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RESEARCH REPORT

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Increase in recreational drug use between 2008 and 2018: results from a prospective cohort study among HIV-negative men who have sex with men

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Abstract

Aims: To test whether recreational drug use (RDU) and sexualized drug use (SDU) changed in the Amsterdam area between 2008 and 2018 and quantify associations of SDU with condomless anal sex (CAS), recent human immunodeficiency virus (HIV) or sexually transmitted infections (STI) among human immunodeficiency virus (HIV)-negative men who have sex with men (MSM).

Design: Open prospective cohort study.

Setting: Public Health Service of Amsterdam, the Netherlands.

Participants: A total of 976 HIV-negative MSM, aged ≥ 18 years.

Measurements: Self-reported RDU and sexual behaviour in the past 6 months. Laboratory-confirmed HIV and STI (chlamydia, gonorrhoea and syphilis). We studied: any RDU; any SDU (i.e. any RDU during sex); specific SDU (i.e. use of mephedrone, methamphetamine, gamma-hydroxybutyric acid/gamma-butyrolactone, ketamine, amphetamine, cocaine and/or ecstasy during sex); use of individual drugs; and use of individual drugs during sex. We evaluated changes over calendar years in the proportion of individuals with these end-points [using logistic regression with generalized estimating equations (GEE)] and number of drugs (using negative binomial regression with GEE), adjusted for current age, country of birth and education level.

Findings: Median age of participants in 2008 was 33.2 years (interquartile range = 27.8–40.1); 83.1% were born in the Netherlands. The proportion of any RDU increased from 67.2% in 2008 to 69.5% in 2018 [adjusted odds ratio (aOR) = 1.25; 95% confidence interval (CI) = 1.03–1.51]. Any SDU increased from 53.8% in 2008 to 59.8% in 2013 (aOR = 1.23; 95% CI = 1.07–1.42) and remained stable afterwards. Specific SDU increased from 25.0% in 2008 to 36.1% in 2018 (aOR = 2.10; 95% CI = 1.71–2.58). The average number of drugs used increased for those reporting any RDU, any SDU and specific SDU (all $P < 0.05$. Among those engaging in sex, any SDU was associated with CAS (aOR = 1.36; 95% CI = 1.19–1.55), HIV (aOR = 5.86; 95% CI = 2.39–14.4) and STI (aOR = 2.31; 95% CI = 1.95–2.73). Specific SDU was associated with CAS (aOR = 1.58;

95% CI = 1.37–1.81), HIV (aOR = 6.30; 95% CI = 3.28–12.1) and STI (aOR = 2.15; 95% CI = 1.81–2.55).

Conclusions: Among human immunodeficiency virus (HIV)-negative men who have sex with men in Amsterdam, recreational drug use, including sexualized drug use, increased between 2008 and 2018. Sexualized drug use was strongly associated with condomless anal sex, HIV and sexually transmitted infections.

KEYWORDS
Chemsex, condomless sex, HIV, longitudinal analysis, men who have sex with men, recreational drug use, sexual behaviour, sexualized drug use, STI

INTRODUCTION

Studies have shown a high prevalence of recreational drug use (RDU) among men who have sex with men (MSM).[1–4] RDU before or during sex, also referred to as sexualized drug use (SDU), has been associated with new diagnoses of human immunodeficiency virus (HIV) and sexually transmitted infections (STI).[5–9] There is still ongoing HIV transmission among MSM, and the STI incidence is increasing.[10–15] Part of these trends might be explained by RDU. Understanding the relationship between RDU and HIV and STI acquisition and the sexual behaviours associated therewith requires a comprehensive assessment of RDU.

The specific types of drugs used by MSM in sexual settings vary greatly, depending on their availability and popularity.[16] Prevalence estimates therefore differ among settings and depend upon definitions used.[16,17] Chemsex, a subset of SDU, is most commonly defined as the use of methamphetamine, gamma-hydroxybutyric acid/gamma-butyrolactone (GHB/GBL) or mephedrone to facilitate and enhance sex.[16–19] To correspond with local RDU patterns, ketamine, cocaine, amphetamine, ecstasy [XTC/3,4-methylenedioxymethamphetamine (MDMA)] and new psychoactive substances (NPS) have been occasionally included as part of the chemsex definition.[20–23] Chemsex has been demonstrated to be associated with condomless anal sex (CAS) and STI acquisition in MSM, and has therefore historically been used as an indicator for STI risk.[21,24–27] However, a recent study from our group in Amsterdam, the Netherlands, demonstrated that STI prevalence was high for several RDU combinations; hence, focus upon an overly narrow definition may not be justified in this setting.[28]

There have been indications that SDU has increased among HIV-negative MSM in Europe, mainly from the United Kingdom and other western European countries, including the Netherlands.[18,29–32] However, longitudinal data are limited to one study from the United Kingdom in which a decrease in use of three chemsex drugs was reported between 2015 and 2018.[33] Despite the rapidly expanding body of literature on SDU, the vast majority of studies assessing its prevalence and association with sexual behaviour and HIV/STI outcomes among HIV-negative MSM have been cross-sectional[5,8,21,24,25,27] or covered few years of follow-up.[7,33,34]

The Amsterdam Cohort Studies (ACS) among MSM has consistently monitored RDU since 2008, alongside measures of sexual behaviour and regular HIV/STI testing. Using these data, we estimate longitudinal community-level trends in RDU and SDU between 2008 and 2018, while investigating associations with sexual behaviour and the prevalence of recent HIV infection and STI in HIV-negative MSM. Specifically, we aim to test whether RDU and SDU changed during calendar years between 2008 and 2018; quantify the associations of SDU with CAS and recent HIV and STI diagnoses; and examine whether the strength of these associations changed over time.

