**Nested event-level case-control study of drug use and sexual outcomes in multipartner encounters reported by men who have sex with men**

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**Abstract**

Previous event-level analyses have often, but not always, found significant associations between drug use and sexual risk behaviour in men who have sex with men (MSM), but these analyses have rarely considered either multipartner encounters specifically, or other sexual outcomes such as pleasure and control. Using data from an internet-based longitudinal survey of MSM, we tested the association between drug use by respondent and by partners and unprotected anal intercourse (UAI), pleasure and control over sexual activity. Overall respondent substance use was significantly associated with increased odds of UAI, though not with pleasure or control. Respondent use of crystal methamphetamine was significantly associated with both increased odds of UAI and decreased odds of control over sexual activity. This analysis agrees with previous studies of dyadic encounters, and specifically suggests that the association between crystal methamphetamine and sexual risk behaviour may be mediated by loss of control.

**Keywords:** Sexual risk behaviour; observational epidemiology; multipartner encounters; drug use; men who have sex with men

**Introduction**

 As a recent systematic review has demonstrated, studies examining event-level associations between specific drugs and sexual risk behaviour in men who have sex with men (MSM) do not yield consistent results (1). This review specifically noted substantial evidence only for associations with excessive alcohol use (i.e. at least five drinks before sex) or crystal methamphetamine. While several event-level case-crossover studies have demonstrated statistically significant associations between specific drug use and sexual risk behaviour (2–5), others have demonstrated non-significant results (6,7). In addition, few event-level studies have specifically examined the context of multipartner sexual encounters, i.e. encounters in which three or more participants are involved. One study examining the most recent multipartner encounter reported by MSM in Australia noted that methamphetamine use and binge drinking were both associated with unprotected anal intercourse (UAI) between HIV serononconcordant partners (8). Another event-level analysis comparing different types of multipartner encounters reported by MSM suggests that drugs are associated with increased odds of the multipartner encounter being unplanned group sex as compared to threesomes or organised sex parties (9).

 It is important to understand contexts and correlates of multipartner sex because observations about dyadic encounters may not be generalisable to such encounters. Multipartner encounters may be an especially salient setting for ‘chemsex’, the intentional combining of sex with drugs, typically crystal methamphetamine, GHB or mephedrone (10). Multipartner encounters are also a defining feature of sex-on-premises venues (SOPVs), including saunas and backrooms of gay bars and clubs, and also occur at organised sex parties in hotel rooms and private homes (9,11,12). SOPVs are of particular concern to HIV health promoters as multipartner encounters, particularly with anonymous partners, may facilitate the mixing of men drawn from sexual networks with different levels of HIV prevalence and infectivity (9,13).

 In addition to the scarcity of event-level evidence on multipartner encounters, to our knowledge, no event-level studies examining drug use in sexual encounters between men have examined outcomes other than risk behaviours. Given that many MSM report combining drugs with sex in order to intensify sensations (10,14,15), pleasure as a sexual outcome is of interest. Finally, given that some qualitative reports have indicated that ‘diminished capacity’ (16) or the inability to maintain safer sex norms established while sober (10,15) follow from drug use before sex, it is also of interest to examine control over sexual activity as an outcome.

 We used a nested case-control design with data on multipartner sexual encounters that were collected as part of a national longitudinal study of men living in England who have sex with men. We used these data to describe and test associations between respondent’s and partners’ drug use and three features of the sexual session: UAI, sexual pleasure and control over what happened during sex. Additional situational characteristics included as potential confounders were perceived HIV serodiscordance between respondent and partners, location of sex and number of partners. To describe more precisely the relationship between situational characteristics and sexual outcomes, we analysed data at the level of the sexual encounter (17) and addressed person-level confounding factors via generalised estimating equations.

