SUBSTANCE-LINKED SEX IN HETEROSEXUAL, HOMOSEXUAL AND BISEXUAL MEN AND WOMEN: AN ONLINE, CROSS-SECTIONAL 'GLOBAL DRUG SURVEY' REPORT

ABSTRACT

Introduction

Substance use in sexual contexts has received recent attention, but it has mostly been restricted to men who have sex with men (MSM) and the so-called 'chemsex' phenomenon.

Aim

To explore the use of licit and illicit substances in combination with sex in heterosexual, homosexual and bisexual men and women; to explore substance-linked sex (SLS) differences across sexual orientation and gender.

Methods

An international online self-selecting cross-sectional drugs survey: the Global Drug Survey (GDS) 2013 (n=22,289). Respondents were asked about: which drugs (including alcohol) they had had sex on; how frequently they used drugs to enhance sex; and how different drugs changed different aspects of the sexual experience. We report descriptive statistics and test differences between men and women and between different sexual orientations.

Main outcome variable

(1) Percentage of each group reporting last-year use of each drug with sex, (2) Mean subjective rating (-10 to +10) from each group for each drug on each aspect of the sexual experience.

Results

SLS occurred across sexual orientations and in both men and women. All groups reported that alcohol, cannabis and 3,4-methylenedioxymethamphetamine (MDMA) were the most commonly used drugs with sex. Larger proportions of homosexual and bisexual men had sex on most drugs than heterosexual men (ps<0.001); and larger proportions of bisexual women had sex on most drugs than heterosexual women (ps<0.004). At least 20% of each group

reported having used drugs with the intention of enhancing a sexual experience; larger proportions of homosexual and bisexual men reported this behaviour than heterosexual men ($ps<0.001$). There were clear dissociations between the effects of different drugs on different aspects of the sexual experience; although GHB/GBL and MDMA were rated consistently highly.

Clinical implications

Men and women of different sexual orientations must be considered when forming harm reduction and treatment strategies. However, 'chemsex' drugs were most commonly used by homosexual men; targeted messages to this group should continue.

Strengths and limitations

Our study is highly novel; no previous study has investigated the combination of sex with this range of drugs. However, our survey is self-selecting, and some groups have a small sample size.

Conclusions

All groups reported SLS to some degree. However, differences in SLS between genders and sexual orientations were found. Alcohol, cannabis and MDMA were most commonly used with sex. 'Chemsex' drugs were more commonly used by homosexual and bisexual men than heterosexual men.

INTRODUCTION

The use of licit and illicit psychoactive substances in sexual contexts has received increasing media, public health and academic research attention in recent years[1-5]. However, this has largely been restricted to men who have sex with men (MSM) and the so-called 'chemsex' phenomenon.

The term 'chemsex' generally refers to the intentional use of substances – specifically methamphetamine, mephredrone and γ-hydroxybutyric acid/γ-butyrolactone (GHB/GBL) – to sustain, enhance, disinhibit or facilitate the sexual experience[1, 2, 6-9]. However, 'chemsex' does not capture the full story of sex and substance use. Despite this combination being typically associated with MSM[4, 10], there is some evidence that sexualised drug use occurs across genders and sexual orientations[11-14]. We therefore use the term 'substance-linked sex' (SLS) to refer to the act of engaging in sexual activity while under the influence of one or more drugs applicable across the range of licit and illicit substances, and across genders and sexual orientations, in various scenarios. When use 'drugs' or 'substances', we always mean to include alcohol.

The extent to which SLS and chemsex occur in the United Kingdom (UK) and around the world is not well known. A recent scoping review concerning MSM in the UK found that prevalence estimates of sexualised drug use ('the use of illicit drugs just before or during sexual activity') ranged from 4% to 41%[10]. The authors concluded that much better data is needed to capture the true extent of chemsex and sexualised drug use in MSM across the whole of the UK. Furthermore, the prevalence of SLS is unknown in other groups, e.g. women who have sex with women[10].

Existing scholarship has demonstrated links between substance use and risky sexual practices. Use of both licit and illicit drugs (across genders and sexual orientations) have been associated with risky practices and harmful outcomes[15-19]. Associations between chemsex in MSM and risky sexual practices/harmful outcomes have received particular attention and concern, specifically in relation to the transmission of HIV and other blood borne viruses[1, 2, 7, 10, 20-22].

