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ORIGINAL PAPER

Association of Sexualized Drug Use Patterns with HIV/STI Transmission Risk in an Internet Sample of Men Who Have Sex with Men from Seven European Countries

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Abstract

We estimated the prevalence of overall sexualized drug use (SDU) and of chemsex in particular, assessed patterns of drug use, and identified subpopulations of men who have sex with men (MSM) where SDU and chemsex are more frequent. Using data from an online survey of 9407 MSM recruited during 2016 in 7 European countries, we calculated the proportion of participants who reported SDU and chemsex (mephedrone, methamphetamine, and/or GHB/GBL) in the last 12 months. We grouped the different drug-use combinations in patterns and described sexual risk behaviors, sexually transmitted infections (STI), and HIV seropositivity for each one of them. Factors associated with SDU and chemsex were assessed with two logistic regression models. SDU was reported by 17.7% and chemsex by 5.2%. Risk indicators increased through the different SDU patterns but were higher within those including chemsex drugs. In the multivariate analysis, chemsex was independently associated with living in Slovenia. Both SDU and chemsex were independently associated with living in Spain; being < 50 years old; living in cities of > 500,000 inhabitants; being open about their sex life; reporting transactional sex; condomless anal intercourse; having received an STI diagnosis and with being HIV positive or having been tested ≤ 12 months ago. Magnitude of associations was higher in the chemsex model. One in five participants reported SDU, but prevalence of chemsex was notably lower. However, the risk profiles and higher prevalence of HIV/STIs among those involved in chemsex suggest the existence of a subpopulation of MSM that could be playing a relevant role in the HIV and STI epidemics, especially in very large cities of some countries.

Keywords Men who have sex with men · Sexualized drug use · Chemsex · HIV · Sexual orientation

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Introduction

The use of illicit drugs among men who have sex with men (MSM) has been reported to be higher than in the male general population (Goldstein, Burstyn, LeVasseur, & Welles, 2016; Mercer et al., 2016). Sexualized drug use (SDU) refers to the use of illicit drugs just before or during sex and studies tend to document a link between SDU and sexual risk behaviors (Bourne & Weatherburn, 2017).

Results of studies reporting associations of single illicit drugs and SDU differ. A systematic review that included laboratory-based drug administration studies (Berry & Johnson, 2018) found one study that assessed the association of cocaine (vs. placebo) on reported condom use likelihood. This study concluded that cocaine administration increased the likelihood of condomless anal intercourse (CAI) (Johnson, Herrmann, Sweeney, LeComte, & Johnson, 2017). The same systematic review only found one study that assessed cannabis (Metrik et al., 2012) and risky sexual decisions and concluded that those who took THC (vs. placebo) decreased sexual risk. Outside laboratory settings, Schumacher, Marzell, Toepp, and Schweizer (2018) conducted a meta-analysis to assess the association between the use of marijuana around the time of intercourse and condom use and found that it was less frequent in marijuana users but only in a subgroup analysis conducted for adolescents. Both reviews, however, did not focus exclusively on MSM.

In MSM, methamphetamine has found to be associated with sexual risk behaviors (Colfax et al., 2010; Maxwell, Shahmanesh, & Gafos, 2019; Vosburgh, Mansergh, Sullivan, & Purcell, 2012) and with HIV seroconversion (Plankey et al., 2007) quite consistently, but results on associations with other drugs vary widely. As highlighted by Vosburgh et al. (2012), the association of poppers and erectile dysfunction drugs with sexual risk behavior in MSM has been frequently investigated, but while some studies found statistically significant associations, others did not. The remaining drugs have been less investigated. Cannabis (marijuana) use during sex has rarely been found to be associated with sexual risk behaviors (Drumright et al., 2006). Two studies found that the use of cocaine before the most recent sexual encounter increased the probabilities of engaging in CAI (Boone, Cook, & Wilson, 2013; Lambert et al., 2011); others, however, did not find that using this substance increased the odds of engaging in risky sexual behavior (Benotsch, Mikytuck, Ragsdale, & Pinkerton, 2006; Drumright, Gorbach, Little, & Strathdee, 2009; Mansergh et al., 2006). The use of ketamine was not found to be associated with recent HIV infection (Carey et al., 2009) but studies that examined ketamine during sex and its association with sexual behaviors present conflicting results with some finding statistically significant associations with CAI (Rusch, Lampinen, Schilder, & Hogg, 2004) and others not (Benotsch et al., 2006; Drumright et al., 2006). Similarly, we found two studies that examined ecstasy use during that did not find an association with sexual risk behaviors (Benotsch et al., 2006; Drumright et al., 2006), while one did (Rusch et al., 2004). Studies examining gamma-hydroxybutyrate/gamma-butyrolactone (GHB/GBL) and its influence on sexual risk behaviors also present differing results with some showing no association (Benotsch et al., 2006; Drumright et al., 2006; Melendez-Torres & Bourne, 2016) and others find that GHB/GBL did increase the odds of CAI (Rusch et al., 2004). The two studies we found that examined the association between mephedrone before sex and CAI (Melendez-Torres & Bourne, 2016; Prestage, Grierson, Bradley, Hurley, & Hudson, 2009) did not find any associations. We did not find studies that assessed the association between amphetamine ('speed') use and sexual risk behaviors. Nevertheless, disentangling the individual effects of individual drugs on sexual risk behaviors is hard in naturalistic scenarios and remains a challenge since SDU often involves poly-drug use and tends to group in different patterns of use.

In the U.S., most of the studies on SDU among MSM focus on the consequences of crystal methamphetamine (Green & Halkitis, 2006; Koblin et al., 2007; Kubicek et al., 2007; Kurtz, 2005; Ober, Shoptaw, Wang, Gorbach, & Weiss, 2009). In Europe, the approach on SDU is different. In spite of a lack of longitudinal data that would enable the assessment of trends of SDU in this population, studies consistently talk about a shift from the use of traditional party drugs such as cocaine or ecstasy to a subset term of SDU known as "chemsex" (Kirby & Thornbern-Dunwell, 2013; Sullivan, 2015). Chemsex is generally known as the use of mephedrone, crystal methamphetamine or GHB/GBL in the context of sexual encounters between men (Edmundson et al., 2018; Public Health England, 2015). These drugs act to increase sexual arousal and performance and are normally taken in private sex parties, sex-on-premise venues, or public sex parties (Schmidt et al., 2016). The proliferation of chemsex is associated with the proliferation of these substances via geospatial networking dating apps (Stuart, 2019).

