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Typology of new psychoactive substance use among the general Australian population
'Running title': Typology of new psychoactive substance use

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ABSTRACT

Aim: The aim of this study was to examine the typology of Australian illicit drug consumers to determine whether those who use new psychoactive substances (NPS) differ from those using other illicit substances.

Methods: Data were from the 2013 National Drug Strategy Household Survey, a representative population study; analyses were limited to participants reporting past year illicit drug use (including NPS; n=3,309). Latent class analysis identified groups based on past year substance use, and a weighted multivariable, multinomial regression model was used to examine characteristics associated with group membership.

Results: Six consumer typologies were identified: *cannabis consumers* (46%), *pharmaceutical consumers* (21%), *ecstasy and cocaine consumers* (19%), *amphetamine and cannabis consumers* (7%), *polysubstance consumers* (6%), and *inhalant consumers* (2%). Sixteen participants (total sample: 0.07%; NPS consumers: 5.7%) reported exclusive NPS use. Synthetic cannabinoid receptor agonist use was highest among *amphetamine and cannabis consumers* and *polysubstance consumers*; other NPS use was highest among *polysubstance consumers*. *Polysubstance consumers* were younger than all other groups, and more likely to engage in dangerous activities while under the influence of substances, inject drugs and report hazardous alcohol consumption. *Amphetamine and cannabis consumers* were more likely to report trouble ceasing their drug use.

Conclusion: We found no distinct profile of NPS-only consumers; however, NPS use was a marker for more problematic patterns of use. Our findings suggest that specialised NPS interventions or harm reduction messages may not be required in the Australian context; rather, they could be based upon existing responses to drug use.

Keywords: New psychoactive substances; NPS; synthetic cannabinoids; typology; latent class analysis

1. Introduction

Over the past decade, the number and range of substances collectively referred to as 'new psychoactive substances' (NPS) has increased dramatically. NPS are defined by the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) as substances which do not fall under international drug controls but which may pose a public health threat (European Monitoring Centre for Drugs and Drug Addiction, 2016b). However, there are a number of problems with this definition (e.g. mere psychoactivity is assumed to be a public health threat; Barratt et al., 2017), and in practicality the term 'NPS' has come to include drugs which have previously not been well-established in recreational drug markets, or which are not well documented. In 2016 over 600 NPS were being monitored by the European Union (European Monitoring Centre for Drugs and Drug Addiction, 2016a), of which 70% were detected in the past five years (European Monitoring Centre for Drugs and Drug Addiction, 2016b).

Despite the rapid growth of the NPS market, and associated concerns of widespread use, prevalence appears to be relatively low amongst adult general population samples (i.e. ⩽1.2%; Home Office, 2017, Australian Institute of Health & Welfare, 2017, Palamar et al., 2015). The use of these substances is thought to be concentrated amongst existing illicit drug consumers (Moore et al., 2013, Sutherland et al., 2016), and other disadvantaged groups (e.g. homeless, prisoners, mentally ill, people who inject drugs; European Monitoring Centre for Drugs and Drug Addiction, 2017b, Joseph et al., 2017, Manseau et al., 2017, Rácz et al., 2016, Tarján et al., 2017). Concerns remain, however, that 'novice' consumers may initiate NPS use, particularly given use of the internet as a means of supply. Indeed, the argument that NPS appeal to novice consumers has been used to advocate for their prohibition, regardless of their harm profile, on the premise of preventing normalisation of NPS use and transition into other illicit drug use (Intergovernmental Committee on Drugs, 2014).

Our ability to address such concerns is limited by the fact that the comparability of NPS consumers with other illicit drug consumers has not been properly explored. Subsequently, it remains unclear whether there is a distinct group of exclusive NPS consumers (i.e. people who use NPS but no other illicit substances), or whether there are particular groups of illicit drug consumers that report elevated rates of NPS use. In order to examine these questions, data from samples where inclusion is not based on illicit substance use, and where people may be consuming a broad range of substances, are required. General population data provide an important opportunity to answer this research question, with latent class analysis (LCA) a particularly suitable method for investigating whether distinct subtypes or classes of NPS consumers exist.

In identifying NPS consumers, it is critical to explore their relative demographic and risk profile. Previous studies have shown that people who report NPS use are typically younger, more likely to be male, report higher levels of poly drug use, younger age of drug initiation, more problematic drug use (e.g. bingeing), and are more likely to report online purchasing behaviours relative to illicit drug consumers who do not use NPS (Bonar et al., 2014, Bruno et al., 2012, Lawn et al., 2014, Palamar, 2015, Palamar and Acosta, 2015, Emmanuel and Attarad, 2006). However, these studies are generally based on samples of people who use illicit drugs, limiting their capacity to identify unique NPS groups (including people using NPS but no other illicit substances).

As such, this study uses data from a general population sample to:

1) Examine the typology of Australian illicit drug consumers to determine if there is a distinct group of exclusive NPS consumers, and if not, determine which consumer 'type' is most likely to use NPS.
2) Compare profiles across these subgroups, based on demographics and risk behaviours.

This information will improve our understanding of the profiles of NPS users, allowing for the development of more targeted harm reduction messages.

2. Method

2.1 Study design and participants

This paper uses data from the 2013 National Drug Strategy Household Survey (NDSHS; for full protocol details, see Australian Institute of Health & Welfare, 2014). The NDSHS, conducted on a triennial basis, collects data from the Australian residential population, and employs a multistage stratified sampling methodology designed to provide a close-to-random sample to obtain data on drug and alcohol use in the Australian population over 14 years of age. In 2013, 23,855 respondents participated in the survey, with analyses based on a subset of participants who reported past year use of a range of licit drugs used for non-medical purposes (e.g. opioid analgesics) and/or illicit drugs, including NPS (n=3,309; 13.9%).