METHODS

Study design and participants

The ACS is an ongoing, open prospective cohort study among MSM at the Public Health Service of Amsterdam (PHSA), which was initiated in 1984.[35] The aim of the ACS is to investigate the epidemiology, psychosocial determinants, pathogenesis and course of HIV-1 infection, STI and blood-borne infections other than HIV, and to evaluate the effect of interventions. Detailed information on recruitment has been provided elsewhere.[36,37] Briefly, men aged ≥ 18 years are eligible for participation if they report sex with men in the 6 months preceding recruitment and live in the Amsterdam area or regularly participate in MSM-related activities in the area. During several time-periods since 1995, recruitment was restricted to HIV-negative MSM aged ≤ 30 years to minimize bias associated with an ageing cohort. Recruitment entailed convenience sampling and chain referral sampling. Participation is voluntary and each participant provided written informed consent before enrolment. The ACS has been approved by the ethics board of the Amsterdam University Medical Centres, location Academic Medical Centre, the Netherlands (MEC 07/182).

Participants completed a self-administered questionnaire on behaviours during the preceding 6 months, including sexual behaviour and RDU, using a paper version or iPad on site, prior to each semi-annual face-to-face consultation with the study nurse. Since 2018, the questionnaires were completed at home on-line during the week prior to the study visit. During the visit, participants were tested free of charge for HIV, syphilis and pharyngeal, urethral and anal gonorrhoea and chlamydia. Detailed sampling and laboratory testing procedures have been described elsewhere.[37] Results from HIV and STI

tests performed during additional, non-study visits to the STI clinic of the PHSA were included in the analysis. Data are pseudonymized.

In the current analysis, we included all MSM who were not diagnosed with HIV by 1 January 2008 and who completed the questionnaire on RDU at least once between 1 January 2008 and 31 December 2018 ($n = 976$; Supporting information, Figure S1).

Measures

Information regarding demographic characteristics (i.e. date and country of birth, education level, sexual orientation and living situation) was collected at enrolment. Semi-annually, participants responded to questions about recreational/non-prescription use of specific drugs. A total of 24 individual drugs were explicitly listed in the questionnaire to reduce recall bias (provided in Supporting information, Table S1). The list of drugs in the questionnaire was adapted over time to reflect drugs reported by ACS participants. Additionally, participants could provide individual drugs that were not listed. For each drug, we assessed any use and use during sex with a steady or casual sexual partner.[38] Participants additionally reported if they injected any drugs and, if so, which drugs were injected.

Analysis

Participants contributed to follow-up beginning at the first visit on or after 1 January 2008 (i.e. 'baseline') and ending at the first HIV-positive visit or last visit before 1 January 2019, whichever occurred first. We examined changes over time for the following: (1) any RDU (i.e. use of one or more of the 24 listed drugs), (2) any SDU (i.e. any RDU during sex), (3) specific SDU (i.e. use of mephedrone, methamphetamine, gamma-hydroxybutyric acid/gamma-butyrolactone, ketamine, amphetamine, cocaine and/or XTC/MDMA during sex); (4) use of individual drugs; and (5) use of individual drugs during sex. We additionally evaluated the number of different drugs used during the preceding 6 months, over time, for end-points 1–3. We excluded the use of alcohol for all end-points, and included additional drugs listed by participants in the evaluation of any RDU, any SDU and number of different drugs used (any/during sex).

To test for changes over time, we modelled each dichotomous drug use end-point with calendar year as the exposure using logistic regression with generalized estimating equations (GEE). From these models, we calculated marginal predicted probabilities of each end-point per calendar year with 95% confidence intervals (CI). Odds ratios (OR) comparing odds of an end-point between calendar years were also obtained along with their 95% CIs. For continuous drug use end-points, we calculated the median number of individual drugs and IQRs for each calendar year among those reporting the use of ≥ 1 drug. We modelled the average number of drugs over calendar years using negative binomial regression models with GEE. From these models, we obtained parameter estimates with 95% CIs, which were interpreted as a relative ratio (RR) comparing the number of drugs between calendar years. For all models, we specified an exchangeable working correlation structure to account for the repeated observations within each participant. We adjusted all models for current age, country of birth and education level. We used Wald χ^2 tests to test for changes across years.

We then examined the association between both SDU measures and the following end-points during the preceding 6 months: (1) CAS, defined as having condomless insertive and/or receptive anal sex; (2) HIV infection; and (3) any STI, defined as having ≥ 1 newly diagnosed chlamydia, gonorrhea and/or syphilis infection during the preceding 6 months. We restricted CAS/HIV/STI analyses to participants who reported sex with ≥ 1 partner during the preceding 6 months. We separately modelled each SDU measure as exposures with each outcome (i.e. six models in total) using logistic regression with GEE. We first adjusted each model for current age, country of birth, education level and calendar year. In the models using HIV or STI as an end-point, we then additionally adjusted for CAS and number of partners to evaluate whether associations remained after correcting for sexual behaviour. We computed ORs comparing odds of end-points among levels of SDU exposures and 95% CIs. To evaluate whether the strength of the association changed over time, we added interaction terms between SDU and calendar year to each model and obtained *P*-values using Wald χ^2 tests.

Continuous variables (age, calendar year, number of partners) were included in all models, when applicable, as restricted cubic splines with three knots at the 10th, 50th and 90th percentiles. Back-transformed ORs or RRs and 95% CI for calendar year were obtained using the 'postrcspline' command in STATA.[39] *P*-values < 0.05 were considered statistically significant. Participants with missing data on a covariate or outcome in a model were excluded. We did not correct for multiple testing and results should be considered exploratory.[40] We performed analyses using Stata IC version 15.1 (College Station, TX, USA).

This study adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting of observational cohort studies.

RESULTS

Study population

Table 1 reports the characteristics of 976 MSM included into the study. Their median age at baseline was 33.2 years (interquartile range [IQR] = 27.8–40.1). The majority of MSM was born in the Netherlands (83.1%), had obtained a college or university degree (76.5%), identified as exclusively homosexual (79.4%), lived in Amsterdam (78.1%) and lived alone (51.6%) at enrolment. One hundred and forty-five of 839 (8.3%) MSM with a visit in 2015 or later and 139 of 669 (20.8%) MSM with a visit during the second half of 2018

TABLE 1 Characteristics of 976 HIV-negative MSM participating in the Amsterdam Cohort Studies at enrolment, Amsterdam, the Netherlands, 2008–18.