As a result of this focus on risks and harms, the ways that drugs and sex might combine to enhance pleasure or enable other desired functions has been left relatively underexplored. Harm-reduction orientated public health messages as opposed to zero-tolerance approaches are growing. Within harm reduction discourses, calls to acknowledge the role of pleasure are also

becoming more frequent[23, 24]. Where sex and drugs are concerned, the focus on harm reduction has generally been geared towards MSM[7, 25], and thus is not necessarily applicable to the needs of all individuals who engage in SLS, including Lesbian/Gay/Bisexual/Transgender/Queer (LGBTQ) women, and heterosexual men and women.

A limited number of past studies have investigated the ways that different drugs affect various aspects of sex. Alcohol has been shown to increase sexual desire for men[26] and women[27]. In a sample of mainly heterosexual men and women, 70% reported that cannabis increased sexual desire, and 80% reported enhanced sexual pleasure[28].

More recently, a European survey found respondents reported strategic use of substances with sex – 28.6% of respondents who used alcohol, for example, used it to facilitate sexual encounters, while 26.2% of those who used cocaine used it to prolong sex[11]. In a Liverpool-based survey, the drugs most commonly combined with sex were, in descending order: alcohol, cannabis and ecstasy[12]. Alcohol, amphetamines, cannabis, cocaine and ecstasy all subjectively improved the sexual experience[12]. Similarly, alcohol, cannabis and (particularly) ecstasy all increased sexual enjoyment in a New York nightlife survey[13]. However, three notable absences in the literature are: (1) the inclusion and comparison of people of different sexual orientations, (2) the inclusion of a wider variety of drugs, including GHB/GBL, methamphetamine and mephedrone and (3) a more thorough investigation of the subjective sexual changes following drug use.

In summary, most research into SLS has focused on harmful practices and outcomes within MSM. There is a distinct gap in the literature for a wide-ranging survey asking people of different genders and sexual orientations about the frequency and subjective consequences of the combination of sex with a range of licit and illicit drugs. Hence, in this exploratory study we sought to investigate: (1) the extent to which different substances are combined with sex; (2) the frequency of intentionally combining drugs and sex; and (3) the subjective effects of different drugs on a variety of aspects of the sexual experience.

METHODS

Design and participants

An anonymous, international, online, self-selecting, cross-sectional drugs survey - the Global Drug Survey (GDS) - was conducted in autumn 2012, as reported in other manuscripts[29, 30]. The link to this survey can be found at: http://www.globaldrugsurvey.com/archive/GDS2013. GDS conducts surveys in partnership with global media partners (e.g. Mixmag, The Guardian and Fairfax Media) and is promoted through social media. All respondents were aged 18 or over. Respondents gave informed consent at the start of the survey. Ethical approval was received from the South London and Maudsley and Institute of Psychiatry NHS Research Ethics Committee.

Assessments

Demographic data and detailed information on drug use were collected. We used 'currency' as a proxy measure for region of residence. We used 'use of drug X in the last 12 months' to indicate the extent of drug use in the sample and each group. Specific questions were asked about participants' sexual experiences and how their drug use was related to and affected their sexual experiences (described below).

First, participants reported their gender (male or female). If a participant didn't identify with either of these options or didn't want to say, they could leave this blank. Second, participants reported their sexual orientation (heterosexual, homosexual, bisexual or prefer not to say). We then split the respondents into six groups: heterosexual male, homosexual male, bisexual male, heterosexual female, homosexual female and bisexual female. We also split respondents simply into men and women, and these included people who did not state their sexual orientation. This means that the total numbers of men and women are very slightly larger than the sums of the heterosexual, homosexual and bisexual totals.

What drugs have respondents had sex on, over the last 12 months?

Respondents stated which of the following drugs they had most commonly had sex on over the last 12 months: alcohol, cocaine, cannabis, GHB/GBL, ketamine, 3,4-methylenedioxymethamphetamine (MDMA), mephedrone, methamphetamine, poppers (isopropyl nitrate) and Viagra. Respondents were allowed to select up to three drugs.

Frequency of intentionally combining drugs with sex

Respondents were asked "do you ever use drugs or alcohol with the specific intent of enhancing your sexual experience?" with possible options: never; less than half the time; approximately half the time; more than half the time; always.