Chemsex has been studied mainly in the UK and has been associated with higher rates of sexually transmitted infections (STI) (Carey et al., 2009; Glynn et al., 2018; Hegazi et al., 2017; Ottaway et al., 2017; Pakianathan et al., 2018; Pufall et al., 2018; Rosinska et al., 2018; Sewell et al., 2017; Tomkins, George, & Kliner, 2018), intravenous drug use (IDU) (Hegazi et al., 2017; Pakianathan et al., 2018; Rosinska et al., 2018), higher number of CAI (Daskalopoulou et al., 2014; Glynn et al., 2018; Hammoud et al., 2018a; Ottaway et al., 2017; Pufall et al., 2018; Sewell et al., 2017; Weatherburn, Hickson, Reid, Torres-Rueda, & Bourne, 2017), and is more frequent among HIV-positive individuals (Carey et al., 2009; Daskalopoulou et al., 2014; Edmundson et al., 2018; Hammoud et al., 2018a; Melendez-Torres et al., 2018; Pakianathan et al., 2018; Rosinska et al., 2018; Schmidt et al., 2016). Thus, it is currently considered an important public health issue that could be driving the epidemics of HIV and other STIs in this population (McCall, Adams, Mason, & Willis, 2015). Other negative outcomes associated

with chemsex are mental health issues (Hirshfield et al., 2015; Kirby & Thornbern-Dunwell, 2013; Pakianathan, Lee, Kelly, & Hegazi, 2016; Pufall et al., 2018) and reports of deaths associated with GHB overdose (Corkery, Loi, Claridge, Goodair, & Schifano, 2018; Hockenhull, Murphy, & Paterson, 2017).

Outside of the UK, there are few studies in Europe that assess chemsex as defined there and the prevalence and the associated risk behaviors in the rest of the continent remain largely unknown. A Spanish study measured drug use immediately before or during sex in a sample of hospital outpatients and found a clear association with high risk sexual behaviors and STIs (Gonzalez-Baeza et al., 2018). Although the authors mention "chemsex," the estimates correspond to overall SDU as they include a range of substances in its definition beyond mephedrone, crystal methamphetamine or GHB/GBL. Additionally, it only included HIV-positive individuals and all participants were recruited in Madrid, a city of more than 3,000,000 inhabitants, and therefore might not reflect MSM living in smaller municipalities. A multi-site study by Rosinska et al. (2018) analyzed drug use at the last intercourse with a male partner. Their chemsex definition added ketamine as a fourth drug and found that the use of "party drugs" (i.e., MDMA, cocaine or amphetamine) during or immediately before sex was more frequent than that of chemsex drugs. However, those who were involved in chemsex were more likely to report sex with multiple partners during their last anal intercourse and an STI diagnosis in the past year. Again, this study only included MSM living in large cities. The study by Rosinska et al. is actually the only one we have found that makes an effort to investigate the different patterns of drug use occurring in sexual contexts. The rest of the studies directly focus on MSM engaging in what each of them define as chemsex or on overall SDU and assess it with a dichotomous outcome (chemsex/SDU yes-chemsex/SDU no). As a consequence, there is a clear gap of knowledge on patterns of SDU different to chemsex. We do not know how frequent they are, and whether the aforementioned problematic outcomes are specific to chemsex or are also present in other SDU patterns.

In this study, we analyzed a sample of HIV-positive and HIV-negative MSM recruited online in seven European countries to identify chemsex and other SDU patterns and describe them in terms of the number and type of drugs used. We also ascertained the sexual risk profiles involved in each pattern and identified the main characteristics of the MSM involved in SDU and chemsex.

Method

In the context of the EURO HIV EDAT project (operational knowledge to improve HIV early diagnosis and treatment among vulnerable groups in Europe), we performed an online cross-sectional survey between April and December 2016 in Denmark, Germany, Greece, Portugal, Romania, Slovenia and Spain.

The research team designed a web-based questionnaire in English that was translated into the different languages. To ensure that no mistakes were made during the translation process, they were back-translated to English. The survey was anonymous and confidential. No variables allowing personal identification were collected.

Participants

Individuals were invited to participate through mailing lists, newsletters, social media messages, personal messages and promotional banners distributed mainly through gay dating Web sites but also through gay media and or community-based organization Web sites (CBO). We used collectors to identify from where participants accessed the survey. Those who decided to access the questionnaire were directed to an initial screen where they were informed about the aim and content of the survey. In order to be redirected to the questionnaire, the participants needed to check on the "I have read and understood the above information, in the country I live in I am old enough to legally have sex and I want to participate" box. No incentive was offered to participants in exchange for participation. More details of the questionnaire and the recruitment procedures can be found elsewhere (Hoyos et al., 2017).

We only included MSM who were male at birth, legally old enough to have sex at their country of residence and who reported having resided for most of the last 12 months in one of the participating countries ($N = 9407$).

Measures

The questionnaire assessed sociodemographics, outness, and sex of lifetime sexual partners, testing history and serostatus, sexual risk behaviors, STI history, and SDU.

Sociodemographics

With the exception of country of residence and place of birth, all the other variables were recoded for analysis. Recodification was based on the distribution of responses. Age at the moment of survey completion was assessed with an open-ended question that was recoded into a 4 group category variable: < 29; 30–39; 40–49; > 50, and number of inhabitants in place of residence originally had 6 response options: ≥ 1,000,000; 500,000–999,999; 100,000-499,999; 50,000–99,999; 10,000–49,999 and < 10,000 that were collapsed into: ≥ 1,000,000; 500,000–999,999; ≥ 50,000–499,999 and < 50,000. We also assessed the highest educational attainment and economic status. Highest educational attainment was assessed with a 6-response option question fabricated "ad hoc" based on the international standard

classification of education: options 5 ("Higher education/university education: specific vocational training, first and second university degrees, Bachelor, Master degree") and 6 ("University education-Doctorate") were collapsed in the "university education" category and the remaining 4 in "no university education." Economic status was assessed with the question "The current financial situation for your household is": "Comfortable"; "It is alright"; "It is tight, I need to be careful"; "I make ends meet with difficulties"; "I am unable to make ends meet." It was recoded into a dichotomous variable: "Comfortable" (comprised by those who chose "comfortable" as their response option and "not comfortable" (comprised by those who chose any of the other three options).

Outness and Sex of Lifetime Sexual Partners

To assess outness, we asked participants "How would you describe the way you live your sex life with men? This question had four response options: "openly," "discreetly," "hidden," "in total secrecy" that were recoded into a dichotomous variable (openly-not openly). Sex of lifetime sexual partners was assessed with the following question: "With whom have you ever had sex?" Response options were: "only with men," "mainly with men but also with women," "equally with men and women," and "mainly women." We recoded it into a dichotomous variable (only with men vs. men and women).