	Total (n = 976)
Age in years at baseline[a] (median, IQR)	33.2 (27.8–40.1)
18–34	550 (56.4%)
35–44	277 (28.4%)
45+	149 (15.3%)
Born in the Netherlands (1 missing)	810 (83.1%)
College or university degree (3 missing)	744 (76.5%)
Exclusively homosexual (5 missing)	771 (79.4%)
Residence in Amsterdam (1 missing)	761 (78.1%)
Living situation (3 missing)	
Alone	502 (51.6%)
With steady partner	204 (21.0%)
With parents/caretakers	56 (5.8%)
With others	211 (21.7%)

IQR = interquartile range; MSM = men who have sex with men.
[a]Age at baseline was defined as the age at 1 January 2008 (for participants who were enrolled before this date) or as the age at enrolment (for those who were enrolled on or after this date).

indicated pre-exposure prophylaxis (PrEP) use in the 6 months preceding their visit. MSM contributed a median of 10 study visits (IQR = 4–19) with RDU data over a median follow-up of 5.3 years (IQR = 1.7–10.5) between 2008 and 2018. Dropout was between 2 and 11% per year, and 30.9% in total (Supporting information, Table S2); 95.4% of all study visits contained information on RDU (Supporting information, Table S3).

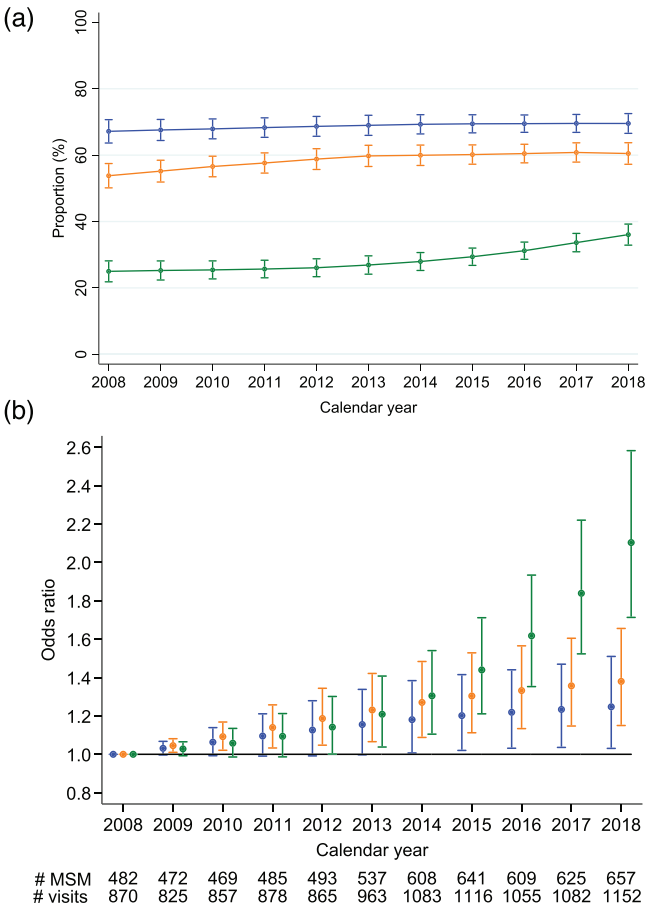

FIGURE 1 Recreational drug use (RDU) per calendar year between 2008 and 2018: (a) proportion and 95% confidence intervals of reporting any RDU (blue), any SDU (orange) and specific SDU (green) during the preceding 6 months and (b) adjusted odds ratios and 95% confidence intervals for reporting use in each calendar year compared to 2008 as a reference

Recreational drug use over calendar years

There was a small but statistically significant increase in the proportion reporting any RDU from 67.2% in 2008 to 69.5% in 2018 (Figure 1a,b; Supporting information, Table S4). Among those reporting any RDU, the median number of recreational drugs used per 6-month interval increased from two (IQR = 1–3) in 2008 to three (IQR = 1–5) in 2018. Any SDU increased from 53.8% in 2008 to 59.8% in 2013 and remained stable afterwards. Among those reporting any SDU, the median number of drugs used per 6-month interval increased from two (IQR = 1–4) in 2008 to three (IQR = 1–5). Specific SDU increased from 25.0% in 2008 to 36.1% in 2018. Among those reporting specific SDU, the median number of drugs used per 6-month interval increased from four (IQR = 3–5) in 2008 to four (IQR = 2–6) in 2018.

Figure 2a,b and Supporting information, Table S5 provide the proportion reporting use of individual drugs per calendar year. Increasing trends over calendar year between 2008 and 2018 were observed for the majority of drugs, with trends in any use reflecting those during sex. Overall, use of poppers was most commonly reported, followed by XTC/MDMA, erectile stimulants, cannabis, cocaine and GHB/GBL. Increases in any use from 2008 to 2018, respectively, were observed for amphetamine (2.5 to 11.0%), ketamine (5.9 to 15.2%), XTC/MDMA (27.0 to 38.1%), methamphetamine (1.1 to 2.5%), cocaine (21.2 to 25.6%) and GHB/GBL (15.4 to 19.8%). Any use of erectile stimulants increased from 23.2% in 2008 to 32.5% in 2017. We observed similar trends for use of all drugs listed above during sex. Between 2008 and 2018, we observed non-significant changes in the use of cannabis (any use: 29.6–28.6%, $P = 0.14$; use during sex: 17.4–16.5%, $P = 0.75$) and poppers (any use: 49.3–48.4%, $P = 0.40$; use during sex: 41.7–44.2%, $P = 0.16$).