**Methods**

 This paper uses data from the Sigma Panel, a longitudinal internet-based study that collected monthly data from community-recruited MSM living in England between January 2011 and January 2012 inclusive. Recruitment and methods are reported elsewhere (18). At three points during the year (months 7, 10 and 13, sent on 1st August and 1st November 2011 and 1st Februrary 2012), respondents answered questions about their most recent sexual encounter. Here we examine encounters reported at those three points in which three or more men participated as sexual partners. That is to say, the sexual encounter was the unit of analysis.

 The main independent variables of interest were respondent’s and partners’ drug use. We measured respondent drug use using a binary (yes/no) variable. We measured partners’ drug use using a four-category variable with the following categories: ‘No, I think he had taken no alcohol or drugs before sex’, ‘Yes, but I don’t know what he’d taken’, ‘Yes, and I’ve an idea what he’d taken’ and ‘I don’t know whether he’d taken anything or not’. We also tested use of specific drugs (poppers, alcohol, erectile dysfunction medication, GHB, crystal methamphetamine, MDMA, mephedrone, cocaine, cannabis and ketamine) reported by the respondent.

 The dependent variables in these analyses were UAI, pleasure and control. We measured UAI as a binary variable. We measured pleasure with the question ‘How good was the sex on this occasion?’ Answers were on a scale from 1 to 10 with 1 labelled ‘the worst sex you’ve had’ and 10 labelled ‘the best sex you’ve had’ (intermediate points were not labelled). Finally, we measured control over what happened during sex with the question ‘How much control of what happened would you say you had during this sexual session?’ The four responses offered (I was in total control of what happened / I was mostly in control of what happened / I had some control of what happened / I had no control of what happened) were collapsed into a binary variable (total or mostly in control vs. some or no control).

 Potential confounders included: HIV serodiscordance between respondent and partners; location of sex; and number of partners. We additionally included the month of reporting as a covariate to test differences in reporting over the course of the study. HIV serodiscordance was a three-category variable reflecting understandings shared between respondent and partners of each other’s HIV serostatus. Encounters were labelled as HIV seroconcordant if the respondent believed himself and all the partners involved had the same HIV serostatus, and as HIV serodiscordant if the respondent believed that different HIV serostatuses were present among sexual partners. Encounters in which either the respondent did not know the HIV status of any sex partner, or where the respondent thought any partner did not know the respondent’s HIV status, were labelled as ‘unknown serostatus match’. Respondents indicated where the session occurred from a checklist of nine options (my (or our) place / his place / a friend’s place / a backroom of a bar, gay sex club, a public gay sex party / a gay sex party in a private home / a gay sauna / a porn cinema / a cruising location (street, roadside service area, park, beach, lavatory) / elsewhere) which was recoded into a three-category variable: homes (my place, his place, a friend’s place, private home); sex-on-premises-venues, or SOPVs (backroom, sauna, cinema); and cruising locations. Number of partners captured the number of partners besides the respondent in the encounter. See online supplemental material for more details on variable construction.

 We first examined each independent variable separately in models with each dependent variable, with multicategorical variables recoded using dummies. We then combined variables significant at *p*<0.05 in initial models in multivariate models. Because of collinearity between respondent and partner drug use measures, we planned *a priori* to compare two multivariate models: one including both respondent’s and partners’ drug use measures alongside the covariates, and one including just the respondent’s drug use measure alongside the covariates. To compare models we used the quasi-Akaike information criterion (QIC), which is equivalent to penalised log likelihood information criteria used with models estimated using maximum likelihood (19). Lower values indicate better model fit as compared to the number of parameters estimated.

 We separately examined specific drugs used. Variables examining use of specific drugs were entered as a block to isolate better the effects of specific drugs in light of the frequency of polydrug combinations. To avoid model instability, we excluded drugs used in fewer than 1% of all encounters.

 We estimated models as generalised estimating equations using exchangeable correlation matrices with a logit link for UAI and control and a Gaussian link for pleasure. We used generalised estimating equations to correct for non-independence of observations. We did not compare encounters within respondents because the average number of multipartner encounters reported by MSM was less than 2. Interpretation of generalised estimating equations is ‘population-average’—that is, comparing across the population of multipartner encounters reported by MSM. Because missing data were trivial (less than 5% in every model), missingness was handled with pairwise deletion.