How different drugs affect different aspects of sexual experience

For the three (or fewer) drugs that respondents stated they had most commonly had sex on over the last 12 months, respondents then rated these drugs on how they affected (from -10 'massive reduction' to +10 'massive increase') different aspects of the sexual experience:

1. Ability to achieve and maintain: an erection (if male) / moistness (if female)
2. Desire to have sexual intercourse
3. Time to orgasm
4. Ability to have multiple orgasms in a session
5. Quality/intensity of orgasm
6. Overall performance
7. Emotional/intimacy aspect of sex
8. Sensual aspect of sex
9. Confidence in trying new things
10. Feelings of shame associated with having sex

The number of respondents in each group who rated specific drugs varied greatly due to group sample sizes differences (e.g. heterosexual men – large; homosexual women – small) and prevalence of drug and sex combinations (e.g. alcohol – large; GHB/GBL – small). For these ratings, we do not report the data (in supplementary materials table S3) for a group if fewer than five respondents in that group rated a specific drug's effects (e.g. for homosexual women rating Viagra).

Overall increased enjoyment/capacity for sex of physical activity

In a separate part of the survey, which focused on different aspects of pleasure associated with different drugs, respondents were asked to rate (from 0 'not at all' to 10 'the most'), how various drugs 'Increased enjoyment/capacity for sex or physical activity'. The drugs included in this part of the survey were slightly different to those in the above sections, they were:

alcohol, amphetamine, cannabis, cocaine, GHB/GBL, ketamine, LSD, magic mushrooms, MDMA, mephedrone and tobacco.

Data presentation and analyses

In table 1, we show the total number and percentage of each group reporting sex on each drug in the last 12 months. We also report chi-square test results for the gender difference and sexual orientation difference (within men and women separately) in these proportions in table 1. In the supplementary materials, we report follow-up z-score tests to identify where specific differences lie. In the main text, we highlight key patterns in these results.

We also investigated whether age, income and region of residence were associated with the likelihood of combining each of the drugs with sex over the last 12 months. Region of residence was measured using currency as a proxy variable: UK - pounds, Eurozone - Euros, United States of America (US) – US dollars, Canada – Canadian dollars, Australia – Australian dollars. We set the UK as the reference category and compared each other region to the UK. We conducted logistic regressions for each drug, with age, income and region as predictors. Full results of the logistic regressions are reported in the supplementary materials in table S2 and the pattern of results is described in the main text.

In table 2, we show the total number and percentage of each group reporting how frequently they use drugs with the specific intent of enhancing sex. In the main text, we report chi-square results for the gender difference and sexual orientation difference (within men and women separately). We dichotomised the frequency options to 'never' and 'not never' to simplify the analysis. We report follow-up z-score tests to identify where specific differences lie in the main text.

In table S3 (in supplementary materials), we show the means, the standard deviations and the number of respondents contributing to the mean, for the ratings of how each drug affected each aspect of the sexual experience for each group. We conducted separate analyses of variance (ANOVAs) for each drug on each aspect of the sexual experience with between-subject factors of gender and sexual orientation. For the more commonly taken drugs, we report the interaction between gender and sexual orientation, and main effects. However, for drugs where one group did not have enough respondents (using $n<5$, e.g. homosexual women for Viagra), we did not conduct an ANOVA with an interaction term. We conducted separate ANOVAs to investigate the main effects of gender and sexual orientation. The F statistics and p values are also reported

in table S3. Follow-up Bonferroni-corrected t-tests were conducted when the F-test was significant, and results are reported in the supplementary materials (table S4).

Some notable gender and sexual orientation results are described in the main text; however, for the sake of space this is not done systematically, so we recommend that the reader looks at table S3 and table S4. We also highlight the drugs that provided the highest rating for each aspect of the sexual experience for males and females. If this rating comes from a drug with fewer than 50 respondents (which it sometimes does for women), we note this and state the drug with the closest rating. We did not include drug as a factor in our analyses because of the large difference in the number of respondents contributing to each drug, e.g. n~11,000 for alcohol and n~140 for mephedrone, and the fact that some participants contribute ratings to three drugs, while others contribute a rating to one drug – thus not permitting a between-subjects analysis. Therefore, our comparisons between drugs are purely qualitative and not supported by statistical evidence.