Testing History and Serostatus

We first assessed the number of previous HIV testing episodes with the question "Besides blood donations, how many times have you been tested for HIV?" Response options ranged from "never" to "more than twenty times." For those who had received one or more HIV tests in the past, we assessed time since last test with the question "When did you last have an HIV test?" Response options were "3 months or less"; "more than 3–6 months ago," "more than 6 months–1 year ago"; "more than 1–2 years ago"; "more than 2–5 years ago"; "more than 5 years ago." To assess HIV serostatus, we used a three-response option question: positive, negative, "I did not collect the results." Reasons for non-collection were not assessed, but for the 41 individuals who chose this option (0.7%) we considered that "negative" was the most likely test result and assumed a negative serostatus for them. This assumption was based on the HIV positivity rates reported for MSM in settings frequented by high-risk populations such as sexual health services (0.2–8%) (Belza et al., 2015; Campos-Outcalt, Mickey, Weisbuch, & Jones, 2006; Chow et al., 2018; Public Health England, 2015) or community-based testing sites (2–6%) (Thornton, Delpech, Kall, & Nardone, 2012). In the worst-case scenario of an 8% positivity rate for the 41 individuals who did not collect their test results, 3 individuals would have been misclassified as HIV negative.

Based on these three questions (number of previous HIV tests, time since last test and last test result), we created a testing history/serostatus variable with three categories: "never tested/underwent testing more than 12 months ago"; "underwent testing < 12 months ago"; HIV positive.

Sexual Risk Behaviors

Transactional sex during the last 12 months was assessed with the following two yes or no questions: "In the last 12 months, have you given money, drugs or other benefits to a man to have sex with you?" and "In the last 12 months, have you received money, drugs or other benefits from a man to have sex with him?" The number of CAI was assessed with the question "With how many men did you have unprotected anal intercourse? (in the last 12 months)." There were seven response options: "None"; "One"; "2–4"; "5–9"; "10–19"; "20–50"; "Over 50." Based on the response distribution we collapsed them into a 4-category variable: none; one; two to four, and five or more.

STI History

To assess past STI diagnosis, we first asked participants "Have you ever been diagnosed with any of these sexually transmitted infections?" Participants were able to select from a list of STIs (multiple choice) and were also given the choice of answering that they had not been diagnosed with an STI in the past. Those who reported having received an STI in the past, were asked "When was your last diagnosis?" Based on these two questions, we created a 3-category variable including "No STI diagnosis," "STI diagnosis > 12 months ago," and "STI diagnosis in the last 12 months."

Sexualized Drug Use

Drug use can occur in both sexual and non-sexual contexts. In the present study, we present data on drug use occurring exclusively in sexual context. Thus, participants were asked if they had taken drugs immediately preceding and/or during sex in the last 12 months. Those who answered "yes" were asked to select the drugs used from a list of drugs. To facilitate identification and distinction, some of the drugs were identified by other commonly used nomenclatures: mephedrone/methylone (Meow, MCAT, Plant food), methamphetamine (Crystal,Tina, Meth, Ice), cocaine, ecstasy/MDMA, ketamine, GHB/GBL (G, Gina, Liquid ecstasy), amphetamines, poppers, erectile dysfunction medications, and cannabis (marijuana, Hachis, synthetic cannabinoids, spice). We also included an open-ended "other drugs" category where participants were able to specify what drug they used if they felt it was not included in the list provided. Responses given

in the open-ended answer category were revised, and when possible, they were reassigned to already existing categories.

When grouping different drugs, we started by creating a category to assess chemsex as defined in the UK context (Public Health England, 2015).

1. *Chemsex drugs* mephedrone, methamphetamine, GHB/GBL. Although there is still no universally agreed definition of what drugs comprise the "chemsex phenomenon," these three substances are always present in the definition (Edmundson et al., 2018; Public Health England, 2015; Stuart, 2019). This category was created to estimate its prevalence and to identify if risks associated in the UK also hold true in continental Europe. Chemsex has fueled the recent concern surrounding SDU among MSM in the international community and the academia in Europe, but there is almost no information regarding the frequency of use and its negative outcomes outside of the UK.

The remaining substances were categorized for further analysis in 3 groups based on theoretical criteria and on the pre-existing literature on SDU:

2. *Sex-performance-enhancing drugs* poppers and erectile dysfunction medications (Rosinska et al., 2018).
3. *Party drugs* including ecstasy, cocaine, amphetamine and ketamine (Rosinska et al., 2018). Also known as "club drugs," these substances are good socializing and confidence giving drugs (Stuart, 2019) and have been traditionally used in club and other social contexts although they can also be taken in sexual contexts.

Based on the frequency of use of these 3 groups and the use of cannabis (which was treated independently), we created a 6-category variable to reflect the most noteworthy patterns of sexualized substance use reported by the participants: (1) only cannabis, (2) only sex-performance-enhancing drugs, (3) cannabis and sex-performance-enhancing drugs, (4) party drugs but not chemsex drugs, (5) chemsex drugs but not party drugs and (6) party drugs and chemsex drugs. We were not able to create categories that reflected the use of party drugs and/or chemsex drugs without the presence sex of performance-enhancing drugs, because exploratory analysis showed that a very high percentage of participants included in one of these two categories also used sex-performance-enhancing drugs. The classification of participants in categories 4–6 was done regardless of their use of cannabis.

Statistical Analysis

Missing data were handled with multiple imputation (MI) techniques. The percentage of missing data was substantially higher for the following variables: number of CAI (33.7%); "has paid for sex" (33.4%); "has been paid for sex" (33.7%); STI history (34.8%) and economic status (35.2%). It was also higher (33.9%) for the questions assessing SDU. The rest of the variables used in the analysis had a percentage of missing values of $<4\%$ (ranging from 0.0 to 3.8%). MI quantifies uncertainty about the missing data by creating different imputed datasets and combining the results obtained from them (Sterne et al., 2009). By using MI, we are able to increase statistical power and reduce the potential biases derived from using complete case analysis. Since the missing data pattern was non-monotone, we used MI by chained equations (MICE) (also known as Fully Conditional Specification) as implemented in SPSS v.25. We created 35 imputed datasets that were combined using Rubin's (1987) method. Many of the variables included in our analysis were associated with missingness, so we assumed that data were missing at random (MAR). All the variables used in the analysis were included in the multiple imputation model with the exception of country of residence (0% missing). To avoid model instability, we did not include this variable as a predictor due to low numbers of respondents from Romania in the questions assessing SDU. As an auxiliary variable, we included educational level. Although it was not used in the multivariate analysis, we decided to include it in the MI model due to its association with missingness in the questions assessing SDU which conformed our main outcome.