2.2 Measures relevant to the current study

2.2.1 Licit and illicit drug use

Participants were asked about their lifetime and past twelve-month use of a range of licit and illicit substances, including tobacco, alcohol, pharmaceutical drugs used for non-medical purposes (i.e. pain killers/analgesics, tranquilisers/sleeping pills, steroids, methadone or buprenorphine, other opiates/opioids), methamphetamine, cannabis, heroin, cocaine, hallucinogens, ecstasy, ketamine, GHB and inhalants. The 2013 NDSHS was the first in the survey series to include questions about NPS. Specifically, participants were asked about their lifetime and past 12 month use of "synthetic cannabis/cannabinoids (e.g. K2, Spice, Kronic)" and "novel psychoactive substances (e.g. mephedrone, methylone, BZP, 2C-B, DMT, MDAI, MDPV)". Hence, for the purposes of this paper NPS will be split

into two categories: synthetic cannabinoids (hereafter referred to as synthetic cannabinoid receptor agonists; SCRA) and other NPS.

2.2.2 Demographics and mental health

The 2013 NDSHS survey collected a range of demographic information, including age, gender, income (AUD), employment and educational status. Relative socio-economic advantage and disadvantage was measured using the Socio-Economic Indexes for Areas (SEIFA), developed by the Australian Bureau of Statistics (Australian Bureau of Statistics, 2013). From this index, areas can be divided into quintiles, with the lowest quintile representing the most disadvantaged areas and the highest quintile representing the most advantaged. This SEIFA quintile variable was included in analyses as an area-level indicator of socio-economic status (SES), with the bottom two quintiles combined to signify the most disadvantaged quintiles.

Participants were also administered the Kessler 10 (K10) Psychological Distress Scale to assess psychological distress (Kessler et al., 2003). The K10 is a 10-item screening tool utilizing a five-point response scale (1 'none of the time' to 5 'all of the time'); a cut-off score of ≥22 (score range 10-50) was used to measure high to very high psychological distress (Andrews and Slade, 2001).

2.2.3 Alcohol and drug-related risk behaviours

The 2013 NDSHS asked participants how many days of work, school, TAFE or university they had missed because of their alcohol use, and how many days they had missed because of their use of drugs other than alcohol, in the past three months. Responses to this variable were recoded into a binary variable with yes/no response options (i.e. did the participant miss any days of work, school, TAFE or university because of their alcohol and/or drug use).

They were also asked if, in the last 12 months, they had done any of the following activities while under the influence of or affected by alcohol or illicit drugs: went to work; went swimming; operated

a boat; drove a motor vehicle; operated hazardous machinery; created a public disturbance or nuisance; cause damage to property; stole money, goods or property; verbally abused someone; or physically abused someone.

Participants who had used non-medicinal pain killers/analgesics, tranquilisers/sleeping pills, methamphetamine, cannabis, heroin, tobacco, steroids, buprenorphine, cocaine, hallucinogens, ecstasy or inhalants were asked if, in the past 12 months, they could not stop or cut down on their use of these substances even though they wanted to or tried to. Participants who had not used these substances were coded as 'no'.

The Alcohol Use Disorders Identification Test Consumption questions (AUDIT-C) was administered as a validated screening measure of hazardous patterns of alcohol consumption (Bradley et al., 2007, Bush et al., 1998). This 3-item scale assesses quantity and frequency of use, with higher scores (range 0-12) indicating more hazardous use. Participants were categorised based on a cut-off indicative of high risk drinking (scores of 9 and above; Harris et al., 2010). Participants who had not consumed alcohol in the past year were given a score of '0'.

Participants were also asked if they had injected any drugs (where injection was the non-intended route of administration for pharmaceutical medicines) in the last 12 months.

2.3 Statistical analysis

To address the first aim, latent class models (one to eight classes) were estimated using past year drug and alcohol use. Specifically, the models were based on past 12 month use of the following drugs: cannabis, ecstasy, meth/amphetamine, cocaine, hallucinogens, inhalants, SCRA, other NPS, pharmaceutical drugs used for non-medical purposes (i.e. pain killers/analgesics, tranquilisers/sleeping pills, steroids, methadone or buprenorphine, other opiates/opioids combined), ketamine, GHB, tobacco (daily) and alcohol (weekly). The fit of each model was compared using MPlus

version 7 (Muthén and Muthén, 2010). Following protocols adopted in past published latent class analyses (LCA) (Ramo et al., 2010), three criteria were used to assess model fit. The first criterion, the Lo-Mendell-Rubin adjusted log-likelihood ratio test (LMR-ALRT) statistic (Lo et al., 2001) was used to compare fit of a *k* class model with a *k*-1 class model, with a low *p* value (<.050) indicating that the latter should be rejected in favour of the model with one additional class. The second and third criteria adopted were the Akaike's Information Criterion (AIC) and the Bayesian Information Criterion (sample-size adjusted; ssaBIC); these models balance likelihood and model fit, with lower values indicating better model fit. The third criterion, the entropy value, was an index of classification accuracy of the given classes, with higher values (range 0.0-1.0) indicating better differentiation of individuals into classes.