Mephedrone was included in the questionnaire from 2010. There was evidence for a difference in any use of mephedrone among calendar years ($P = 0.033$), but the increase from 3.1% in 2010 to 4.5% in 2018 was not statistically significant. Use of mephedrone during sex increased from 1.9% in 2010 to 4.1% in 2018. Benzodiazepams, 2-CB, 4-FA and ritalin were included to the questionnaire from 2015. Any

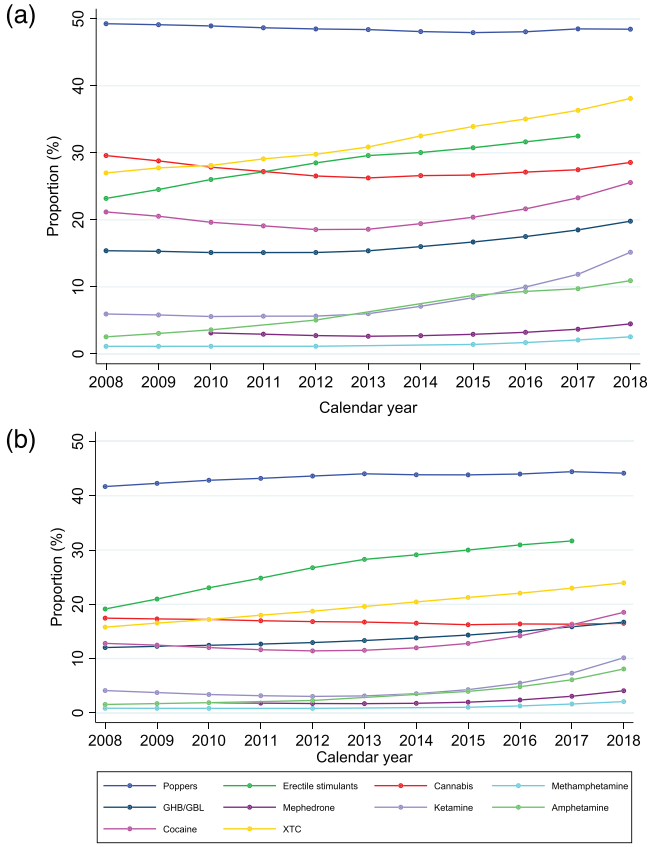

FIGURE 2 Proportion reporting use of individual drugs during the preceding 6 months per calendar year between 2008 and 2018, for (a) any use and (b) use during sex, after adjusting for current age, country of birth and education level. Data for erectile stimulants were not included in 2018 due to an error in the questionnaire

use of benzodiazepams increased from 1.0% in 2015 to 4.9% in 2018, with a similar trend observed for use during sex (Supporting information, Figure S2a, S2b). There was no evidence for a change in any use of 2-CB ($P = 0.084$) and ritalin ($P = 0.52$). Any use of 4-FA decreased from 6.5% in 2015 to 4.0% in 2018, while there was no evidence for a change in use during sex ($P = 0.20$).

Injecting drug use (IDU) was reported by ≤ 1.1% of participants in each calendar year, which precluded analysis of trends over time. Overall, 24 MSM (2.5%) reported to have injected drugs during the preceding 6 months on a total of 49 questionnaires between 2008 and 2018.

Associations of recreational drug use with CAS, HIV and STI

CAS was positively associated with any and specific SDU (Table 2). Associations became stronger over time for any SDU (any SDU: $P = 0.019$ for interaction, Supporting information, Figure S3a; specific SDU: $P = 0.070$, Supporting information, Figure S3b).

A total of 55 new HIV infections were diagnosed between 2008 and 2018; nine and 10 of these were excluded from analysis for any and specific SDU, respectively, due to missing exposure or covariate information on the study visit at diagnosis or the first study visit after diagnosis. No HIV infections were diagnosed among participants using PrEP. HIV was strongly and positively associated with any and specific SDU (Table 2). Associations were slightly attenuated after additionally adjusting for CAS and number of partners. We did not test for a difference in effect over time, given the low number of HIV outcomes.

There were 1276 study visits at which an STI was diagnosed during the preceding 6 months, of which 117 and 122 were excluded from analysis for any and specific SDU, respectively, due to missing exposure or covariate information. The odds of being diagnosed with an STI during the preceding 6 months were more than doubled for those who reported any and specific SDU compared to those who did not (Table 2). Associations were slightly attenuated after additionally adjusting for CAS and number of partners. There was no evidence for a difference in effect over time for any (Supporting information, Figures S4a, S5a) or specific SDU (Supporting information, Figures S4b, S5b) (all $P > 0.05$).

DISCUSSION

This longitudinal analysis of RDU among MSM in Amsterdam shows an increase in the proportion of MSM who use recreational drugs, particularly for use in sexual settings, between 2008 and 2018. Increases in use were observed for the majority of drugs, but mainly for amphetamines, ketamine and XTC/MDMA. We also observed increases in the number of drugs used among those reporting use. We found strong positive associations between SDU with CAS and prevalent recent HIV and STI, while the associations with CAS strengthened over time.

We estimated 60% any SDU in a sample of HIV-negative MSM in Amsterdam in 2018. This is similar to the 60% among sexually active MSM attending the STI clinic in Amsterdam in 2017, but slightly higher than MSM attending STI clinics in urban areas surrounding Amsterdam (42% in 2017) and outside major cities in the Netherlands (54% in 2018).[22,41] These studies and ours showed MSM use a wide variety of drugs during sex. The drugs most commonly used in our cohort were poppers, erectile stimulants, XTC/MDMA, cocaine, GHB/GBL and cannabis, whose use was an estimated 15% throughout calendar years. Additionally, we found a stark increase in the use of ketamine. While mephedrone and methamphetamine are included in most chemsex definitions, the use of these drugs seems to be less prevalent (i.e. under 5%) in our cohort, despite increases over time.