In figure 1, we present the mean ratings for "increased enjoyment or capacity for sex or physical activity" for each group separately. We then conducted ANOVAs for each drug on this rating with between-subjects factors of gender and sexual orientation. The number of participants contributing to each mean for each group are shown in table S5. Full results of these ANOVAs are shown in table S6. In the main text, we highlight key patterns in these results. We did not include drug as a factor in our analyses for the same reason as above.

GDS aims for as many respondents as possible from across the globe. Missing data were not imputed; we state the number of respondents contributing to each statistic in every table.

RESULTS

Whole sample demographics

A total of 22,289 responses were collected. The majority of respondents were men (n=14,050 men, 63.0%; 6,419 women, 28.8%; 1,820 prefer not to say, 8.2%). Of the men, 11,577 were heterosexual (82.4%), 1,225 were homosexual (8.7%), 942 were bisexual (6.7%) and 306 either preferred not to say or did not say (2.2%). Of the women, 4,970 were heterosexual (77.4%), 282 were homosexual (4.4%), 962 were bisexual (15.0%) and 205 either preferred not to say or did not say (3.19%).

One-third (n=7,360; 33.0%) of respondents were from the UK, 7,784 (34.9%) were from Australia, 3,756 (16.9%) were from the USA, 2,164 (9.7%) were from the Euro-Zone, and 618 (2.8%) were from Canada. The mean age was 31.4 years (SD=12.4)

General drug use (table S1 in supplementary materials)

In general, last year use of recreational drugs was relatively high. Ninety to 95% of each group reported drinking alcohol in the last year. Last year cannabis use ranged from 48.0% of heterosexual women to 77.2% of bisexual men. Last year MDMA use ranged from 25.2% of homosexual women to 41.4% of bisexual men.

What drugs have people had sex on, over the last 12 months? (table 1)

Across all groups, alcohol was the most commonly reported drug to have sex on (58.5% of men and 60.4% of women). Similarly, across all groups, cannabis was the second and MDMA the third most commonly reported drug combined with sex (37.0% of men and 26.3% of women; 15.5% of men and 15.5% of women, respectively).

The chi-square test results for differences between men and women and differences between sexual orientations within each gender can be found in table 1. A full set of follow-up z-tests to investigate significant chi-square results can be found in the supplementary materials. In summary, a greater proportion of women had sex on alcohol than men, and a greater proportion of men had sex on cannabis, poppers, Viagra, GHB/GBL, and methamphetamine. A greater proportion of homosexual men and bisexual men had sex on MDMA, poppers, Viagra, GHB/GBL, methamphetamine, and ketamine than heterosexual men. A greater proportion of homosexual men had sex on cocaine and mephedrone than heterosexual men. A greater

proportion of bisexual women had sex on alcohol, cannabis, cocaine, MDMA and ketamine than heterosexual women.

Several drugs were very rarely reported with sex in certain groups (<1%): GHB/GBL and poppers in heterosexual men; Viagra, poppers and GHB/GBL in homosexual women; and Viagra, poppers, GHB/GBL and methamphetamine in heterosexual women.

Age was negatively associated with the likelihood of combining the following drugs with sex: alcohol, cannabis, cocaine, GHB/GBL, ketamine, MDMA and mephedrone; for poppers and Viagra, age was positively associated with that likelihood. Income was positively associated with the likelihood of combining all drugs apart from cannabis with sex; contrastingly, income was negatively associated with the likelihood of combining sex with cannabis.

Being from the UK (compared to the Eurozone, the US, Canada and Australia) was positively associated with likelihood of combining alcohol, cocaine, ketamine, MDMA, mephedrone (very strongly), poppers and Viagra, with sex over, the last year. Contrastingly, being from the UK was negatively associated with combining cannabis with sex.

Do you ever use drugs with the specific intent of enhancing your sexual experience? (table 2)

A greater proportion of men (31.2%) reported using drugs with the specific intent of enhancing the sexual experience at least sometimes (i.e. not 'never') than women (22.9%) ($\chi^2_{(1, n=17299)}$=127.502, p<0.001).

Within men, there was a significant relationship between sexual orientation and the proportion of people who reported this behaviour ($\chi^2_{(2, n=11521)}$=143.245, p<0.001). A greater proportion of homosexual men (45.5%) reported this (i.e. not 'never') than heterosexual men (29.0%) (z=11.086, p<0.001). A greater proportion of bisexual men (38.7%) reported this than heterosexual men (z=5.661, p<0.001).