To address the second aim, correlates of latent class membership were analysed using bivariate and multivariable multinomial logistic regression conducted in SAS Version 9.4: correlates found to be significant ($p<.05$) in the bivariate models were entered into the final multivariable model. Descriptive statistics comprised percentages for categorical data, means for normally distributed continuous variables, and medians for continuous data with significant positive skew and/or kurtosis.

Given this is a general population sample, both the LCA and regression analyses were conducted taking into account the effects of complex sampling methods. Data were weighted to correct for differential response rates and to account for over-sampling in some of the smaller jurisdictions. Strata and cluster variables were used in the analyses to account for the multilevel stratification of recruitment of the sample. For further information regarding these procedures please refer to the 2013 NDSHS technical report (Roy Morgan Research, 2014).

3. Results

3.1 Sample characteristics

Among the entire sample (n=23,855), the most commonly used illicit substance was cannabis (10.2%), followed by ecstasy (2.5%), methamphetamine (2.1%), cocaine (2.1%), hallucinogens (1.3%), SCRA (1.2%), inhalants (0.8%), NPS (excluding SCRA; 0.4%), ketamine (0.3%), heroin (0.1%) and GHB (<0.1%). Non-medicinal pharmaceutical drug use in the preceding year was reported by 4.7% of the sample, with past-year alcohol use reported by the majority (78.3%) of the sample. Very few participants (0.07% of entire sample; 5.7% of NPS consumers) reported use of SCRA and/or NPS but no other illicit substances.

Among those who reported past year use of any illicit substance (n=3,309), the sample was predominantly male (59%), with a mean age of 36 years. Participants were relatively well-educated: two-thirds (67%) had completed a trade certificate or other educational qualification, although most (63%) reported a gross (i.e. before tax) annual income of <52,000 AUD. Almost one-in-five participants (18%) reported high levels of psychological distress, almost half (47%) had engaged in some form of 'hazardous' behaviour (e.g. driving a vehicle, destroying property) while under the influence of alcohol and/or drugs, and one-third (34%) reported that they had experienced difficulties ceasing their drug use in the past year.

3.2 Model selection

Examination of model fit statistics showed that AIC and ssaBIC was lowest for the 8-class model, whilst entropy was highest for the 2-class model (Table 3). Notably, the LMR-ALRT showed that the 6-class solution provided a significant improvement in fit over the 5-class model, but the 7-class solution did not provide a significant improvement over the 6-class model, nor did the 8-class provide any significant improvement over the 7-class model. Examination of class composition alongside fit statistics further supported selection of the 6-class model: each class was substantive and clearly distinct in their patterns of drug use.

3.3 Latent Class Probabilities and Class Definitions

Response probabilities for each class are shown in Figure 1 (presented across two figures to facilitate ease of interpretation). Classes are described as follows: *cannabis consumers* (46%) - comprising people who had a high probability of past year cannabis use (1.0) and a low probability of any other illicit drug use; *pharmaceutical consumers* (21%) - comprising people who had a high probability of non-medicinal pharmaceutical drug use (1.0) and a low probability of any other illicit drug use; *ecstasy and cocaine consumers* (19%) – comprising people who had a high probability of cocaine (0.50) and ecstasy (0.48) use, as well as cannabis (0.64) and weekly alcohol (0.73) use; and *inhalant consumers* (2%) – comprising people who had a high probability of inhalant use (1.0) and a low probability of any other illicit drug use.

Two additional groups of note include: *amphetamine and cannabis consumers* (7%) and *polysubstance consumers* (6%). The former had a high probability of past year amphetamine (0.58) and cannabis (0.82) use and daily tobacco (0.79) use, and the highest probability of SCRA use (0.35). The latter comprised people who had a high probability of past year use of multiple drugs. This group had the highest probability of past year ecstasy (0.997), amphetamine (0.71), cocaine (0.61), hallucinogen (0.66), GHB and ketamine (0.26), and weekly alcohol use (0.79). This group also had the highest probability of other NPS use (0.31), and the second highest probability of SCRA use (0.31).

3.4 Correlates of subgroup membership

To determine if the consumer groups with the highest rates of NPS use differed from other illicit drug consumers, the bivariate and multinominal regression models were run with both *amphetamine and cannabis consumers* and *polysubstance consumers* as the referent categories (these two groups had the highest probability of SCRA and other NPS use). In both situations, all variables were found to be significant in the bivariate analyses (see Table 4) and were therefore included in the final multivariable multinomial regression models (see Table 2). Descriptive statistics for each group are outlined in Table 1.

3.5 Multivariable Multinomial Regression Models

3.5.1 Amphetamine and cannabis consumers as the referent group

3.5.1.1 Demographics

Pharmaceutical consumers, inhalant consumers and *cannabis consumers* were significantly older than *amphetamine and cannabis consumers,* whilst *polysubstance consumers* were significantly younger. *Pharmaceutical consumers* had significantly lower odds of being unemployed and *ecstasy and cocaine consumers* had significantly lower odds of earning a gross annual income of <$52,000, compared to the *amphetamine and cannabis consumer* group*.* All groups (except *inhalant consumers*) had significantly lower odds of residing in low SES areas, and *inhalant consumers* had significantly lower odds of reporting high levels of psychological distress, than *amphetamine and cannabis consumers.*

3.5.1.2 Risk behaviours

Pharmaceutical consumers, inhalant consumers and *cannabis consumers* had significantly lower odds of having engaged in dangerous activities while under the influence of drugs and/or alcohol in the past year, compared to *amphetamine and cannabis consumers.* Conversely, *polysubstance consumers* had significantly higher odds of having engaged in such activities. All groups had significantly lower odds of having had trouble ceasing their drug use in the past year compared to *amphetamine and cannabis consumers. Inhalant consumers* and *cannabis consumers* also had significantly lower odds of having injected any drug in the past year.