One of the few studies comparing SDU among MSM across European cities, EMIS-2017, found that sexualized stimulant drug use during the past 4 weeks was most common in Amsterdam (17%), which is somewhat higher than Barcelona (14%), Paris (12%), London (11%) and Berlin (11%).[42] The Netherlands is a large producer of certain drugs, such as cannabis and XTC/MDMA, and an important

TABLE 2 Unadjusted and adjusted associations of recreational drug use with CAS, HIV and STI among 976 MSM participating in the Amsterdam Cohort Studies, Amsterdam, the Netherlands, 2008–18.

			Univariable model		Multivariable model 1[a]		Multivariable model 2[b]	
	Number of outcomes	Number of visits	OR (95% CI)	*P*-value	aOR (95% CI)	*P*-value	aOR (95% CI)	*P*-value
CAS[c]								
Any SDU	6113	10 470	1.39 (1.22–1.59)	< 0.001	1.36 (1.19–1.55)	< 0.001	–	–
Specific SDU	6095	10 444	1.65 (1.43–1.91)	< 0.001	1.58 (1.37–1.81)	< 0.001	–	–
HIV infection in preceding 6 months[d,e]								
Any SDU	46	10 535	4.94 (2.10–11.7)	< 0.001	5.86 (2.39–14.4)	< 0.001	4.06 (1.62–10.2)	0.003
Specific SDU	45	10 508	5.60 (3.01–10.4)	< 0.001	6.30 (3.28–12.1)	< 0.001	4.77 (2.44–9.29)	< 0.001
STI in preceding 6 months[d,f]								
Any SDU	1159	9603	2.23 (1.90–2.62)	< 0.001	2.31 (1.95–2.73)	< 0.001	1.73 (1.45–2.08)	< 0.001
Specific SDU	1154	9577	2.26 (1.91–2.68)	< 0.001	2.15 (1.81–2.55)	< 0.001	1.69 (1.43–2.01)	< 0.001

aOR = adjusted odds ratio; CAS = condomless anal sex; CI = confidence interval; HIV = human immunodeficiency virus; MSM = men who have sex with men; OR = odds ratio; RDU= recreational drug use; SDU = sexualized drug use; STI = sexually transmitted infection.

[a]Adjusted for current age, country of birth, education level and calendar year.

[b]Adjusted for current age, country of birth, education level, calendar year, CAS and number of sexual partners.

[c]There were 6233 visits at which CAS was reported, of which 120 and 138 were excluded from analysis for specific and any SDU, respectively, due to missing data.

[d]Including diagnoses made at additional, non-study visits to the STI clinic.

[e]55 recent HIV infections were diagnosed, of which nine and 10 were excluded from analysis for any and specific SDU, respectively, due to missing data.

[f]There were 1276 visits at which an STI was diagnosed, of which 117 and 122 were excluded from analysis for any and specific SDU, respectively, due to missing data.

transit country for other drugs, such as cocaine.[43,44] In addition, the use of any drugs is not punishable by law. These country-level factors increase the availability and ease of obtaining these drugs and should be considered when comparing our results to other countries. The increasing trends observed in our study are in contrast with a decrease in chemsex between 2015 and 2018 in a cohort of HIV-negative MSM in the United Kingdom,[33] which was a closed cohort and only studied three chemsex drugs, but corroborate with increases in HIV-positive MSM in Switzerland between 2007 and 2017.[45]

The low IDU prevalence of 1% in our cohort is noteworthy. Studies in other countries have described more prevalent injecting use of methamphetamine and other drugs in sexual settings.[21,46–49] In a cohort of early PrEP adopters in Amsterdam, of whom 90% reported recent SDU at enrolment, IDU was also low at 4%.[50] Our findings suggest that IDU is restricted to a small group of MSM in the Netherlands. In addition, previous reports have shown very low and even decreasing IDU over time in the Netherlands, which probably reflects changes in drug culture and drug market.[51,52]

The increases over time in RDU parallel those in CAS and STI previously found in our cohort: the percentage engaging in CAS with a casual partner increased from 27% in 2009 to 39% in 2017, while the incidence rate for any bacterial STI increased from 16.8 per 100 person-years (PY) in 2010 to 33.1 per 100 PY in 2017.[37] This is of concern, given the associations between RDU and HIV/STI observed in our study. These associations could be explained by a myriad pathways. RDU may be causally responsible for increased HIV/STI acquisition through enhancing certain sexual behaviours or could act as a proxy for sexual behaviours.[53] The use of recreational drugs is known to increase disinhibition and mitigate prevention strategies.[26,54] The stronger associations of any and recent SDU with CAS over time might suggest these behaviours have become more normalized in recent years. Associations with HIV and STI were attenuated but remained positive after adjusting for CAS and number of sexual partners. It is likely that the intensity or practice of other sexual behaviours further mediate these associations, such as frequency of CAS acts, duration of sex, group sex, decreased serosorting and certain sex practices (i.e. fisting, use of sex toys). Further qualitative and quantitative research making use of data on specific sexual and drug use behaviours per sexual act[55] should be conducted to identify the exact pathways through which RDU is implicated in HIV/STI acquisition, which can be targeted in interventions. Additionally, a qualitative study in Madrid identified multiple types of chemsex, with each type involving different profiles of MSM, group dynamics, settings, motivations, attitudes and forms of and exposure to risk.[56] It might then be helpful to focus upon the wider context in which SDU is practiced, thus requiring different prevention strategies.