Within women, there was a significant relationship between sexual orientation and the proportion of people who reported this behaviour ($\chi^2_{(2, n=5414)}$=92.271, p<0.001). There was not a significant difference between homosexual (25.2%) and heterosexual (20.9%) women reporting this (i.e. not 'never') (z=1.809, p=0.070). A greater proportion of bisexual (35.2%) women reported this than heterosexual women (z=9.583, p<0.001).

How different drugs affect different aspects of sexual experience (table S3 and table S4 in supplementary materials)

Erection (males) and moistness (females)

In men, Viagra had the highest average score (8.21). In women, GHB/GBL had the highest average score (5.30). However, only 30 women made this rating. Considering ratings made by 50 women or more, MDMA had the highest average score (2.82).

Heterosexual men rated alcohol higher for erection than bisexual men ($p=0.016$). Bisexual women rated alcohol higher moistness than heterosexual ($p=0.007$) and homosexual ($p=0.026$) women. Overall, women rated alcohol higher than men ($p<0.001$) and heterosexual respondents rated it higher than homosexual respondents ($p=0.034$).

Sexual desire

In men, GHB/GBL had the highest average score (8.15). In women, GHB/GBL had the highest average score (7.89). However, only 28 women made this rating. Considering ratings made by 50 women or more, MDMA had the highest average score (5.79).

Bisexual women ($p<0.001$) and heterosexual women ($p<0.001$) rated alcohol higher for sexual desire than homosexual women. Heterosexual men rated alcohol higher than homosexual men ($p<0.001$). Overall, women rated alcohol higher than men ($p=0.024$). Overall, bisexual ($p<0.001$) and heterosexual respondents ($p<0.001$) rated alcohol higher than homosexual respondents.

Time to orgasm

In men, methamphetamine had the highest average score – referring to a longer time to orgasm (3.82). In women, cannabis had the highest average score (1.50).

Overall, men rated MDMA higher than women for time to orgasm ($p<0.001$). And, overall, heterosexual respondents rated MDMA higher than homosexual respondents ($p=0.013$).

Multiple orgasms

In men, Viagra had the highest average score (3.47). In women, GHB/GBL had the highest average score (2.88). However, only 26 women made this rating. Considering ratings made by 50 women or more, methamphetamine had the highest average score (1.98).

Overall, women rated cannabis higher for multiple orgasms than men (p=0.003). And, overall, bisexual respondents rated cannabis higher than heterosexual respondents (p=0.005).

Intensity of orgasm

In men, methamphetamine had the highest average score (6.55). In women, GHB/GBL had the highest average score (4.56). However, only 27 women made this rating. Considering ratings made by 50 women or more, methamphetamine had the highest average score (4.45).

Overall, men rated MDMA higher for intensity of orgasm than women (p<0.001) and, overall, bisexual respondents rated MDMA higher than heterosexual respondents (p=0.001).

Overall performance

In men, Viagra had the highest average score (6.87). In women, GHB/GBL had the highest average score (6.22). However, only 27 women made this rating. Considering ratings made by 50 women or more, methamphetamine had the highest average score (5.41).

Within women, both bisexual (p=<0.001) and heterosexual (p=<0.001) women rated alcohol higher for overall performance than their homosexual counterparts. Within men, alcohol was rated higher by heterosexual respondents than both bisexual (p=<0.001) and homosexual (p=0.012) respondents. Overall, women rated alcohol higher than men (p=<0.001). And, overall, heterosexual respondents rated alcohol higher than both homosexual (p=<0.001) and bisexual (p=0.009) respondents.

Emotionality/intimacy

In men, MDMA had the highest average score (5.93). In women, MDMA had the highest average score (5.40).

Overall, women rated ketamine higher for emotionality/intimacy than men (p=0.015). Within men, homosexual respondents rated ketamine higher than heterosexual respondents (p=0.016).

Sensual aspects

In men, MDMA had the highest average score (6.16). In women, MDMA had the highest average score (5.86).

Within men, homosexual respondents rated cocaine higher for sensual aspects of the sexual experience than heterosexual respondents (p=0.011). Overall, men rated cocaine higher than women (p=0.027).

Confidence in trying new things

In men, methamphetamine had the highest average score (mean=7.12). In women, GHB/GBL had the highest average score (7.22). However, only 27 women made this rating. Considering ratings made by 50 women or more, methamphetamine had the highest average score (6.35).