3.5.2 Polysubstance consumers as the referent group

3.5.2.1 Demographics and mental health

All groups were significantly older than *polysubstance consumers,* with *pharmaceutical consumers* also less likely to be male. *Inhalant consumers* and *cannabis consumers* had significantly lower odds

of having completed a tertiary qualification, and *cannabis consumers* had significantly higher odds of having a gross annual income of <$52,000, compared to *polysubstance consumers*. *Amphetamine and cannabis consumers* had significantly higher odds of residing in low SES areas.

3.5.2.2 Alcohol and drug-related risk behaviours

Cannabis consumers had significantly lower odds of scoring ≥9 on the AUDIT-C, compared to *polysubstance consumers*. All groups had significantly lower odds of having engaged in dangerous activities while under the influence of drugs and/or alcohol in the past year, with *cannabis consumers* also having lower odds of having missed work or school due to their alcohol and drug use. As noted above, *amphetamine and cannabis consumers* had significantly higher odds of having had trouble ceasing their drug use in the past year, while *pharmaceutical consumers* had lower odds of trouble ceasing drug use. Both *inhalant consumers* and *cannabis consumers* had significantly lower odds of having injected any drug in the past year, compared *to polysubstance consumers*.

4. Discussion

We found that there was no distinct profile of exclusive SCRA or other NPS consumers, with very few participants (n=16; 5.7% of NPS consumers) reporting sole use of these substances. Rather, SCRA and NPS consumers mostly fell into the *amphetamine and cannabis consumer* and *polysubstance consumer* groups, respectively, providing support for the argument that most NPS consumers use a range of other illicit substances.

Polysubstance consumers (the group most likely to use NPS) were found to be significantly younger than all other groups, and were generally more educated, with few differences in terms of income or socio-economic status. They were also more likely to engage in a range of drug-related risk behaviours, including undertaking dangerous activities while under the influence of drugs and/or alcohol (most commonly driving a motor vehicle), injecting drugs and hazardous alcohol consumption. This suggests

that *polysubstance consumers* are a high-risk taking group, regardless of their NPS use, and as such, may not need specific NPS interventions. Rather, existing harm reduction messages surrounding drug use (e.g. the dangers of mixing substances, driving while under the influence, safe injecting practices) could be tailored for poly drug consumers more generally.

Amphetamine and cannabis consumers (the group most likely to use SCRA) were also quite young, however were more disadvantaged in terms of socio-economic status. They were more likely than all other groups to report trouble ceasing their drug use. Given that persistent desire or repeated unsuccessful attempts to quit is one of the markers of substance use disorder (Hasin et al., 2013), it would seem that this is the group that may benefit most from treatment interventions. Indeed, existing treatment centres could incorporate the use of SCRA and other NPS into their screening/assessment processes, with treatment plans tailored accordingly. *Amphetamine and cannabis consumers* were also more likely than most other groups (excluding *polysubstance* and *ecstasy and cocaine consumers*) to engage in hazardous activity while under the influence of drugs and/or alcohol.

To date, responses to the NPS market have largely been regulatory (European Monitoring Centre for Drugs and Drug Addiction, 2016c), with uncertainty regarding the most appropriate health- and drug-related interventions. More specifically, it has been unclear whether there needs to be specialised NPS interventions or harm reduction messages, and if so what these would look like. Our findings suggest that interventions could be based upon existing responses to drug use and targeted towards illicit drug consumers more generally. In contrast to Vreeker et al. (2017) (who concluded that NPS users may be considered a distinct group of users who need another approach in terms of prevention), we found that there was no distinct profile of NPS or SCRA consumers, at least in the Australian population, with the probability of use of these substances highest among *amphetamine and cannabis consumers* and *polysubstance consumer* groups - both of which were found to have higher rates of drug-related harms and/or risk behaviours. Indeed, it seems that the use of SCRA or other NPS may

be indicative of more problematic patterns of drug use; a 'red flag' which could be easily assessed by health professionals working in the drug and alcohol field.

Furthermore, our findings suggest that NPS consumers are a heterogenous group. We found that people who had used SCRA in the past year were different to those who had used other forms of NPS. In particular, it appears that people who use SCRA may be more at risk of experiencing drug-related harms (e.g. dependence), whilst other NPS consumers may be more likely to engage in drug-related risk behaviours (e.g. driving while intoxicated). However, our ability to expand upon the heterogeneity of NPS consumers is limited by the fact that the NDSHS only breaks NPS down into two categories, when in fact there are different ways of categorising NPS (e.g. chemical group, effect on the central nervous system), and multiple possible classes within these approaches (European Monitoring Centre for Drugs and Drug Addiction, 2016a, The Drugs Wheel. A new model for substance awareness, 2018), with a lack of standardisation evident in the literature. It seems likely that there are further differences among NPS consumers that we have not been able to tease out (e.g. Sutherland et al., 2016) and as such, future research should examine whether correlates of use vary across NPS classes. It is also important for future research to consider differences *within* NPS classes, with our findings showing that people who reported SCRA use had almost equal probabilities of falling into the a*mphetamine and cannabis consumer* and *polysubstance consumer* groups.