HIV incidence in our cohort was low and previously shown to decrease over time, probably as the result of treatment as prevention.[37] PrEP use in our cohort was below 10% until 2017,[57] and the national roll-out of PrEP began in September 2019. In our sample, 8% of MSM with a visit in 2015–18 indicated recent PrEP use and no HIV infections were diagnosed among MSM using PrEP. However, SDU was common among early PrEP adopters in Amsterdam,[50] and qualitative analysis among these users indicated a link between PrEP use and engagement in more disinhibited and experimental use of drugs.[58] It is therefore worth considering SDU as an additional eligibility criterion for PrEP even if other sexual behaviour criteria are not met, as is the case in Ireland.[59]

Besides increased HIV/STI acquisition, problematic RDU could be associated with other health problems. Studies have shown a high prevalence of co-occurring syndemic comorbidities among MSM, such as depression, sex and substance use disorders and growing drug dependency.[60–63] In light of increasing RDU rates, it is important to screen for problematic RDU and mental health problems during sexual health-seeking contacts (e.g. HIV and STI testing) to identify MSM who may benefit from additional counselling and referral to help. In the Amsterdam STI clinic, walk-in peer-led chemsex counselling sessions have been initiated to address syndemic-driven difficulties.[64]

Our study is subject to some limitations. First, this study included mainly urban MSM, of whom the majority was born in the Netherlands and highly educated, and therefore may not represent MSM nation-wide. Secondly, we were unable to distinguish any use from use outside of sexual settings, such as parties and festivals.[65] Thirdly, self-reporting of sexual and RDU behaviours may have led to under-reporting. Fourthly, as we analysed only individuals with complete data, we assumed that their probability of being included in the model was independent of the outcome after conditioning on the covariates. This assumption might not hold for certain models. Lastly, our study could be subject to selection bias due to differential loss to follow-up; however, dropout was relatively low.

In conclusion, our study revealed increases in RDU including SDU over time in a sample of HIV-negative MSM in Amsterdam. Increases were found for the majority of drugs. SDU was associated with new HIV and STI diagnoses, which calls for interventions such as counselling (including peer-led sessions), referrals to specialized care (if there is problematic RDU use) and targeted PrEP.

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DECLARATION OF INTERESTS

M.P. obtained unrestricted research grants and speaker fees from Gilead Sciences, Roche, Abbvie and MSD, all of which were paid to her institute and were unrelated to the current work. The other authors report no conflicts of interest.

AUTHOR CONTRIBUTIONS

Liza Coyer: Conceptualization; data curation; formal analysis; investigation; methodology; validation; visualization. **Anders Boyd:** Formal analysis; investigation; methodology; supervision; visualization. **Udi Davidovich:** Conceptualization; data curation; funding acquisition; investigation. **Ward van Bilsen:** Data curation. **Maria Prins:** Conceptualization; funding acquisition; investigation; supervision. **Amy Matser:** Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; supervision.

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REFERENCES

1. Cochran SD, Ackerman D, Mays VM, Ross MW. Prevalence of nonmedical drug use and dependence among homosexually active men and women in the US population. Addiction. 2004;99:989–98.
2. Mercer CH, Prah P, Field N, Tanton C, Macdowall W, Clifton S, et al. The health and well-being of men who have sex with men (MSM) in Britain: evidence from the third National Survey of sexual attitudes and lifestyles (Natsal-3). BMC Public Health. 2016;16:525.
3. Roxburgh A, Lea T, de Wit J, Degenhardt L. Sexual identity and prevalence of alcohol and other drug use among Australians in the general population. Int J Drug Policy. 2016;28:76–82.
4. UK Government. Drug misuse: Findings from the 2013/14 crime survey for England and Wales [internet]. London, UK: Office for National Statistics; 2014 [updated 2015 August 15; cited 2021 February 22]. Available at: https://www.gov.uk/government/statistics/drug-misuse-findings-from-the-2013-to-2014-csew/drug-misuse-findings-from-the-201314-crime-survey-for-england-and-wales (accessed 22 February 2021).
5. Heiligenberg M, Wermeling PR, van Rooijen MS, Urbanus AT, Speksnijder AG, Heijman T, et al. Recreational drug use during sex and sexually transmitted infections among clients of a city sexually transmitted infections clinic in Amsterdam, the Netherlands. Sex Transm Dis. 2012;39:518–27.
6. Feaster DJ, Parish CL, Gooden L, Matheson T, Castellon PC, Duan R, et al. Substance use and STI acquisition: secondary analysis from the AWARE study. Drug Alcohol Depend. 2016;169:171–9.
7. Koblin B, Husnik M, Colfax G, Huang Y, Madison M, Mayer K, et al. Risk factors for HIV infection among men who have sex with men. AIDS. 2006;20:731–9.
8. Daskalopoulou M, Rodger A, Phillips AN, Sherr L, Speakman A, Collins S, et al. Recreational drug use, polydrug use, and sexual behaviour in HIV-diagnosed men who have sex with men in the UK: results from the cross-sectional ASTRA study. Lancet HIV. 2014;1:e22–31.
9. Stall R, Purcell DW. Intertwining epidemics: a review of research on substance use among men who have sex with men and its connection to the AIDS epidemic. AIDS Behav. 2000;4:181–92.
10. van Sighem AI, Wit FWNM, Boyd A, Smit C, Matser A, Reiss P. Monitoring Report 2019. Human Immunodeficiency Virus (HIV) Infection in the Netherlands. Amsterdam, the Netherlands: Stichting HIV Monitoring; 2019. www.hiv-monitoring.nl/
11. Slurink IAL, Aar F, Op de Coul ELM, Heijne JCM, van Wees DA, Hoenderboom BM, et al. Sexually transmitted infections in the Netherlands in 2018. Bilthoven, the Netherlands: National Institute for Public Health and the Environment (RIVM); 2019.
12. European Centre for Disease Prevention and Control, WHO Regional Office for Europe. HIV/AIDS surveillance in Europe 2020–2019 data. Copenhagen, Denmark: WHO Regional Office for Europe; 2020.
13. Public Health England (PHE). Sexually transmitted infections and screening for chlamydia in England, 2019. London, UK: PHE; 2020.
14. Australian Institute of Health and Welfare. Australia's health 2018. Canberra, ACT: Australian Institute of Health and Welfare; 2018.
15. Centers for Disease Control and Prevention (CDC). Sexually Transmitted Disease Surveillance 2019. Atlanta, GA: Department of Health and Human Services; 2021.
16. Maxwell S, Shahmanesh M, Gafos M. Chemsex behaviours among men who have sex with men: a systematic review of the literature. Int J Drug Policy. 2019;63:74–89.
17. Tomkins A, George R, Kliner M. Sexualised drug taking among men who have sex with men: a systematic review. Perspect Public Health. 2019;139:23–33.
18. Stuart D. Sexualised drug use by MSM: background, current status and response. HIV Nursing. 2013;13:6–10.
19. Edmundson C, Heinsbroek E, Glass R, Hope V, Mohammed H, White M, et al. Sexualised drug use in the United Kingdom (UK): a review of the literature. Int J Drug Policy. 2018;55:131–48.
20. Schmidt AJ, Bourne A, Weatherburn P, Reid D, Marcus U, Hickson F, et al. Illicit drug use among gay and bisexual men in 44 cities: findings from the European MSM internet survey (EMIS). Int J Drug Policy. 2016;38:4–12.
21. Glynn RW, Byrne N, O'Dea S, Shanley A, Codd M, Keenan E, et al. Chemsex, risk behaviours and sexually transmitted infections among men who have sex with men in Dublin. Ireland. Int J Drug Policy. 2018;52:9–15.
22. Evers YJ, Van Liere G, Hoebe C, Dukers-Muijrers N. Chemsex among men who have sex with men living outside major cities and associations with sexually transmitted infections: a cross-sectional study in the Netherlands. PLOS ONE. 2019;14:e0216732.
23. Hibbert MP, Brett CE, Porcellato LA, Hope VD. Psychosocial and sexual characteristics associated with sexualised drug use and chemsex among men who have sex with men (MSM) in the UK. Sex Transm Infect. 2019;95:342–50.
24. Kohli M, Hickson F, Free C, Reid D, Weatherburn P. Cross-sectional analysis of chemsex drug use and gonorrhoea diagnosis among men who have sex with men in the UK. Sex Health. 2019;16:464–72.
25. Druckler S, van Rooijen MS, de Vries HJC. Chemsex among men who have sex with men: a sexualized drug use survey among clients of the sexually transmitted infection outpatient clinic and users of a gay dating app in Amsterdam, the Netherlands. Sex Transm Dis. 2018;45:325–31.
26. Melendez-Torres GJ, Hickson F, Reid D, Weatherburn P, Bonell C. Nested event-level case-control study of drug use and sexual outcomes in multipartner encounters reported by men who have sex with men. AIDS Behav. 2016;20:646–54.