We first performed a descriptive analysis of the main characteristics of the participants stratifying our data by drug use in sexual contexts during the last 12 months (SDU vs. No SDU). Those who reported using at least one of the listed substances were included in the SDU group. Differences were assessed using the chi-square test for categorical variables.

We present the prevalence of each pattern of drug use both overall and by country. Within each pattern of SDU, we estimate the prevalence of use of each type of drug and number of drugs consumed. For each pattern of SDU, we also calculated the prevalence of HIV and STI infection and of the following sexual risk indicators: having given money or goods for sex in the last 12 months, having received money or goods in exchange for sex in the last 12 months, having received an STI diagnosis in the last 12 months and having had ≥ 5 CAI in the previous 12 months. To assess the existence of a linear trend between the patterns of SDU and each of the aforementioned HIV/STI diagnosis and sexual risk indicators, we used the chi-square for linear trend.

Two multivariable logistic regression models were built to identify the factors associated with SDU as well as engagement in chemsex. For each model, we calculated both crude and adjusted odds ratios and 95% confidence intervals. Following Hosmer and Lemeshow's (2000) method, all variables with a significance level of $<.20$ were included in the final model.

Results

General Characteristics of the Participants (Table 1)

Overall, 9407 individuals were included in the analysis of which 43.8% lived in Spain. Some 17.7% reported having used drugs immediately before or during sex in the previous 12 months. Those who reported SDU were significantly different ($p < .001$) from those who did not use drugs in sexual contexts in all the variables analyzed, except for level of education and type of recruitment site. Thus, a higher proportion of those reporting SDU (12.4% vs. 9.0%) had been born in a country different to that of residence; lived in cities of ≥ 1.000.000 inhabitants (37.8% vs . 28.4%) defined their economic status as uncomfortable (40.0% vs. 35.2%) and reported being open about their sex life (54.5% vs. 32.9%).

The proportion of participants with sexual risk behaviors in the last 12 months were always higher among participants who reported SDU. Both the prevalence of an STI diagnosis in the last 12 months (19.7% vs. 8.4%) and the prevalence of HIV infection (21.3% vs. 8.4%) were also notably higher among those who reported SDU.

Prevalence and Patterns of Sexualized Drug Use by Country of Residence (Table 2)

Overall, SDU was reported by 17.7% of participants. The two most prevalent SDU patterns were the ones comprised by "only sex-performance-enhancing drugs" and of "party but not chemsex drugs" (4.5% and 3.9%), closely followed by "party and chemsex drugs" (3.5%). The other patterns were less frequent.

By country, we can distinguish three levels of SDU prevalence: low (Romania, 10.2%), intermediate (Greece and Portugal) and high (the rest of the countries, with prevalence reaching 20.6% in Spain). In Germany (6.6%), Greece (3.1%), Portugal (2.9%) and Romania (3.1%), "only sex-performance-enhancing drugs" was the most common pattern. In Denmark (5.3%), the most common pattern was "party and chemsex drugs," in Slovenia (5.2%) it was "chemsex but not party drugs" and in Spain it was "party drugs but not chemsex drugs" (4.9%).

Patterns of Sexualized Drug Use (Table 3 and Fig. 1)

Overall, sex-performance-enhancing drugs were the most common type of drug used (13.4%), mainly due to the use of poppers (12.6%). Cannabis was reported by 8.0%, party drugs by 7.3%, and chemsex drugs were used by 5.2%. Cocaine was the most frequent party drug (5.1%), and GHB/GBL the most common chemsex substance (3.9%).

Focusing on the patterns that included either party or chemsex drugs, those who reported "party drugs but not chemsex drugs" drugs reported less use of poppers (56.9%) and erectile dysfunction medications (23.1%) than those who reported "chemsex drugs but not party drugs" (67.3% and 35.6%), and those who used "party and chemsex drugs" (87.1% and 67.8%). Likewise, the number of party and number of chemsex drugs used were consistently higher among those who reported having used "party drugs and chemsex drugs" than among those who reported only using one of the two types of drugs.

A risk ladder can be seen in Fig. 1: the prevalence of the different sexual risk behaviors and of HIV or STI diagnosis increases from those with no SDU through the different SDU patterns and peaks when chemsex drugs are present, especially among those who report having used both chemsex and party drugs.

Factors Associated with Chemsex or SDU (Table 4)

In the adjusted model built to assess factors associated with chemsex, odds of having used chemsex drugs in the last 12 months were significantly higher in those living in Spain and Slovenia. It was higher among those under 50 years of age and among those living in cities of over 500.000 inhabitants. It was also higher in those who were open about their sex life and among those who had had sex with men and women. Neither place of birth nor economic status was related to chemsex. Regarding sexual risk behaviors, chemsex was associated with having paid or received money or other goods in exchange for sex, having had CAI in the last 12 months and having being diagnosed with an STI. It was also associated with being HIV positive and having being tested for HIV less than 12 months ago.

The variables retained in the multivariable model for SDU are the same as those in the model for chemsex, as well as the direction of the associations detected. However, the magnitudes of the associations were lower.

Discussion

Approximately one in five of the MSM recruited online in seven different European countries reported having used at least one of the drugs assessed immediately before or during sex in the preceding 12 months. The proportion of MSM who reported the use of chemsex specific drugs was substantially smaller. The rising prevalence of different indicators (number of drug used, sexual risk behaviors and HIV/STI infections) in the patterns of SDU identified seems to display a risk ladder which starts

Table 1 General characteristics of the study participants by sexualized drug use, during last 12 months, in 7 European countries