**Results**

 A total of 321 respondents reported 438 multipartner encounters. On average, respondents included in our analyses reported 1.36 encounters (SD=0.61). The mean age of respondents reporting multipartner encounters was 44.6 years (SD=10.5). See Table 1 for a description of the study sample.

 Respondents reported UAI in 37.7% of encounters. On average, respondents’ encounters were rated 6.8 for pleasure (SD=1.6). Respondents reported that they were totally or mostly in control over the sex in 87.2% of their encounters. Respondents reported drug use in 67.7% of encounters and partner drug use in 43.3% of encounters. The most commonly used specific drugs reported by respondents were poppers (45.4% of encounters), alcohol (38.0%) and erectile dysfunction medications (26.3%). The drugs most commonly implicated in chemsex were also frequently reported: GHB was used in 9.2% of encounters, crystal methamphetamine was used in 8.0% of encounters, and mephedrone was used in 7.3% of encounters. In total, 14.2% of multipartner encounters included at least one of these chemsex drugs. Variables for amphetamine (speed), heroin, LSD or crack cocaine were not included in the analyses because five or fewer encounters involved the use of each of these drugs. See Table 2 for characteristics of included encounters.

 **Models testing associations with UAI.** Any respondent drug use was significantly associated with UAI (see Table 3). Only two specific drugs were significantly associated with UAI while controlling for other specific drugs—erectile dysfunction medications (OR 2.23, 95% CI [1.26, 3.96]) and crystal methamphetamine (3.18, [1.19, 8.48]) (see Table 4). Of the three dummies generated for the categorical measure of any drug use by partners, only specific knowledge of partners’ drug use was associated, on average, with increased odds of UAI as compared to no drug use (1.71, [1.03, 2.83]). Dummies for not knowing partners’ drug use and not knowing specific drugs taken by partners were not significantly associated with UAI (both *p*s>0.10).

 Relative to encounters where all partners were believed to be HIV seroconcordant, encounters with partners of unknown serostatus match were, on average, less likely to involve UAI (OR 0.39, 95% CI [0.25, 0.63]), but no association was found for HIV serodiscordant multipartner encounters (0.62, [0.21, 1.81]). Neither location of sex nor number of male participants was significantly associated with UAI.

We then estimated two multivariate models: one including categorical measures of respondent’s and partners’ drug use, serodiscordance and wave of reporting, and one including categorical measures of respondent drug use alone, HIV serodiscordance and wave of reporting (see Table 5). Both models included associations for HIV serodiscordance similar in magnitude and significance to those seen in initial models. However, only the second model included a statistically significant association between respondent drug use and odds of UAI (OR=1.67, 95% CI [1.06, 2.62]). Comparison between QIC values for the first model including partners’ drug use (557.41) and for the second model with respondent’s drug use alone (556.26) indicated that the second model would be preferable, though only slightly.

 **Models testing associations with pleasure.** Any drug use by respondent was not associated with pleasure (*p*>0.10), and for specific drugs only use of poppers was marginally associated (*p*<0.10, but not *p*<0.05) with higher pleasure (see Table 3). In a model testing partner substance use, not knowing if partners had used drugs was associated with decreased pleasure (β=-0.50, 95% CI [-0.91, -0.09]) as compared to no drug use by partners. However, any drug use by partners was not significantly associated with increased pleasure relative to no drug use (both *p*s>0.10).

 Each additional participant was associated on average with an increase in pleasure of 0.05 points out of 10 (95% CI [0.02, 0.09]). Relative to encounters where all partners were believed to be HIV seroconcordant, encounters including partners of unknown serostatus match were, on average, associated with less pleasure (-0.38, [-0.76, -0.001]), though HIV serodiscordant encounters were not statistically different from seroconcordant encounters. On average, multipartner encounters in cruising locations were less pleasurable than encounters in homes (-1.02, [-1.54, -0.50]), but encounters in SOPVs were not statistically different from those in homes (*p*>0.10).

