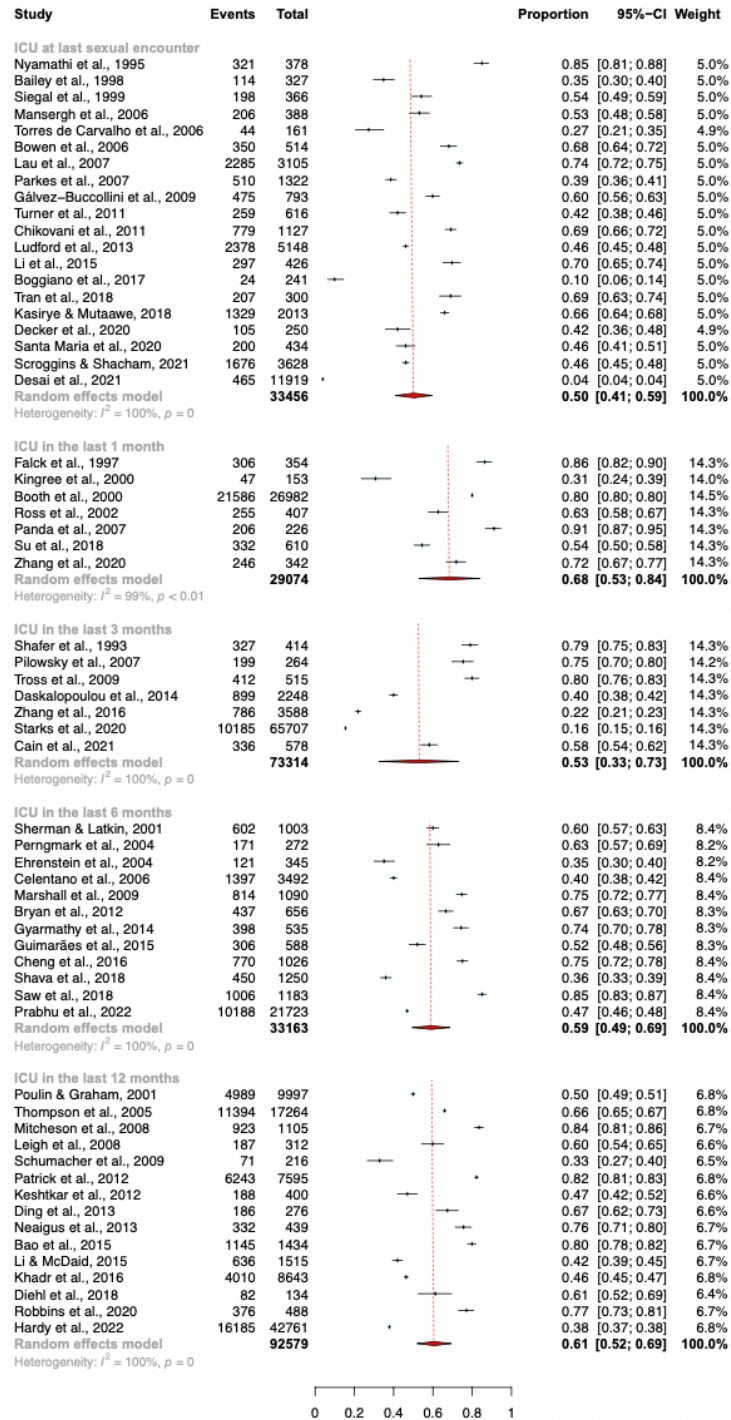


Fig. 6 Pooled odds ratio of sociodemographic characteristics associated with inconsistent condom use with any sexual partners among individuals with substance use disorders