4.1 Limitations and future research

This study has certain limitations. Firstly, our findings are based on data from the 2013 NDSHS, as this was the first year to collect information on the use of NPS. In the intervening years, hundreds of additional NPS have been identified (265 from 2014-2016; European Monitoring Centre for Drugs and Drug Addiction, 2015, European Monitoring Centre for Drugs and Drug Addiction, 2016a, European Monitoring Centre for Drugs and Drug Addiction, 2017a), which may have changed the nature of the NPS market (although findings from the 2016 NDSHS show that past 12 month SCRA use has

decreased, rather than increased; Australian Institute of Health & Welfare, 2017). Furthermore, household surveys fail to capture certain populations (e.g. prisoners, homeless) which have been shown to have elevated rates of NPS use (Joseph et al., 2017, Ralphs et al., 2017), and as such our findings cannot be generalised to these populations. General population surveys must be accompanied by targeted surveys in order to adequately capture NPS use among marginalised, transient and institutionalized populations.

Secondly, analyses are reliant upon self-report data from participants which may be subject to bias. Although evidence points to sufficient validity and reliability of self-report in studies assessing illicit drug use (Darke, 1998), it is possible that people may have under-reported rates of use. This is compounded by the fact that definitions of NPS vary across countries and studies, and that the phrasing of questions can impact upon response options. For example, Palamar et al. (2017) found that 'gate' questions (which utilise skip logic, such that only a 'yes' response to use of a specific drug class will lead to more extensive queries of drug use in that class) resulted in lower response estimates than directly asking about specific NPS.

Furthermore, the data presented here refers to intentional NPS use only, and rates of 'unintentional' NPS consumption are likely much higher than reported. For example, wastewater analysis in Queensland detected a high frequency of methylone use (Thai et al., 2016), which was in contrast to low rates of reported use among sentinel samples of illicit drug consumers. Where possible, future studies should corroborate their findings through chemical analysis (e.g. Salomone et al., 2017). However, it should be noted that intentional and unintentional NPS use are distinct issues that require different harm reduction messages or interventions (e.g. unintentional use would be best addressed through interventions such as drug-testing and issuing health alerts when contaminants have been identified; Brunt et al., 2017).

Although our findings show that most people who use SCRA or other NPS also use other illicit substances, it is unclear from this study which came first and it would be of benefit for future studies to explicitly explore this, through longitudinal analyses, or through surveys which specifically ask about age of initiation. Finally, there was a very small group of people (n=16) who reported exclusive use of SCRA and/or other NPS, and it may be of benefit for future research to examine this group in more detail, although we acknowledge that, in the Australian context at least, such small numbers could limit the ability to do so. However, complex cultural and regulatory differences mean that there could be differing typologies of NPS consumers across countries (e.g. typologies may be markedly different in countries, such as Australia, where blanket bans have been introduced, prohibiting all NPS, compared to countries where NPS use is decriminalised and/or legal), and it would be of benefit for similar analyses to be conducted on general population data in other countries.

5. Conclusions

This study found no distinct profile of exclusive NPS consumers; rather the probability of SCRA and other NPS use was highest among *amphetamine and cannabis consumers* and *polysubstance consumers*. These groups reported the highest rates of drug-related harms (i.e. trouble ceasing use) and drug-related risk behaviours, respectively, suggesting that the use of SCRA or other NPS could be indicative of patterns of problematic drug use. These findings suggest that there may not need to be specialised NPS interventions or harm reduction messages; rather, they could be built into existing responses to drug use and targeted towards illicit drug consumers more generally.

Figure 1: Past 12-month licit and illicit drug use according to group for the 6-class solution

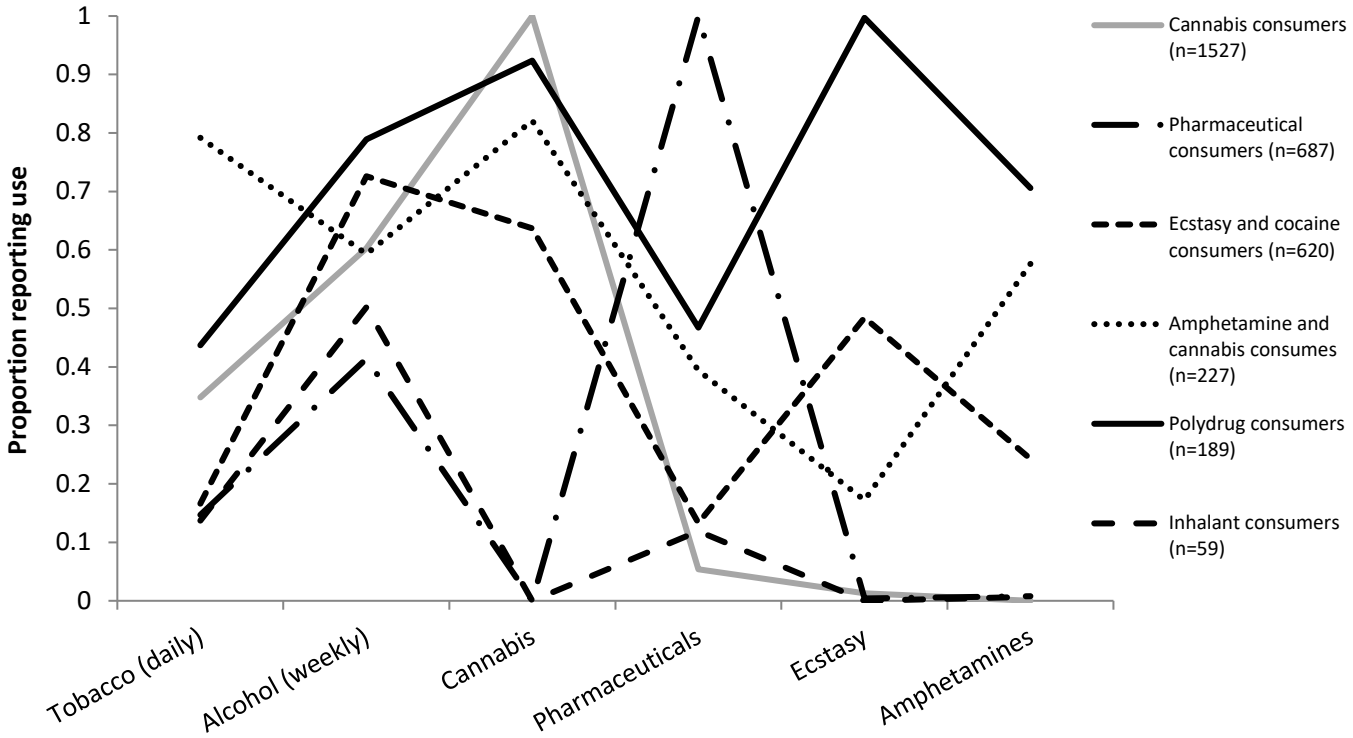
Proportion reporting use
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Tobacco (daily)
Alcohol (weekly)
Cannabis
Pharmaceuticals
Ecstasy
Amphetamines
Cannabis consumers (n=1527)
Pharmaceutical consumers (n=687)
Ecstasy and cocaine consumers (n=620)
Amphetamine and cannabis consumes (n=227)
Polydrug consumers (n=189)
Inhalant consumers (n=59)