	Total		NO sexualized drug use*		Sexualized drug use*		Chi square *p* value
	N = 9407		*N* = 7743		*N* = 1664		
	100.0%		82.3%		17.7%		
	N	%	*N*	%	*N*	%	
Country of residence							< .001
Denmark	467	5.0	380	4.9	88	5.3	
Germany	1964	20.9	1600	20.7	364	21.9	
Greece	950	10.1	830	10.7	120	7.2	**
Portugal	861	9.2	743	9.6	118	7.1	**
Romania	769	8.2	691	8.9	78	4.7	**
Slovenia	273	2.9	228	2.9	45	2.7	
Spain	4123	43.8	3272	42.3	851	51.1	**
Type of recruitment site							.193
Gay dating apps	7919	84.2	6542	84.5	1377	82.8	
Gay media/CBO Web sites	1195	12.7	959	12.4	236	14.2	
Others	293	3.1	242	3.1	51	3.1	
Age							< .001
< 29	2675	28.4	2218	28.6	457	27.5	
30–39	2850	30.3	2307	29.8	543	32.6	**
40–49	2330	24.8	1883	24.3	447	26.9	**
> 50	1552	16.5	1335	17.2	217	13.0	**
Place of birth							< .001
In country of current residence	8500	90.4	7044	91.0	1457	87.5	**
In other country	907	9.6	700	9.0	207	12.4	**
Number of inhabitants in place of residence							< .001
≥ 1,000,000	2825	30.0	2196	28.4	629	37.8	**
500,000–999,000	1005	10.7	787	10.2	218	13.1	**
50,000–499,999	3012	32.0	2532	32.7	480	28.9	**
< 50,000	2565	27.3	2228	28.8	337	20.3	**
Education							.279
No university education	4605	49.0	3789	48.9	816	49.0	
University education	4802	51.0	3954	51.1	848	51.0	
Economic status							< .001
Comfortable	6017	64.0	5018	64.8	999	60.0	**
Unconfortable	3390	36.0	2725	35.2	665	40.0	**
Lives sex life with men…							< .001
Openly	3448	36.7	2543	32.9	905	54.5	**
Discreetly	3661	39.0	3139	40.6	522	31.4	**
Hidden	1064	11.3	957	12.4	107	6.5	**
In total secrecy	1224	13.0	1098	14.2	126	7.6	**
Sex of sex partners (ever)							< .001
Only men	5065	53.8	4179	54.0	886	53.2	
Mainly men	2743	29.2	2160	27.9	583	35.0	**
Men and women equally	902	9.6	788	10.2	114	6.9	**
Mainly women	697	7.4	616	8.0	81	4.9	**
Has paid or given any kind of goods in exchange for sex (last 12 months)							< .001
No	8702	92.5	7256	93.7	1446	86.9	**
Yes	705	7.5	488	6.3	218	13.0	**

Table 1 (continued)

	Total		NO sexualized drug use*		Sexualized drug use*		Chi square *p* value
	N = 9407		*N* = 7743		*N* = 1664		
	100.0%		82.3%		17.7%		
	N	%	*N*	%	*N*	%	
Has received money or other goods in exchange for sex (last 12 months)							< .001
No	8923	94.9	7500	96.9	1423	85.5	**
Yes	484	5.1	243	3.1	241	14.5	**
Number of condomless anal intercourses (last 12 months)							< .001
None	3599	38.3	3204	41.4	394	23.7	**
1	2819	30.0	2416	31.2	403	24.2	**
2–4	1850	19.7	1426	18.4	424	25.5	**
≥ 5	1139	12.1	697	9.0	442	26.6	**
History of sexually transmitted infections diagnosis							< .001
No STI diagnosis	5878	62.5	5165	66.7	713	42.9	**
STI diagnosis > 12 months ago	2552	27.1	1930	24.9	622	37.4	**
STI diagnosis in the last 12 months	977	10.4	649	8.4	329	19.7	**
HIV serostatus/testing history							< .001
Never tested/last HIV test negative > 12 months	4683	49.8	4150	53.6	532	32.0	**
Last HIV test negative ≤ 12 months	3717	39.5	2941	38.0	776	46.7	**
HIV positive	1007	10.7	652	8.4	355	21.3	**

*Cannabis, poppers, erectile dysfunction medications, ecstasy, cocaine, amphetamine, ketamine, mephedrone, methamphetamine or GHB/GBL

**Statistically significant

Table 2 Patterns of sexualized drug use by country of residence, in 7 European countries

	Overall sexualized drug use*	Only cannabis	Only sex-performance-enhancing drugs (1)	Cannabis and sex-performance-enhancing drugs	Party drugs (2) but not chemsex drugs (3)**	Chemsex drugs but not party drugs **	Party drugs and chemsex drugs**
Total (%)	17.7	1.9	4.5	2.2	3.9	1.8	3.5
Country of residence							
Denmark (*N* = 467)	18.7	1.8	3.8	1.4	4.7	1.8	5.3
Germany (*N* = 1964)	18.5	1.5	6.6	2.3	3.6	1.6	3.0
Greece (*N* = 950)	12.7	1.9	3.1	1.9	2.3	1.6	1.9
Portugal (*N* = 861)	13.7	2.5	2.9	2.8	2.6	1.0	2.1
Romania (*N* = 769)	10.2	1.7	3.1	1.3	1.9	1.5	0.7
Slovenia (*N* = 273)	16.4	1.4	1.6	0.5	3.4	5.2	4.3
Spain (*N* = 4123)	20.6	2.1	4.6	2.5	4.9	1.8	4.6

*Cannabis, poppers, erectile dysfunction medications, ecstasy, cocaine, amphetamine, ketamine, mephedrone, methamphetamine or GHB/GBL

**Regardless of participants use of cannabis, poppers or erectile dysfunction drugs

(1) Sex-performance-enhancing drugs: poppers or other erectile dysfunction medications. (2) Party drugs: ecstasy, cocaine, amphetamine, ketamine (3) Chemsex drugs: mephedrone, methamphetamine, GHB/GBL

Table 3 Types and number of drugs used for sex in the last 12 months by pattern of sexualized drug use, in 7 European countries

	Total	Only cannabis	Only sex-performance-enhancing drugs (1)	Cannabis and sex-performance-enhancing drugs	Party drugs (2) but not chemsex drugs (3)*	Chemsex drugs but not party drugs*	Party drugs and chemsex drugs*
	N = 9407	*N* = 181	*N* = 421	*N* = 207	*N* = 364	*N* = 165	*N* = 326
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Cannabis	8.0	100.0		100.0	40.8	29.9	52.4
Sex-performance-enhancing drugs	13.4		100.0	100.0	59.3	69.6	91.4
Poppers	12.6		92.9	93.7	56.9	67.3	87.1
Erectile dysfunction medications	5.3		20.0	23.3	23.1	35.6	67.8
Party drugs	7.3						
Ecstasy	3.2				31.2		57.3
Cocaine	5.1				65.8		74.0
Amphetamine	2.1				19.7		37.1
Ketamine	1.5				9.5		33.1
Chemsex drugs	5.2						
Mephedrone	2.0					28.6	43.2
Methamphetamine	2.1					26.7	47.7
GHB/GBL	3.9					74.8	75.3
Number of party or chemsex drugs used							
Party drugs							
1					78.6		41.5
2					17.1		28.2
3					4.0		17.7
4					0.4		12.7
Chemsex drugs							
1						77.3	49.1
2						21.2	34.6
3						1.5	16.3

*Regardless of participants use of cannabis, poppers or erectile dysfunction drugs

(1) Sex-performance-enhancing drugs: poppers or other erectile dysfunction medications. (2) Party drugs: ecstasy, cocaine, amphetamine, ketamine (3) Chemsex drugs: mephedrone, methamphetamine, GHB/GBL

with the lowest risk found among those who report no SDU and finishes with the highest risk found among those who are combining chemsex and party drugs.