Within women, alcohol was rated higher for confidence in trying new things by bisexual respondents than heterosexual (p=0.042) and homosexual (p=0.001) respondents. Heterosexual women rated alcohol higher than homosexual women (p=0.019). Overall, women rated alcohol higher than men (p=<0.001). And, overall, bisexual respondents rated alcohol higher than homosexual respondents (p=0.001), and heterosexual respondents rated it higher than homosexual ones (p=0.002).

Feelings of shame

In men, mephedrone had the lowest average score – referring to greatest reduction in shame (-2.66) and alcohol the highest average score (-0.83). In women, GHB/GBL had the lowest average score – referring to greatest reduction in shame (-3.19). However, only 27 women made this rating. Considering ratings made by 50 women or more, MDMA had the lowest average score (-1.84) and alcohol had the highest average score (-0.39).

Overall, women rated alcohol higher for feelings of shame than men (p=0.007).

How different drugs affect enjoyment/capacity for sex or physical activity (figure 1, tables S5 and S6 in supplementary materials)

In terms of the overall rating for how each drug 'affects enjoyment or capacity for sex or physical activity', GHB/GBL was rated the highest by both men (mean=7.21, SD=3.17, median=8) and women (mean=6.89, SD=3.40, median=8), collapsed across sexual orientation. However, GHB/GBL was not taken by many respondents, and so few rated its overall effect

on sex and physical activity (n=333 for men; n=75 for women). MDMA was rated by many more people, and was rated second highest by both men (mean=6.72, SD=3.06, median=8, n=5,394) and women (mean=6.72, SD=3.14, median=8, n=1,937). For both men and women, alcohol, ketamine and tobacco were rated 9th, 10th and 11th respectively in terms of their abilities to affect enjoyment or capacity for sex or physical activity.

For full details on gender by sexual orientation interactions and main effects of gender and sexual orientation, and follow-up tests, see the table S6 in supplementary materials. In summary, men rated cannabis higher than women; bisexual respondents rated MDMA and cannabis higher than homosexual respondents; and bisexual and homosexual respondents rated ketamine higher than heterosexual respondents.

DISCUSSION

To the authors' knowledge, this is the largest study to date on the combination of drugs (licit and illicit) and sex, with many thousands of respondents answering relevant questions. Furthermore, it is the first study to investigate the effects of drugs on the sexual experience across both gender and sexual orientation. Within our international, self-selecting sample of people who use drugs, SLS was not uncommon. In the past year, over half of our sample had had sex under the influence of alcohol, around a third had had sex on cannabis, and just under one sixth on MDMA. On the whole, being younger, having a higher income and being from the UK were positively associated with the likelihood of combining drugs (including alcohol) with sex. In general, larger proportions of men had sex on drug than women; larger proportions of homosexual and bisexual men had sex on drugs than heterosexual men; and larger proportions of bisexual women had sex on drugs than heterosexual women. At least 20% of each group reported having used drugs with the intention of enhancing a sexual experience. A larger proportion of men reported this behaviour than women, a larger proportion of homosexual and bisexual men reported this behaviour than heterosexual men, and a larger proportion of bisexual women reported this behaviour than heterosexual women. In general, drugs tended to subjectively improve the sexual experience for all groups. In an overall item, GHB/GBL and MDMA were the top two drugs as rated by both men and women. However, there were clear dissociations between the reported effects of different drugs on different aspects of the sexual experience. People of different genders and sexual orientations often rated drugs' sexual effects similarly, although there were some notable differences.

In line with previous research[12], alcohol, cannabis and MDMA were the most common drugs to be taken in combination with sex. The fourth most common for all groups, with the exception of homosexual men, was cocaine. For homosexual men, the fourth most common drug to have sex on was poppers. Alcohol, cannabis, MDMA and cocaine have frequently been found as among the most prevalently used drugs in the UK[31], much of Europe[32], USA[33] and Australia[34], so their corresponding level of use in combination with sex over other substances is unsurprising. More specifically, in our current sample, last year drug use was most common for alcohol, cannabis, MDMA and cocaine. Thus, the pattern of SLS drug use prevalence tended to follow the pattern of general drug use prevalence. However, it must be noted that we did not conduct statistical tests to support differences between proportions of people using each drug.