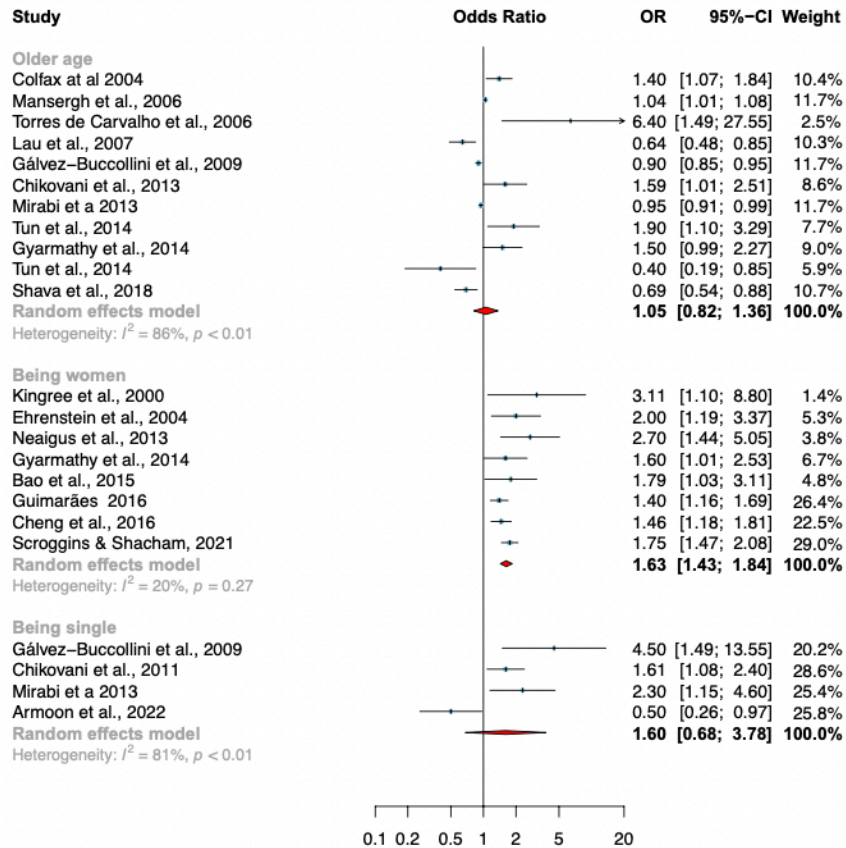


Fig. 7 Pooled odds ratio of high-risk behaviors associated with inconsistent condom use with any sexual partners among individuals with substance use disorders

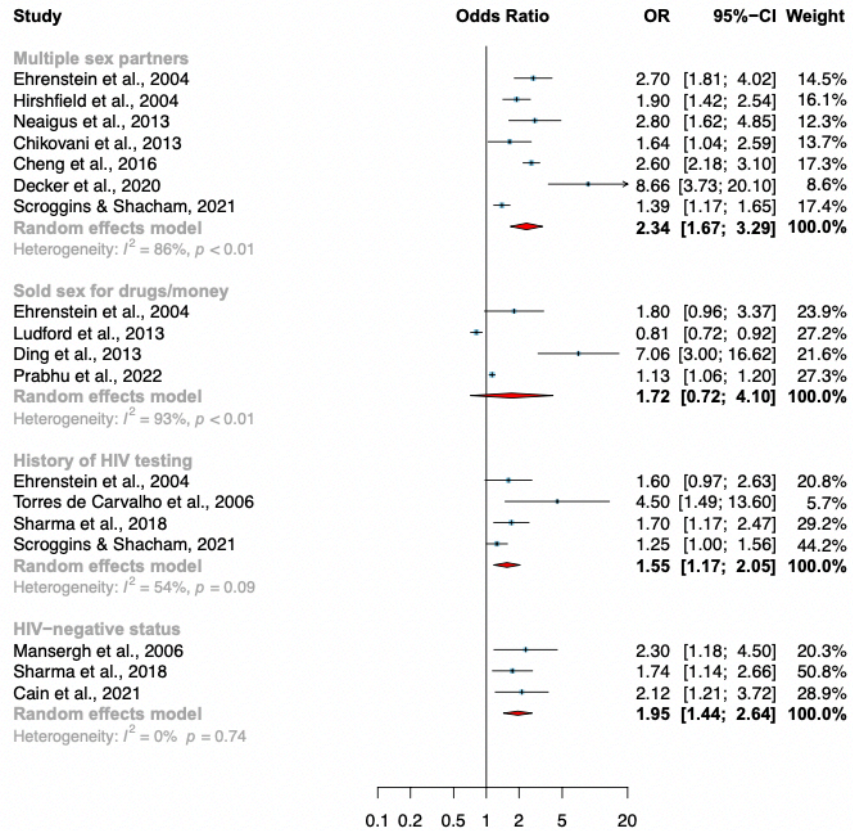


Fig. 8 Pooled odds ratio of type of drug use associated with inconsistent condom use with any sexual partners among individuals with substance use disorders