Comparisons of SDU rates between studies are troublesome due to various reasons: lack of uniformity of definitions used, different periods considered, study populations with diverse characteristics and different recruitment procedures (Edmundson et al., 2018; Maxwell et al., 2019). Our results show that the overall prevalence of SDU was similar to that of a small-scale study conducted among MSM attendees of a sexual health clinic in Brighton (Ottaway et al., 2017) but lower than that seen in other studies. Thus, the difference with the proportion of SDU found in a study conducted in a number of European cities (Rosinska et al., 2018) is substantial, especially if we take into account that their time reference was limited to participants' last sexual encounter as opposed to all sexual encounters during the preceding 12 months we used in our study. At least part—but probably not all—of the difference could be explained by the fact that their sample was obtained in major cities, whereas almost half of ours was comprised by MSM residing in areas of < 500,000 inhabitants where the prevalence of SDU and chemsex is lower. We also found a number of studies that defined all SDU as chemsex (vs. only considering mephedrone, methamphetamine and GBH/GBL) highlighting the need of a standardized definition for chemsex. Comparisons against these studies are made using our data on SDU instead of chemsex given that the list of drugs is similar. Thus, a study conducted among attendees of a gay men health service in the city of Dublin (Glynn et al., 2018) found a higher prevalence. Likewise, a study by Gonzalez Baeza et al. (2018)

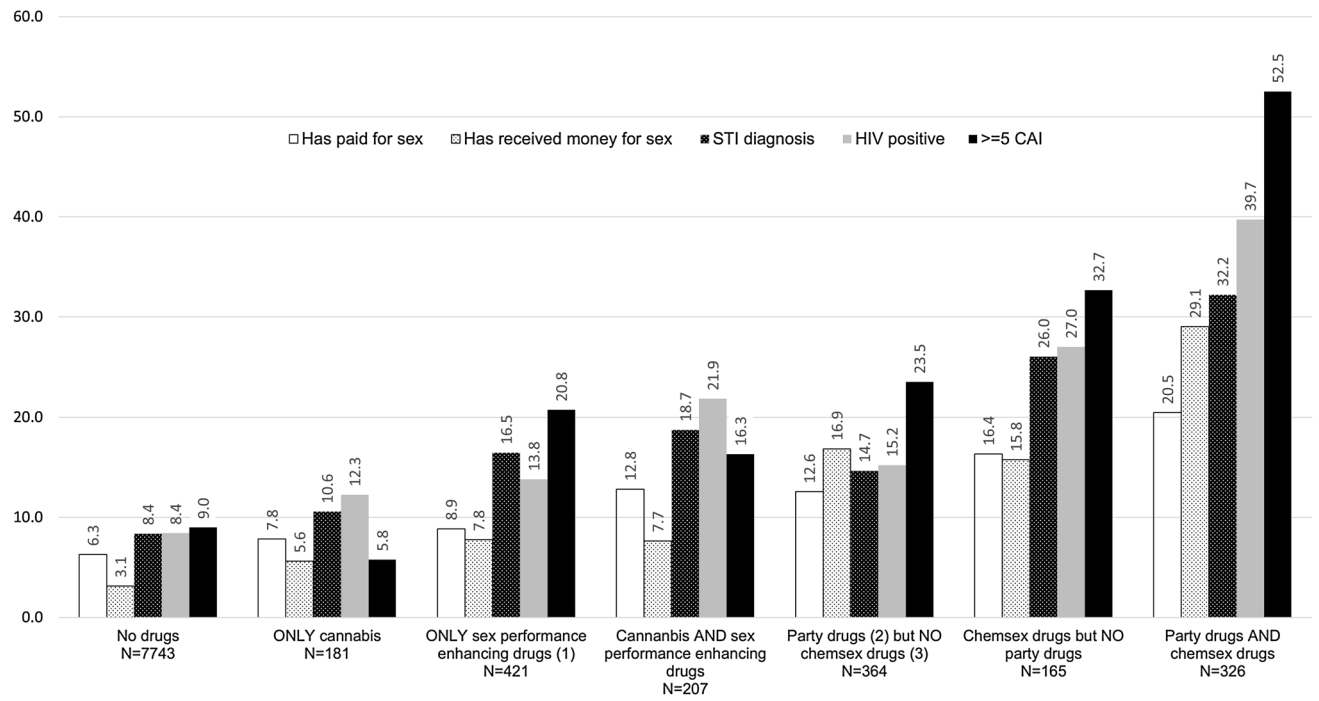

Fig. 1 Prevalence of sexual risk indicators*, diagnosis of STI* and HIV serostatus by type of sexualized drug use pattern in the last 12 months. *In the last 12 months. Chi-square test for linear trend: paid for sex $p < .001$; received money for sex $p < .001$; STI diagnosis $p < .001$; HIV positive $p < .001$; ≥ 5 CAI $p < .001$. (1) Sex-performance-enhancing drugs: poppers, erectile dysfunction medications. (2) Party drugs: ecstasy, cocaine, amphetamine, ketamine. (3) Chemsex drugs: mephedrone, methamphetamine, GHB/GBL

also found a higher prevalence of SDU. This is the only study we found that was conducted in Spain. They analyzed a sample of individuals recruited in hospitals from Madrid and assessed their use of mephedrone, methamphetamine, GHB/GBL, ketamine, cocaine, amphetamine and/or ecstasy during sex in the previous 12 months. However, their sample was comprised entirely by people living with HIV who have been found to engage in SDU more often than HIV-negative MSM (Edmundson et al., 2018). In fact, if we compare their results against participants who reported being HIV positive in our study, the prevalence in our study is higher. This is the first time that data of SDU and chemsex from countries such as Germany, Denmark, Portugal, Romania, Slovenia, and Greece have been presented. The EMIS Network (2010) study did present data of drug use among MSM but not specific to sexual contexts. Although the sample size is limited, the high prevalence found in Slovenia merits attention and could deserve a wider exploration to further assess this phenomenon of SDU and chemsex.

When comparing our prevalence for chemsex with other studies that use similar criteria regarding the type of drugs used in their definitions, we also found differences in the time period considered. Additionally, we also found that very few studies explicitly assess the use of chemsex drugs in sexual contexts. Assuming that the use of GHB/GBL, mephedrone and methamphetamine is for the purpose of sex could overestimate the occurrence of chemsex. For this reason, we ensured respondents were aware that we referred to use immediately before or during sex. One of the few papers we found that assessed chemsex in this manner was conducted in sexual health clinics in the UK among HIV-negative MSM and found a higher prevalence of chemsex than that reported by participants in our study (Sewell et al., 2017).