 We then estimated a multivariate model that included measures of partners’ drug use, HIV serodiscordance, location of sex and number of partners. Associations were similar to those seen in univariate models, with the exception of unknown serostatus match, which was no longer statistically significant (see Table 5). We tested a model that also included respondent drug use, but this did not change findings and did not yield a significant association for respondent drug use (data not shown).

 **Models testing associations with control.** Neither any drug use by respondent nor drug use by partners was associated with reporting being in control of sexual outcomes (both *p*<0.10), though as expected, both associations were negative in direction (see Table 3). None of the covariates tested were significantly associated with odds of control (all *p*>0.10).

A model for specific drugs used by respondent only yielded a significant association between crystal methamphetamine and reduced odds of control (OR=0.15, 95% CI [0.05, 0.53]), though cocaine was marginally associated (*p*<0.10, but *p*>0.05) with reduced odds of control (0.37, [0.13, 1.03]) (see Table 4). All other specific drugs except for alcohol appeared to be associated with *increased* odds of control, though confidence intervals were wide and associations statistically non-significant in all accounts.

**Discussion**

In this nested case-control study of multipartner encounters reported by MSM living in England, we found that on average, a binary measure of respondent drug use in multipartner encounters was significantly associated with increased odds of UAI, but not with pleasure or control. Considering use of specific drugs, erectile dysfunction medication and crystal methamphetamine were both associated with UAI, but no specific drug was associated with pleasure. Only use of crystal methamphetamine was significantly associated with decreased odds of control in multipartner encounters. In initial models, knowing the specifics of partners’ drug use was associated with increased odds of UAI, while not knowing about partners’ drug use was associated with decreased pleasure. Only the finding on pleasure persisted in multivariate models. Findings on crystal methamphetamine and sexual risk match that of a systematic review of event-level encounters (1). Findings on erectile dysfunction medications and crystal methamphetamine also match with person-level studies of MSM describing associations between specific drug use and longitudinal risk of HIV seroconversion conducted on cohorts in Australia (20) and in the United States (21).

 The additional situational characteristics used as covariates also painted an interesting picture. Encounters with more partners were associated with increased pleasure, but not UAI or control. An unknown serostatus match between respondent and partners, but not HIV serodiscordance, was associated with decreased odds of UAI and decreased pleasure, though the association with pleasure was not significant in multivariate models. Similarly, while location of sex was not associated with UAI, cruising locations were consistently associated with less pleasure than homes and SOPVs. This finding regarding decreased pleasure in unknown serostatus match encounters may be due to decreased partner familiarity. This is in part supported by the decreased pleasure also associated with encounters in cruising locations. Qualitative evidence has shown that MSM report greater pleasure in encounters with well-known, long-term partners (10,22). Similarly, associations between unknown serostatus partners and decreased odds of UAI are also likely due to partner familiarity, as prior research comparing frequency of behaviours with different partners reported by the same respondent has shown (23). There are several mechanisms that may be part of this association, including refusal to not use condoms with casual sex partners and ‘strategic’ engagement in sexual practices that are lower risk for HIV transmission than UAI.

 **Strengths and limitations.** This study drew on a sizeable sample of encounters and addressed a type of encounter that has not been studied extensively. Moreover, it included additional sexual session characteristics besides risk behaviour to better understand the contexts and outcomes of sexual encounters. Multipartner encounters may be a particular feature of SOPVs (11). In this regard, this paper is uniquely positioned to add to comparative understandings of sexual risk between these and other venues of sex.