Figure 1 (continued): Past 12-month licit and illicit drug use according to group for the 6-class solution

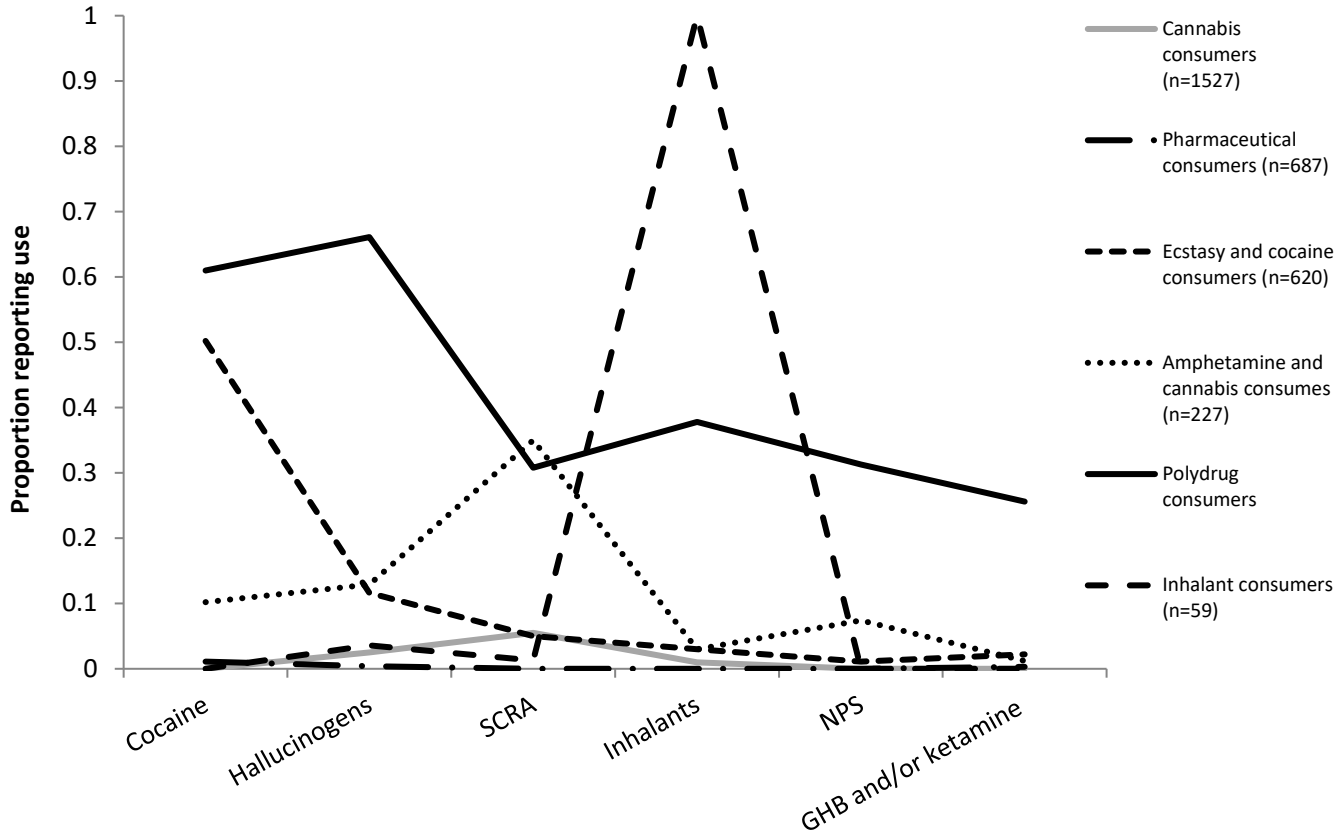
Proportion reporting use
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Cocaine
Hallucinogens
SCRA
Inhalants
NPS
GHB and/or ketamine
Cannabis consumers (n=1527)
Pharmaceutical consumers (n=687)
Ecstasy and cocaine consumers (n=620)
Amphetamine and cannabis consumes (n=227)
Polydrug consumers
Inhalant consumers (n=59)