SDU and chemsex were significantly higher among city residents, probably reflecting a higher availability of drugs and higher interconnectivity with networks of people who engage in sex under the influence of drugs as has been suggested in other studies (Hammoud et al., 2018a, 2018b). Similarly, the increased odds of SDU and chemsex among participants who were open about their sex life could also be related to the fact that they have access to larger networks where drug use is more common. Given the cross-sectional nature of the study, we could not make causal inferences between SDU and/or chemsex and sexual behaviors. But in spite of causal direction, transactional sex and condomless anal intercourse were all associated with taking drugs immediately before or during sex and associations were especially strong among chemsex drug users. This finding is not surprising and is in line with previous studies as is the fact that those involved in SDU and chemsex have higher rates of STI (Glynn et al., 2018; Gonzalez-Baeza et al., 2018; Pufall et al., 2018; Rosinska et al., 2018) and HIV diagnosis (Glynn et al., 2018). Substance use in people living with HIV

Table 4 Prevalence of sexualized drugs use and chemsex in the last 12 months and sociodemographic, behavioral, and clinical correlates, in 7 European countries ($N = 9407$)

	Sexualized drug use (1)						Chemsex (2)					
	Prevalence (%)	cOR	*p* value	(95% CI)	aOR	(95% CI)	Prevalence (%)	cOR	*p* value	(95% CI)	aOR	(95% CI)
Country of residence			*						*			
Portugal	13.7	1.0			1.0		3.1	1.0			1.0	
Denmark	18.7	1.5		1.0–2.1	0.8	0.5–1.2	7.1	2.4		1.3–4.4	1.1	0.6–2.2
Germany	18.5	1.4		1.1–1.9	1.2	0.9–1.6	4.6	1.5		0.9–2.5	1.1	0.6–1.9
Greece	12.7	0.6		0.6–1.3	0.9	0.5–1.2	3.5	1.1		0.6–2.2	0.9	0.5–1.9
Romania	10.2	0.4		0.3–0.7	0.8	0.5–1.2	2.2	0.7		0.3–1.5	0.8	0.4–1.9
Slovenia	16.4	1.5		1.0–2.3	1.4	0.9–2.1	9.6	3.4		1.8–6.2	5.0	2.5–10.1
Spain	20.6	1.9		1.5–2.5	1.4	1.1–1.8	6.5	2.2		1.4–3.6	1.8	1.1–3.1
Type of recruitment site			***						****			
Gay dating apps	17.4	1.0			1.0		5.1	1.0				
Gay media/CBO Web sites	19.7	1.2		1.0–1.4	1.0	0.8–1.3	6.4	1.3		1.0–1.7		
Others	17.5	1.0		0.7–1.4	1.0	0.7–1.5	4.9	1.0		0.5–1.7		
Age			*						*			
< 29	17.1	1.3		1.0–1.6	1.5	1.2–2.0	4.4	1.4		1.0–2.1	2.1	1.3–3.2
30–39	19.0	1.4		1.2–1.8	1.6	1.3–2.0	6.4	2.1		1.5–3.1	2.6	1.7–4.0
40–49	19.2	1.5		1.2–1.8	1.6	1.3–2.0	6.1	2.0		1.4–3.0	2.3	1.5–3.6
> 50	14.0	1.0			1.0		3.1	1.0			1.0	
Place of birth									**			
In country of current residence	17.1	1.0			1.0		4.9	1.0			1.0	
In other country	22.8	1.4		1.2–1.7	1.0	0.8–1.3	8.2	1.7		1.3–2.3	1.0	0.7–1.4
Number of inhabitants in place of residence			*						*			
≥ 1,000,000	22.3	1.9		1.6–2.3	1.4	1.2–1.7	7.9	2.8		2.1–3.7	1.9	1.4–2.7
500,000–999,999	21.7	1.8		1.4–2.3	1.	1.1–1.8	6.5	2.2		1.5–3.3	1.7	1.1–2.6
50,000–499,999	15.9	1.3		1.0–1.5	1.2	0.9–1.5	4.2	1.4		1.0–2.0	1.3	0.9–1.8
< 50,000	13.1	1.0			1.0		3.0	1.0			1.0	
Economic status			**						***			
Comfortable	16.6	1.0			1.0		4.6	1.0			1.0	
Unconfortable	19.6	1.2		1.1–1.4	1.1	1.0–1.3	6.3	1.4		1.1–1.7	1.2	0.9–1.5
Lives sex life with men…			*						*			
No openly	12.7	1.0			1.0		3.1	1.0			1.0	
Openly	26.3	2.4		2.2–2.8	1.6	1.4–1.9	8.8	3.0		2.4–3.7	1.6	1.3–2.1
Sex of sex partners (ever)			****						***			
Only men	17.5	1.0					5.6	1.0			1.0	
Men and women	17.9	1.0		0.9–1.2			4.8	0.9		0.7–1.1	1.2	0.9–1.6
Has paid or given any kind of goods in exchange for sex (last 12 months)			*						*			

Table 4 (continued)

	Sexualized drug use (1)						Chemsex (2)					
	Prevalence (%)	cOR	*p* value	(95% CI)	aOR	(95% CI)	Prevalence (%)	cOR	*p* value	(95% CI)	aOR	(95% CI)
No	16.6	1.0			1.0		4.6	1.0			1.0	
Yes	30.9	2.2		1.8–2.7	1.6	1.3–2.0	13.3	3.2		2.4–4.2	1.8	1.3–2.6
Has received money or other goods in exchange for sex (last 12 months)			*						*			
No	15.9	1.0			1.0		4.2	1.0			1.0	
Yes	49.8	5.2		4.1–6.6	3.3	2.5–4.3	25.0	7.7		5.8–10.1	3.7	2.7–5.2
Number of condomless anal intercourses (last 12 months)			*						*			
None	11.0	1.0			1.0		1.7	1.0			1.0	
1	14.3	1.4		1.1–1.6	1.3	1.0–1.5	3.2	1.9		1.3–2.8	1.8	1.2–2.7
2–4	22.9	2.4		2.0–2.9	2.0	1.7–2.4	6.3	3.9		2.7–5.7	3.0	2.0–4.5
≥ 5	38.8	5.2		4.3–6.2	2.9	2.3–3.6	19.8	14.5		10.3–20.4	6.5	4.5–9.3
History of STIs			*						*			
No STI diagnosis	12.1	1.0			1.0		2.2	1.0			1.0	
STI diagnosis > 12 months ago	24.4	2.3		2.0–2.7	1.6	1.3–1.8	8.3	4.0		3.1–5.1	2.1	1.5–2.8
STI diagnosis in the last 12 months	33.6	3.7		3.0–4.5	1.8	1.4–2.2	15.2	7.8		5.9–10.4	2.5	1.8–3.6
HIV serostatus/testing history			*						*			
Never tested/underwent testing > 12 months ago	11.4	1.0			1.0		2.3	1.0			1.0	
Underwent testing <=12 months ago	20.9	2.1		1.8–2.4	1.6	1.3–1.9	5.7	2.6		2.0–3.5	1.	1.2–2.3
HIV positive	35.3	4.2		3.5–5.2	2.3	1.8–2.9	17.3	9.1		6.8–12.1	3.7	2.6–5.2