 This study drew from a large-scale community-recruited sample of MSM in England. This may present a weakness, as community-recruited samples may report more risk than probability-recruited samples in surveys of MSM (24,25). Moreover, while the focus on multipartner encounters offers a specific examination of a class of sexual encounters, these results may not be generalisable to dyadic encounters. Another limitation is that we were unable to examine partner familiarity and relationship consistently across all multipartner encounters in this dataset. Partner familiarity, though difficult to measure in a clear and consistent fashion, may be an important confounder in respect of risk for UAI in multipartner encounters. Finally, we note that a stronger form of analysis would have been to use a within-subjects comparison (e.g. conditional logistic regressions) to separate out the effect of person-level characteristics. However, we did not have enough encounters per respondent to accomplish this.

 **Implications for research and practice.** The findings from this study match those of analyses of dyadic encounters that found significant associations between drug use and UAI in MSM (2,3,5,26,27), and stands in contrast to those studies which have not found a significant association (6,7). Previous studies have been mixed as to the association between location of sex and sexual risk behaviour in MSM (5,7,28–30). The non-significant associations between location of sex and sexual risk behaviour in this study continue the debate and extend findings to multipartner encounters specifically. Finally, this analysis agrees with previous studies that have shown negative associations between perceived HIV serononconcordance and sexual risk behaviour (7,30,31). One possible reason for differences between this study’s findings and the findings of other studies is that UAI was compared here against all other sexual behaviour, instead of against a more limited coital repertoire—such as anal intercourse or oral intercourse (3) or against protected anal intercourse specifically (7). Thus, the findings of this specific study may be best understood in terms of understanding how situational characteristics are associated with a specific high-risk behaviour, that is, UAI, rather than in understanding how situational characteristics are associated with the decision to use a condom or not in anal intercourse. An analysis comparing UAI against other anal intercourse would require a dataset specifically powered to examine this difference between encounters—something we were not powered to test with our dataset.

 The pattern of results contains implications for future research and practice. In multivariate models testing associations with UAI, it appeared that partners’ and respondent drug use confounded each other. Indeed, a model including just respondent drug use fit the data as well as a model with both respondent and partners’ drug use. Put otherwise, including partners’ drug use in the model did not offer any additional improvement in model fit above and beyond the binary measure of respondent drug use. This has implications for the measurement of drug use and sexual risk behaviour in future studies, including a) the possibility of unreliable measures of partners’ drug use, b) the ‘adequacy’ of capturing respondent drug use to measure the potential for sexual risk behaviour, and c) the suggestion that respondent and partners’ drug use may be planned prior to sex, or that patterns of drug use before sex may be understood by respondent and partners, perhaps as a function of the venues or the events where these encounters occur. To test this last possibility, encounters from the same respondent within the same venue or visit to an SOPV would need to be compared, though qualitative research on chemsex suggests that drug use is more often planned prior to sexual encounters rather than in the ‘heat of the moment’ (15,32,33).

 The use of pleasure as an outcome in this study quantifies for the first time a relationship that many HIV health promoters, researchers and public health practitioners, let alone MSM who use drugs recreationally, have qualitatively believed for a time—namely, that drug use is associated with increased sexual pleasure. Yet our findings did not support these associations in the context of multipartner encounters. What is particularly interesting, however, is that none of the specific drugs tested yielded statistically significant associations, though use of poppers did reach marginal significance (*p*<0.10). This may be due to statistical power, as many of the drugs did not occur with high frequency. Moreover, a novel finding is that lack of knowledge of partners’ drug use was associated with *decreased* pleasure—a finding that may point to larger characteristics of multipartner encounters relating to their organisation and respondent’s familiarity with partners.

 Finally, this analysis tested control as an outcome. This outcome has several theoretical interpretations, including as a test of whether loss of control mediates the relationship between drug use and sexual risk. It is particularly striking that neither respondent nor partners’ drug use were significantly associated with control, though this may be due to a ‘small-cell’ problem since respondents reported relatively few encounters not characterised by control over sexual activities. However, of specific drugs tested, use of crystal methamphetamine was significantly and substantially associated with decreased odds of control. This matches the substantial and significant association between crystal methamphetamine use and UAI. Though there is little evidence of the association between drug use generally and sexual risk behaviour being mediated by control over sexual activities, it would appear that this may be the case for crystal methamphetamine. Future research should seek to understand mediating factors between drug use and sexual risk behaviour.