There were some differences between these patterns though, which cast light on drugs that may be used particularly because of their relationship with sex. For men, Viagra was higher in the rankings of SLS drug use prevalence (5th) than general drug use prevalence (7th), which is unsurprising given it is marketed to produce and sustain erections[35, 36]. In homosexual men, methamphetamine was one place higher in the rankings of SLS drug use compared to general drug use, in line with methaphetamine's position as a chemsex drug in the MSM community[2]. Overall in women, mephedrone was ranked higher in SLS drug use (6th) than in general drug use (8th).

A significantly larger proportion of homosexual and bisexual men reported MDMA, GHB/GBL, methamphetamine, mephedrone, poppers, ketamine and Viagra use in combination with sex, in comparison to heterosexual men. Our results support and extend previous chemsex studies that highlight the use of these drugs in MSM[2, 7]. However, homosexual men did not report greater SLS with all drugs relative to other groups – heterosexual men reported use of cannabis in combination with sex more than homosexual men. Overall, women had a lower prevalence of SLS drug use than men for cannabis, poppers, Viagra, GHB/GBL and methamphetamine.

Younger people were more likely to combine all drugs with sex, apart from methamphetamine, Viagra and poppers – and for the latter two, older people were more likely combine these drugs with sex. Younger people around the world often report higher likelihoods of using drugs in general[37]; our results extend this to SLS and support messages that target younger people. Interestingly, greater income was associated with combining all drugs with sex, apart from cannabis, which showed the opposite relationship. More respondents from the UK combined drugs with sex than from other regions, apart from cannabis. This effect was particularly striking with mephedrone, which gained popularity in the UK in the late 2000s[38]. The UK may have to engage with the topic of SLS more so than other countries.

Strikingly, at least 20% of each group reported having used drugs with the intention of enhancing a sexual experience (endorsing any answer other than 'never'). Homosexual men reported the highest level (45%) and heterosexual women reported the lowest level (20%). Overall, a significantly greater proportion of men reported this behaviour than women. Within men, a significantly greater proportion of homosexual and bisexual men reported this behaviour than heterosexual men. These results again support previous research that MSM are the highest-risk group for intentional use of drugs for sex[2]. However, within women, there was no

significant difference between homosexual and heterosexual women, but a larger proportion of bisexual women reported this behaviour than heterosexual women. This suggests a diverging relationship between sexual orientation and gender on intentional SLS. Chemsex research within MSM may benefit from making finer grained distinctions in sexual orientations, as a means of tailoring harm reduction messages/practices to specific groups.

Considering our overall item of 'increased enjoyment/capacity for sex or physical activity', GHB/GBL was rated as best by both men and women, with means of around seven and medians of eight (out of ten). This corroborates previous research that found GHB/GBL to be enjoyed sexually by MSM[2, 20], and also extends this finding to heterosexual men and women of different sexual orientations. In terms of specific sexual effects, GHB/GBL appeared to receive high ratings across the board. However, GHB/GBL was rated by relatively few respondents (333 male and 75 female respondents) and very few female bisexual (n=5) and homosexual (n=27) respondents, which limits this finding.

MDMA was rated second best on this overall item, and by many more respondents. This finding corroborates previous research (which did not include GHB/GBL) showing MDMA has particularly positive effects on the sexual experience[12, 13]. Specifically, MDMA has been shown to enhance the quality of orgasm[12, 13], sex organ sensitivity[13], and connection and sensuality[39], which our results support. However, it must be noted again that these between drug comparisons discussed in the last three paragraphs were not supported by statistical evidence, only by the qualitative patterns in the ratings of drugs.

Some significant differences in ratings of how each drug affects each aspect of the sexual experience between men and women, and between heterosexual, homosexual and bisexual respondents, were noted. There were often interactions between gender and sexual orientation for alcohol. For instance, for sensual aspects, bisexual women rated alcohol higher than homosexual women, but homosexual men rated alcohol higher than bisexual men. These interactions demonstrate the importance of considering gender and sexual orientation together when researching the combination of drugs with sex; the relationship between orientation and sexual effects of drugs is moderated by gender.