Crude and adjusted logistic regression analysis

cOR crude odds ratio, *CI* confidence interval, *aOR* adjusted odds ratio

*p value < .001, **p value < .05, ***p value ≥ .05 and ≤ .20 ****p value > .20

(1) Cannabis, poppers, erectile dysfunction medications, ecstasy, cocaine, amphetamine, ketamine, mephedrone, methamphetamine or GHB/GBL

(2) Mephedrone, methamphetamine or GHB/GBL

can have specific implications. Previous studies have shown elevated viral loads (Ellis et al., 2003) and a greater odd of progression to AIDS (Carrico et al., 2014) among stimulant using HIV-positive individuals. However, these studies do not focus solely on drug use occurring in sexual contexts and whether these associations remain true for those involved in SDU remains unknown.

To our knowledge, this is the first study that demonstrates the existence of a risk ladder for the different patterns of drug use. The lower steps are conformed by participants who report no SDU or only use cannabis and the highest one by those who are combining chemsex and party drugs. Chemsex has been associated with higher number of CAI or HIV-STI diagnoses, but this study provides evidence as to whether these associations are true only for those using chemsex-related drugs (GHB/GBL, crystal methamphetamine, mephedrone) or are also true for other SDU patterns. We found that all the sexual risk behaviors assessed as well as STI and the presence of HIV-positive individuals tended to rise when drugs were present. An exception to this can be made among participants who reported only using cannabis who showed a risk profile similar to participants who reported no SDU. Nevertheless, the sharpest increase was observed when there was presence of chemsex drugs. In fact, we found that the increase in the prevalence of sexual risk indicators and HIV and other STIs among those who only used sex performance drugs was modest. In this sense, sex-performance-enhancing drugs could be contributing to risk only when other drugs are also present as has been previously reported (Ostrow et al., 2009). The particularly high levels of risk observed among users of chemsex substances support that the concerns expressed by some editorials regarding the role that chemsex could be playing in HIV/STI and hepatitis C epidemics in the UK, could also hold true for other European countries (Kirby & Thornbern-Dunwell, 2013; McCall et al., 2015). Additionally, the fact that GHB was the most common chemsex drug has to be taken especially into account due to its associations with overdose-related deaths (Hockenhull et al., 2017). The most problematic group was the one comprised by individuals who reported the use of both party and chemsex drugs. This group presented higher number of both party drugs and chemsex drugs, than MSM who reported consuming chemsex or party drugs alone. Poly drug use has been associated with increased sexual risk behaviors in the past (Santos et al., 2013; Sewell et al., 2017), but we could not ascertain if use occurred simultaneously during the same episode or in different days. Some studies conducted in the US provide limited support for the efficacy of behavioral interventions designed to decrease condomless anal intercourse and substance use among MSM (Carrico, Zepf, Meanley, Batchelder, & Stall, 2016). However, these studies are referred to drug use in all contexts and focus mainly on methamphetamine. Further studies are needed in Europe to assess if behavioral interventions could also reduce sexual risk behaviors among those using drugs specifically in sexual contexts. Based on our data, interventions would be especially necessary among those using chemsex related substances alone or in combination with party drugs.

Our results are not without limitations. We did not assess sexual orientation in the questionnaire, and its influence on chemsex and SDU remains unknown. We could not assess other important aspects that need to be taken into account when considering the potential role of drug use in the acquisition and/or transmission of HIV. Viral load of people living with HIV, serosorting—selection of sexual partners according to HIV serostatus—and strategic positioning—selection of sexual role in anal intercourse between receptive (more risk) or insertive (less risk) according to HIV serostatus and viral load of sex partner—all need to be taken into account and were not assessed in the present study. HIV pre-exposure prophylaxis (PrEP) is another factor to be considered, but in 2016 the presence of PrEP in the countries assessed was expected to be minimal (ECDC, 2016). We also need to consider that certain drugs could be involved in unwanted interactions with highly active antiretroviral therapy and lower adherence levels (Antoniou & Tseng, 2002; Bracchi et al., 2015) both of which could affect HIV viral load and infectiousness. Nevertheless, undetectable HIV viral load (Mayer & de Vries, 2019), serosorting by HIV serostatus (Jin et al., 2012), and HIV PrEP (Kojima, Davey, & Klausner, 2016) are protective against HIV, but are not effective against hepatitis C and other STIs, which are caused by different viruses and bacteria. Some variables had a percentage of missing values of > 30%. All of them were situated at the end of the questionnaire, and we assumed that their situation in the questionnaire was the cause of increased missingness. To deal with it, we used MI techniques allowing us to work with a sample of 9407 individuals. To assess the validity of the results after MI, we replicated the analysis using complete case analysis (CCA) obtaining very similar results. When running CCA, the prevalences of overall SDU and chemsex were 18.1% (vs. 17.7%) and 6.1% (vs. 5.2%), respectively. In the multivariable models, the differences between CCA vs. main analysis were as follows: in the SDU model the categories "Romania" and "Slovenia" were significant in the CCA and not in our main analysis. In the chemsex model, after performing MI, "Sex of sex partners" was not independently associated anymore. In both models, the values of the ORs were consistently lower than in the CCA.

Conclusion

Although the prevalence of SDU and chemsex found in the present study tended to be lower than that reported in other countries, the increased rates of sexual risk behaviors and

higher rates of STI and HIV-positive individuals, especially among those who engaged in chemsex, suggest that drug use in sexual contexts could be playing a role in the HIV, STI and hepatitis C epidemics. Our results suggest that SDU is higher in certain countries and in MSM living in larger urban areas. The fact that MSM who engage in SDU and chemsex in particular were more open about their sex life suggests that they could be relatively well integrated in the gay community and identifies an intervention opportunity to reduce problematics related to drug use in sexual contexts in this population.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was approved by the Research Ethics Committee of the Institute of Health Carlos III CEI PI52_2015-v2).

Informed Consent Informed consent was obtained from all individual participants included in the study.

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