**Table 1.** Descriptive statistics of included sample.

|  |  |
| --- | --- |
| **Variable** | **N (%)Mean (SD, range)** |
| **Age (n=320)** | 44.6 (10.5, 18-70) |
| **Education (n=319)** |  |
| Low (no post 16 academic qualifications) | 13.5% (43) |
| Medium (post 16 qualifications but no university degree) | 33.5% (107) |
| High (university degree) | 53.0% (169) |
| **Ethnic group (n=319)** |  |
| White British | 79.3% (253) |
| White other | 14.4% (46) |
| Black (African, Caribbean) | 1.9% (6) |
| Asian (Indian, Pakistani, Bangladeshi) | 2.5% (8) |
| Other | 1.9% (6) |
| **Place of residence (n=310)** |  |
| London | 39.7% (123) |
| Rest of England | 60.3% (187) |
| **Relationship status at enrolment (n=319)** |  |
| Single | 44.8% (143) |
| One man only | 42.0% (134) |
| Two or more men, no women | 5.0% (16) |
| One or more women | 8.1% (26) |
| **Describe sexual orientation (n=316)** |  |
| Gay or homosexual | 84.2% (266) |
| Bisexual, straight or other | 15.8% (50) |

**Table 2.** Characteristics of included encounters.

|  |  |  |
| --- | --- | --- |
| **Variable** | **N** | **% (n)Mean (SD, range)** |
| **UAI** | 438 | 37.7% (165) |
| **Pleasure** | 435 | 6.8 (1.6, 1-10) |
| **Totally/mostly in control** | 436 | 87.2% (380) |
| **Any drug use by respondent** | 437 | 67.7% (296) |
| **Number of drugs used** | 433 | 1.6 (1.8, 0-10) |
| **Drug use by respondent: specific** | 437 |  |
| Poppers (n=434) |  | 45.4% (197) |
| Alcohol |  | 38.0% (166) |
| Erectile dysfunction medications |  | 26.3% (115) |
| GHB |  | 9.2% (40) |
| Crystal methamphetamine |  | 8.0% (35) |
| MDMA |  | 7.8% (34) |
| Mephedrone |  | 7.3% (32) |
| Cocaine |  | 7.1% (31) |
| Ketamine |  | 6.0% (26) |
| Cannabis |  | 5.3% (23) |
| Amphetamine (speed) |  | 1.1% (5) |
| Heroin |  | 0.5% (2) |
| LSD |  | 0.7% (3) |
| Crack |  | 0% (0) |
| **Any drug use by partner** | 436 |  |
| No drug use by partner |  | 30.7% (134) |
| Don't know |  | 25.9% (113) |
| Yes, but unsure what |  | 14.2% (62) |
| Yes, specifically |  | 29.1% (127) |
| **Number of participants** | 437 | 3.7 (4.3, 1-50) |
| **HIV serodiscordance** | 434 |  |
| Seroconcordant |  | 21.7% (94) |
| Unknown serostatus match |  | 74.9% (325) |
| Serodiscordant |  | 3.5% (15) |
| **Location of sex** | 434 |  |
| Homes |  | 51.6% (224) |
| Sex-on-premises venue |  | 37.6% (163) |
| Cruising location |  | 10.8% (47) |
| **Wave of reporting** | 438 |  |
| Wave 1 |  | 35.6% (156) |
| Wave 2 |  | 30.4% (133) |
| Wave 3 |  | 34.0% (149) |