27. Sewell J, Miltz A, Lampe FC, Cambiano V, Speakman A, Phillips AN, et al. Poly drug use, chemsex drug use, and associations with sexual risk behaviour in HIV-negative men who have sex with men attending sexual health clinics. Int J Drug Policy. 2017;43:33–43.
28. Achterbergh RCA, de Vries HJC, Boyd A, Davidovich U, Druckler S, Hoornenborg E, et al. Identification and characterization of latent classes based on drug use among men who have sex with men at risk of sexually transmitted infections in Amsterdam, the Netherlands. Addiction. 2020;115:121–33.
29. Sewell J, Cambiano V, Miltz A, Speakman A, Lampe FC, Phillips A, et al. Changes in recreational drug use, drug use associated with chemsex, and HIV-related behaviours, among HIV-negative men who have sex with men in London and Brighton, 2013–2016. Sex Transm Dis. 2018;94:494–501.
30. Ottaway Z, Finnerty F, Buckingham T, Richardson D. Increasing rates of reported chemsex/sexualised recreational drug use in men who have sex with men attending for postexposure prophylaxis for sexual exposure. Sex Transm Infect. 2017;93:31.
31. Kenyon C, Wouters K, Platteau T, Buyze J, Florence E. Increases in condomless chemsex associated with HIV acquisition in MSM but not heterosexuals attending a HIV testing center in Antwerp, Belgium. AIDS Res Ther. 2018;15:14.
32. Knoops L, Bakker IB, Zantkuijl P. Tina & slammen: MSM, crystal meth-gebruik en het injecteren van drugs in een seksuele setting [MSM, Crystal Meth and Intravenous Drug Use in a Sexual Setting]. Amsterdam, the Netherlands: Mainline, Soa Aids Nederland; 2015.
33. Sewell J, Cambiano V, Speakman A, Lampe FC, Phillips A, Stuart D, et al. Changes in chemsex and sexual behaviour over time, among a cohort of MSM in London and Brighton: findings from the AURAH2 study. Int J Drug Policy. 2019;68:54–61.
34. Colfax G, Coates TJ, Husnik MJ, Huang Y, Buchbinder S, Koblin B, et al. Longitudinal patterns of methamphetamine, popper (amyl nitrite), and cocaine use and high-risk sexual behavior among a cohort of San Francisco men who have sex with men. J Urban Health. 2005;82:i62–70.
35. van Griensven GJ, Tielman RA, Goudsmit J, van der Noordaa J, de Wolf F, de Vroome EM, et al. Risk factors and prevalence of HIV antibodies in homosexual men in the Netherlands. Am J Epidemiol. 1987;125:1048–57.
36. Jansen IA, Geskus RB, Davidovich U, Jurriaans S, Coutinho RA, Prins M, et al. Ongoing HIV-1 transmission among men who have sex with men in Amsterdam: a 25-year prospective cohort study. AIDS. 2011;25:493–501.
37. van Bilsen WPH, Boyd A, van der Loeff MFS, Davidovich U, Hogewoning A, van der Hoek L, et al. Diverging trends in incidence of HIV versus other sexually transmitted infections in HIV-negative MSM in Amsterdam. AIDS. 2020;34:301–9.
38. van den Boom W, Stolte I, Sandfort T, Davidovich U. Serosorting and sexual risk behaviour according to different casual partnership types among MSM: the study of one-night stands and sex buddies. AIDS Care. 2012;24:167–73.
39. Buis ML. POSTRCSPLINE: Stata Module Containing Post-Estimation Commands for Models Using a Restricted Cubic Spline. Boston, MA: Statistical Software Components, Boston College Department of Economics; 2008.
40. Rothman KJ. No adjustments are needed for multiple comparisons. Epidemiology. 1990;1:43–6.
41. Achterbergh RCA, Druckler S, van Rooijen MS, van Aar F, Slurink IAL, de Vries HJC, et al. Sex, drugs, and sexually transmitted infections: a latent class analysis among men who have sex with men in Amsterdam and surrounding urban regions, the Netherlands. Drug Alcohol Depend. 2020;206:107526.
42. Schmidt AJ. S07.3 challenges in defining Chemsex. Answers for surveillance from EMIS-2017. Sex Transm Infect. 2019;95:A1–15.
43. European Monitoring Centre for Drugs and Drug Addiction. European Drug Report 2019. Luxembourg: Publications Office of the European Union; 2019.
44. European Monitoring Centre for Drugs and Drug Addiction. EU Drug Markets Report 2019. Luxembourg: Publications Office of the European Union; 2019.
45. Hampel B, Kusejko K, Kouyos RD, Boni J, Flepp M, Stockle M, et al. Chemsex drugs on the rise: a longitudinal analysis of the Swiss HIV cohort study from 2007 to 2017. HIV Med. 2020;21:228–39.
46. Pufall EL, Kall M, Shahmanesh M, Nardone A, Gilson R, Delpech V, et al. Sexualized drug use ('chemsex') and high-risk sexual behaviours in HIV-positive men who have sex with men. HIV Med. 2018;19:261–70.
47. Scheim A, Knight R, Shulha H, Nosova E, Hayashi K, Milloy MJ, et al. Characterizing men who have sex with men and use injection drugs in Vancouver, Canada. AIDS Behav. 2019;23:3324–30.
48. Stevens O, Moncrieff M, Gafos M. Chemsex-related drug use and its association with health outcomes in men who have sex with men: a cross-sectional analysis of antidote clinic service data. Sex Transm Infect. 2020;96:124–30.
49. Bui H, Zablotska-Manos I, Hammoud M, Jin F, Lea T, Bourne A, et al. Prevalence and correlates of recent injecting drug use among gay and bisexual men in Australia: results from the FLUX study. Int J Drug Policy. 2018;55:222–30.
50. Hoornenborg E, Achterbergh RC, van der Loeff MFS, Davidovich U, van der Helm JJ, Hogewoning A, et al. Men who have sex with men more often chose daily than event-driven use of pre-exposure prophylaxis: baseline analysis of a demonstration study in Amsterdam. J Int AIDS Soc. 2018;21:e25105.
51. van der Knaap N, Grady BP, Schim van der Loeff MF, Heijman T, Speksnijder A, Geskus R, et al. Drug users in Amsterdam: are they still at risk for HIV? PLOS ONE. 2013;8:e59125.
52. European Monitoring Centre for Drugs and Drug Addiction. Trends in injecting drug use in Europe. Luxembourg: Publications Office of the European Union; 2010.
53. Drumright LN, Patterson TL, Strathdee SA. Club drugs as causal risk factors for HIV acquisition among men who have sex with men: a review. Subst Use Misuse. 2006;41:1551–601.
54. Bourne A, Reid D, Hickson F, Torres-Rueda S, Weatherburn P. Illicit drug use in sexual settings ('chemsex') and HIV/STI transmission risk behaviour among gay men in South London: findings from a qualitative study. Sex Transm Infect. 2015;91:564–8.
55. Vosburgh HW, Mansergh G, Sullivan PS, Purcell DW. A review of the literature on event-level substance use and sexual risk behavior among men who have sex with men. AIDS Behav. 2012;16:1394–410.
56. Santoro P, Rodriguez R, Morales P, Morano A, Moran M. One 'chemsex' or many? Types of chemsex sessions among gay and other men who have sex with men in Madrid, Spain: findings from a qualitative study. Int J Drug Policy. 2020;82:102790.
57. Coyer L, van Bilsen W, Bil J, Davidovich U, Hoornenborg E, Prins M, et al. Pre-exposure prophylaxis among men who have sex with men in the Amsterdam cohort studies: use, eligibility, and intention to use. PLOS ONE. 2018;13:e0205663.
58. Zimmermann HM, Postma L, Achterbergh R, Schim van der Loeff M, de Vries H, Hoornenborg E, et al. The impact of pre-exposure prophylaxis on sexual well-being among men who have sex with men. Arch Sex Behav. 2021;50:1829–41.
59. Clinical management guidance for individuals taking HIV PrEP within the context of a combination HIV (and STI) prevention approach in Ireland [internet]. Version 1.1; October 2019 [updated October 2019; cited 2021 February 22]. Available at: https://www.sexualwellbeing.ie/for-professionals/prep-information-for-service-providers/guidelines-for-the-management-of-prep-in-ireland.pdf (accessed 22 February).