Table 1: Demographics and risk behaviours according to group

	People who had not consumed any illicit substance N=20,024	People who had consumed an illicit substance/s N=3309	Cannabis consumers n=1541	Pharmaceutical consumers n=762	Ecstasy and cocaine consumers n=571	**Amphetamine and cannabis consumers n=212**	**Polysubstance consumers n=150**	Inhalant consumers n=73
Demographics and Mental Health:								
Mean age (years)	44.6	36.3	34.6	48.5	30.5	**30.6**	**26.6**	55.2
Male %	47.8	59.4	61.4	48.4	62.6	**61.6**	**70.0**	61.8
Completed trade or other educational qualification %	63.4	66.9	64.9	65.1	75.9	**56.3**	**77.3**	54.2
Unemployed %	6.4	10.2	10.6	6.8	7.8	**19.0**	**15.4**	11.9
Gross annual income <$52,000 %	62.3	63.3	66.0	63.1	53.9	**75.6**	**61.3**	59.5
Low SES %	36.6	38.0	39.9	41.6	25.7	**52.5**	**28.5**	49.2
K10 score ≥22 %	9.2	18.4	15.9	20.0	16.4	**33.5**	**24.3**	9.1
Risk Behaviours:								
AUDIT-C score ≥9 %		17.5	14.8	6.4	24.9	**27.4**	**35.9**	7.1
Dangerous activity whilst under AOD influence past year %		46.5	45.3	18.9	58.4	**74.4**	**84.5**	22.9
Missed work/school/TAFE/university for AOD reason in past 3 months %		9.7	7.0	3.9	13.6	**14.5**	**26.9**	2.4

Trouble ceasing drug use in past year %		33.8	31.7	25.8	29.0	**72.3**	**49.9**	20.6
Injected any drug (past year) %		2.1	0.5	0.7	1.3	**13.8**	**8.9**	0
Daily cannabis		8.8	10.9	0	4.5	**29.9**	**15.1**	0
Weekly or more meth		2.2	0	0	2.4	**18.5**	**8.7**	0

Note: Figures for *amphetamine and cannabis consumers*, and *polysubstance consumers*, are bolded since they are the two referent categories (i.e. these two groups have the highest probability of SCRA and other NPS use). AUDIT-C: Alcohol Use Disorders Identification Test; K10: Kessler Psychological Distress Scale; SES: socio-economic status.

Table 2: Demographics and risk behaviours according to group, with *polysubstance consumers* and *amphetamine and cannabis consumers* as the referent groups: Multivariable models.

	Polysubstance consumers vs.					Amphetamine and cannabis consumers vs.				
Outcome	Cannabis consumers AOR (95% CI; *p*)	Pharmaceutical consumers AOR (95% CI; *p*)	Ecstasy and cocaine consumers AOR (95% CI; *p*)	Amphetamine and cannabis consumers AOR (95% CI; *p*)	Inhalant consumers AOR (95% CI; *p*)	Cannabis consumers AOR (95% CI; *p*)	Pharmaceutical consumers AOR (95% CI; *p*)	Ecstasy and cocaine consumers AOR (95% CI; *p*)	Polysubstance consumer AOR (95% CI; *p*)	Inhalant consumers AOR (95% CI; *p*)
Demographics and Mental Health:										
Mean age (years)	1.09 (1.06-1.12)***	1.12 (1.09-1.16)***	1.04 (1.01-1.08; 0.006)**	1.05 (1.02-1.09; 0.004)**	1.13 (1.07-1.18)***	1.03 (1.01-1.06; 0.006)**	1.07 (1.04-1.10)***	0.99 (0.97-1.02; 0.57)	0.95 (0.92-0.98; 0.004)**	1.07 (1.02-1.12; 0.004)**
Male %	0.77 (0.42-1.42; 0.41)	0.39 (0.20-0.78; 0.008)**	0.66 (0.35-1.24; 0.19)	0.71 (0.33-1.53; 0.38)	0.64 (0.17-2.49; 0.52)	1.09 (0.61-1.95; 0.77)	0.55 (0.28-1.08; 0.08)	0.93 (0.49-1.74; 0.82)	1.41 (0.65-3.04; 0.38)	0.90 (0.23-3.55; 0.89)
Completed trade/qualification %	0.40 (0.19-0.83; 0.01)*	0.49 (0.21-1.11; 0.09)	0.56 (0.26-1.22; 0.15)	0.42 (0.16-1.11; 0.08)	0.21 (0.05-0.83; 0.03)*	0.93 (0.48-1.81; 0.84)	1.15 (0.54-2.44; 0.72)	1.33 (0.65-2.70; 0.43)	2.36 (0.90-6.19; 0.08)	0.50 (0.13-1.94; 0.32)
Unemployed %	0.56 (0.18-1.74; 0.32)	0.18 (0.04-0.78; 0.02)*	0.29 (0.07-1.14; 0.08)	0.77 (0.17-3.44; 0.74)	3.60 (0.53-24.65; 0.19)	0.73 (0.25-2.12; 0.56)	0.23 (0.05-0.98; 0.046)*	0.37 (0.09-1.50; 0.16)	1.29 (0.29-5.73; 0.74)	4.65 (0.70-31.10; 0.11)
Gross annual income <$52,000 %	2.00 (1.10-3.64; 0.02)*	1.16 (0.59-2.31; 0.67)	0.88 (0.46-1.68; 0.69)	2.05 (0.92-4.55; 0.08)	1.09 (0.31-3.83; 0.90)	0.98 (0.53-1.78; 0.94)	0.57 (0.28-1.15; 0.11)	0.43 (0.23-0.81; 0.009)**	0.49 (0.22-1.09; 0.08)	0.53 (0.15-1.89; 0.33)
Low SES %	1.09 (0.61-1.93; 0.78)	1.04 (0.53-2.04; 0.91)	0.73 (0.40-1.34; 0.31)	2.30 (1.11-4.77; 0.03)*	1.71 (0.48-6.12; 0.41)	0.47 (0.27-0.85; 0.01)*	0.45 (0.23-0.89; 0.02)*	0.32 (0.17-0.59)***	0.44 (0.21-0.91; 0.03)*	0.75 (0.21-2.62; 0.65)
K10 score ≥22 %	0.94 (0.46-1.90; 0.86)	1.74 (0.75-4.05; 0.20)	0.94 (0.46-1.93; 0.87)	1.48 (0.64-3.43; 0.36)	0.13 (0.01-1.49; 0.10)	0.64 (0.33-1.22; 0.17)	1.18 (0.52-2.65; 0.70)	0.64 (0.31-1.29; 0.21)	0.68 (0.29-1.56; 0.36)	0.09 (0.01-0.99; 0.049)*
Risk Behaviours:										