**Table 3.** Initial models.a

| **Variable** | **UAI** | **Pleasure** | **Control** |
| --- | --- | --- | --- |
| OR (95% CI) | Intercept (95% CI) | Beta (95% CI) | Intercept (95% CI) | OR (95% CI) | Intercept (95% CI) |
| **Drug use by respondent** | 1.73\* (1.12, 2.70) | 0.41\*\*\* (0.28, 0.60) | 0.25 (-0.09, 0.59) | 6.61\*\*\* (6.33, 6.89) | 0.62 (0.31, 1.22) | 10.46\*\*\* (5.71, 19.16) |
| **Drug use by partner** |  | 0.45\*\*\* (0.31, 0.66) |   | 6.86\*\*\* (6.58, 7.15) |   | 10.37\*\*\* (5.54, 19.41) |
| No drug use | Reference |   | Reference |   | Reference |  |
| Don't know | 1.33 (0.80, 2.23) |   | -0.50\* (-0.91, -0.09) |   | 0.78 (0.34, 1.77) |   |
| Yes, but unsure what | 1.33 (0.72, 2.46) |   | 0.20 (-0.30, 0.69) |   | *0.47 (0.19, 1.13)* |   |
| Yes, specifically | 1.71\* (1.03, 2.83) |   | 0.08 (-0.32, 0.49) |   | 0.63 (0.28, 1.39) |   |
| **Number of participants** | 1.04 (0.99, 1.08) | 0.52\*\*\* (0.39, 0.69) | 0.05\*\* (0.02, 0.09) | 6.58\*\*\* (6.37, 6.79) | 1.11 (0.97, 1.27) | 5.25\*\*\* (3.18, 8.68) |
| **HIV serodiscordance** |  | 1.18 (0.78, 1.78) |   | 7.04\*\*\* (6.70, 7.38) |   | 7.45\*\*\* (4.07, 13.66) |
| Seroconcordant | Reference |   | Reference |   | Reference |   |
| Unknown serostatus match | 0.39\*\*\* (0.25, 0.63) |  | -0.38\* (-0.76, -0.001) |   | 1.00 (0.52, 1.92) |  |
| Serodiscordant | 0.62 (0.21, 1.81) |   | 0.50 (-0.39, 1.39) |  | 1.02 (0.22, 4.84) |   |
| **Location of sex** |  | 0.69\*\* (0.52, 0.91) |  | 6.94\*\*\* (6.72, 7.17) |   | 6.00\*\*\* (4.04, 8.93) |
| Homes | Reference |   | Reference |   | Reference |   |
| Sex-on-premises venue | 0.74 (0.49, 1.12) |  | -0.13 (-0.46, 0.21) |   | 1.54 (0.84, 2.82) |  |
| Cruising location | 0.71 (0.36, 1.40) |   | -1.02\*\*\* (-1.54, -0.50) |  | 2.43 (0.72, 8.18) |   |
| **Wave of reporting** |  | 0.52\*\*\* (0.38, 0.70) |   | 6.81\*\*\* (6.56, 7.06) |   | 7.48\*\*\* (4.91, 11.38) |
| Wave 1 | Reference |   | Reference |   | Reference |   |
| Wave 2 | 1.03 (0.71, 1.49) |   | -0.10 (-0.44, 0.24) |   | 1.17 (0.71, 1.91) |   |
| Wave 3 | 1.43\* (1.01, 2.03) |   | -0.01 (-0.33, 0.32) |  | 0.93 (0.59, 1.47) |   |