There were a variety of overall gender effects. For instance, for intensity of orgasm, men rated cocaine, cannabis, MDMA, mephedrone, methamphetamine and poppers higher than women, which suggests that men's intensity of orgasm is more easily affected by drug use than

women's intensity of orgasm. By contrast, women rated ketamine higher for emotionality/intimacy, confidence in trying new things and erection/moistness. Indeed, erection/moistness was more positively affected for women than men for alcohol, MDMA, mephedrone and methamphetamine, perhaps due in part to the general impact of intoxication on erection in men[40]. The different biology and psychology underpinning arousal and sexual function in men and women would also likely contribute to these differences[41-43]. Overall, bisexual respondents rated MDMA and/or cannabis more highly than heterosexual respondents on: confidence in trying new things, sensual aspects, intensity of orgasm, multiple orgasms and sexual desire. This could be related to bisexual respondents being more experienced with MDMA and cannabis than homosexual respondents (see table 1 and S1). On the other hand, alcohol was often rated more highly by heterosexual respondents than homosexual respondents.

With regard to the role of pleasure in harm reduction strategies for substance use, this research found chemsex drugs to be rated highly by respondents for various aspects of the sexual experience, particularly: sexual desire, intensity of orgasm and confidence in trying new things. Recent research has identified potential positive outcomes of engaging in chemsex, where the social contexts in which chemsex drugs are used may provide wellbeing benefits, especially for HIV positive men who are likely to experience stigma in other settings[44]. Our results contribute to a better understanding of how drugs and sex combine to alter pleasure. Thus, chemsex-related harm reduction strategies are likely to benefit from consideration of both the functions associated with chemsex - e.g. pleasure and other wellbeing benefits - as well as the potential harms. This would hopefully generate messages that are not patently at odds with individuals' experiences, understanding and behaviour[23, 24].

Strengths and limitations

This is the first large-scale study to investigate the frequency and subjective ratings of SLS across different substances in different genders and sexual orientations. One strength of the GDS methodology is to capture people who use a wide range of drugs, as opposed to commonly used drugs like alcohol, cannabis and MDMA. Another strength is respondents' willingness to answer questions on personal, sexual topics. The GDS is well-suited for investigating cross-drug, cross-group questions because of the large sample sizes and the extensive experience of drug use in some respondents.

However, the GDS has well-documented general limitations[38, 45, 46] that apply to the current study. First and foremost, it uses a self-selecting sample – GDS results do not represent true global prevalence, or prevalences of individual countries (see supplementary materials). Furthermore, despite being 'global', the GDS 2013 respondents were mainly from Western countries, thus missing populous areas of the world, e.g. China and India. There are also study-specific limitations. The number of people rating alcohol's effects were always impressive (>3,000 for men and women; >100 for all groups). However, the number of people rating less common drugs tended to be low. This was a more serious drawback for women; GHB/GBL, mephedrone, poppers and Viagra all had fewer than 50 women rating their effects.

Furthermore, our *overall* item: how do drugs 'affect enjoyment/capacity for sex or physical activity?' conflates sex with physical activity, so we cannot know whether one drug was rated more highly than another because of effects on sex or physical activity. Given the large number of variables involved, our results should be considered exploratory. We did not conduct statistical tests to differentiate drugs. Accordingly, these results must be interpreted as qualitative, not confirmed quantitative differences. However, we can now form hypotheses based on these results for more focused future work. Finally, the formation of gender and sexual identity groups could have been improved. There was not a 'trans' or 'non-binary' option for gender; and no 'queer' or non-hetero/homo/bisexual option for sexual identity.

CONCLUSIONS

Our study is the largest to investigate SLS and specific sexual effects of different drugs in homosexual, heterosexual and bisexual men and women. Above all, our findings show that SLS is not limited to homosexual men in the context of chemsex. In general, drugs were rated to subjectively improve the sexual experience by all groups, with GHB/GBL, methamphetamine and MDMA rated particularly highly. There were clear dissociations between the reported effects of different drugs on different aspects of the sexual experience, and some differences between genders and sexual orientations on these effects.

Our results have implications for harm reduction. That the most popular SLS drugs (alcohol, cannabis, MDMA and cocaine) were consistent across groups provides a useful direction for the focus of harm reduction attention. However, we confirmed that chemsex drugs (and non-chemsex drugs) were more popular during SLS within homosexual and bisexual men than heterosexual men. Future research should improve categorisation of gender and sexual orientation, improve sample sizes for less well-represented groups, and examine relationships between pleasurable effects, intentional SLS and harmful outcomes. Developing an understanding of how risk can be reduced while maintaining the drug-related pleasures people seek could further improve harm reduction. Our study represents a step forward in this important understanding of drug-related sexual pleasure.

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