60. Maxwell S, Gafos M, Moncrieff M, Shahmanesh M, Stirrup O. Pre-exposure prophylaxis use among men who have sex with men who have experienced problematic chemsex. Int J STD AIDS. 2020;31:474–80.
61. Torres TS, Bastos LS, Kamel L, Bezerra DRB, Fernandes NM, Moreira RI, et al. Do men who have sex with men who report alcohol and illicit drug use before/during sex (chemsex) present moderate/high risk for substance use disorders? Drug Alcohol Depend. 2020;209:107908.
62. Chakraborty A, McManus S, Brugha TS, Bebbington P, King M. Mental health of the non-heterosexual population of England. Br J Psychiatry. 2011;198:143–8.
63. King M, Semlyen J, Tai SS, Killaspy H, Osborn D, Popelyuk D, et al. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. BMC Psychiatry. 2008;8:70.
64. GGD Amsterdam. Chemsex [last updated 2021 January 25; cited 2021 February 22]. Available at: https://www.ggd.amsterdam.nl/english/sti-hiv-sense/chemsex/ (accessed 22 February 2021).
65. Deimel D, Stöver H, Hößelbarth S, Dichtl A, Graf N, Gebhardt V. Drug use and health behaviour among German men who have sex with men: results of a qualitative, multi-Centre study. Harm Reduct J. 2016;13:36.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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