a\**p*<0.05, \*\**p*<0.01, \*\*\**p*<0.001

**Table 4.** Associations between outcomes and specific drugs used by respondent.a

| **Variable** | **UAI: OR (95% CI)** | **Pleasure: Beta (95% CI)** | **Control: OR (95% CI)** |
| --- | --- | --- | --- |
| Intercept | 0.46\*\*\* (0.33, 0.64) | 6.50\*\*\* (6.26, 6.75) | 8.82\*\*\* (5.35, 14.53) |
| Poppers | 1.06 (0.69, 1.65) | *0.31 (-0.02, 0.65)* | 1.03 (0.55, 1.94) |
| Alcohol | 0.82 (0.50, 1.34) | 0.03 (-0.34, 0.39) | 0.61 (0.32, 1.17) |
| Erectile dysfunction medications | 2.23\* (1.26, 3.96) | 0.26 (-0.19, 0.72) | 2.02 (0.83, 4.88) |
| GHB | 1.50 (0.54, 4.17) | -0.02 (-0.80, 0.72) | 3.93 (0.70, 22.04) |
| Crystal methamphetamine | 3.18\* (1.19, 8.48) | 0.17 (-0.55, 0.89) | 0.15\*\*\* (0.05, 0.53) |
| MDMA | 0.64 (0.25, 1.61) | 0.24 (-0.46, 0.94) | 1.33 (0.38, 4.64) |
| Mephedrone | 1.05 (0.42, 2.59) | 0.02 (-0.67, 0.72) | 1.39 (0.35, 5.53) |
| Cocaine | 0.92 (0.39, 2.14) | 0.04 (-0.61, 0.70) | *0.37 (0.13, 1.03)* |
| Ketamine | 1.64 (0.63, 4.30) | 0.002 (-0.61, 0.70) | 1.15 (0.31, 4.27) |
| Cannabis | 0.58 (0.21, 1.57) | 0.23 (-0.50, 0.95) | 1.22 (0.32, 4.61) |

a\**p*<0.05, \*\**p*<0.01, \*\*\**p*<0.001

**Table 5.** Multivariate models.a

|  |  |  |
| --- | --- | --- |
| **Variable** | **UAI** | **Pleasure** |
| **Model 1**n=431 | **Model 2**n=433 | n=424 |
| OR (95% CI) | OR (95% CI) | Beta (95% CI) |
| **Intercept** | 0.70 (0.39, 1.24) | 0.75 (0.43, 1.29) | 6.95\*\*\* (6.54, 7.36) |
| **Any drug use by respondent** | 1.48 (0.90, 2.44) | 1.67\* (1.06, 2.62) |  |
| **Any drug use by partner** |   |   |  |
| No drug use | Reference |   | Reference |
| Don't know | 1.50 (0.85, 2.66) |   | -0.49\* (0.92, -0.05) |
| Yes, but unsure what | 1.31 (0.67, 2.56) |   | 0.04 (-0.47, 0.55) |
| Yes, specifically | 1.39 (0.77, 2.49) |   | 0.06 (0.02, 0.09) |
| **Number of partners** |  |  | 0.06 (0.02, 0.09) |
| **HIV serodiscordance** |   |   |  |
| Seroconcordant | Reference | Reference | Reference |
| Unknown serostatus match | 0.35\*\*\* (0.21, 0.57) | 0.38\*\*\* (0.24, 0.62) | -0.19 (-0.60, 0.21) |
| Serodiscordant | 0.55 (0.18, 1.65) | 0.57 (0.19, 1.70) | 0.70 (-0.21, 1.61) |
| **Location of sex** |  |  |  |
| Homes |  |  | Reference |
| Sex-on-premises venue |  |  | -0.06 (-0.45, 0.34) |
| Cruising location |  |  | -0.78\*\* (-1.33, -0.22) |
| **Month of reporting** |   |   |  |
| Month 7 | Reference | Reference |  |
| Month 10 | 1.04 (0.70, 1.57) | 1.06 (0.71, 1.59) |  |
| Month 13 | 1.38 (0.39, 1.24) | *1.41 (0.96, 2.08)* |  |
| **Wald test (χ2, df, *p*-value)** | 25.84, 8, 0.001 | 24.17, 5, 0.0002 | 34.47, 8, <0.0001 |
| **QIC** | 557.41 | 556.26 | 1163.32 |

a\**p*<0.05, \*\**p*<0.01, \*\*\**p*<0.001

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