AUDIT-C score ≥9 %	0.54 (0.29-0.99; 0.04)*	0.45 (0.19-1.04; 0.06)	0.79 (0.42-1.48; 0.45)	0.55 (0.24-1.23; 0.15)	0.53 (0.09-3.29; 0.50)	0.98 (0.51-1.89; 0.95)	0.81 (0.33-2.02; 0.66)	1.44 (0.71-2.89; 0.31)	1.83 (0.81-4.12; 0.15)	0.97 (0.15-6.14; 0.98)
Dangerous activity whilst under AOD influence past year %	0.14 (0.06-0.33)***	0.07 (0.03-0.16)***	0.23 (0.10-0.54)***	0.32 (0.12-0.86; 0.02)*	0.08 (0.02-0.35)***	0.45 (0.24-0.85; 0.01)*	0.22 (0.11-0.43)***	0.72 (0.37-1.43; 0.35)	3.18 (1.16-8.67; 0.02)*	0.26 (0.07-0.99; 0.049)*
Missed work/school/TAFE/university for AOD reason in past 3 months %	0.38 (0.18-0.79; 0.01)*	0.42 (0.15-1.15; 0.09)	0.68 (0.32-1.44; 0.32)	0.57 (0.21-1.53; 0.27)	0.40 (0.04-3.64; 0.42)	0.66 (0.29-1.49; 0.32)	0.72 (0.25-2.09; 0.55)	1.19 (0.50-2.85; 0.70)	1.75 (0.65-4.67; 0.27)	0.70 (0.08-6.45; 0.75)
Trouble ceasing drug use in past year %	0.61 (0.32-1.14; 0.12)	0.36 (0.17-0.75; 0.007)**	0.55 (0.29-1.05; 0.07)	3.54 (1.55-8.09; 0.003)**	0.23 (0.05-1.14; 0.07)	0.17 (0.09-0.33)***	0.10 (0.05-0.22)***	0.16 (0.08-0.32)***	0.28 (0.12-0.65; 0.003)**	0.07 (0.01-0.32)***
Injected any drug in past year %	0.02 (0.004-0.11)***	0.09 (0.01-1.00; 0.05)	0.18 (0.02-1.66; 0.13)	0.32 (0.08-1.24; 0.10)	<0.001***	0.06 (0.01-0.36; 0.002)**	0.29 (0.03-2.75; 0.28)	0.57 (0.07-4.37; 0.59)	3.11 (0.81-11.94; 0.10)	<0.001***

Note. An odds ratio (OR) or adjusted odds ratio (AOR) of 1 indicates the event is equally probable in each group, > 1 indicates the event is more likely to occur in the non-reference group relative to the reference group, and <1 indicates the event is less likely to occur in the non-reference group relative to the reference group.
*p<.050; **p<.010; ***p<.001; exact p values not presented where <0.001.
CI: confidence interval; AOD: alcohol and/or drugs; AUDIT-C: Alcohol Use Disorders Identification Test; K10: Kessler Psychological Distress Scale; SES: socio-economic status.

SUPPLEMENTARY MATERIALS

Table S3: Latent Class Fit Statistics for models with 1 to 8 classes for licit and illicit drug use variables (n=3309)

Model	AIC	ssaBIC	LMR-ALRT	LMR-ALRT *p* value	Entropy	Percentage (n) in Each Class							
						Class 1	*Class 2*	*Class 3*	*Class 4*	*Class 5*	*Class 6*	*Class 7*	*Class 8*
1 Class	31543	31578	-	-	-	100 (3309)	-	-	-	-	-		
2 Class	29601	29674	1950	<.001	0.943	79 (2613)	21 (696)	-	-	-	-		
3 Class	28069	28180	1543	<.001	0.839	21 (690)	47 (1562)	32 (1057)	-	-	-		
4 Class	27599	27748	491	.0132	0.807	22 (720)	21 (697)	8 (271)	49 (1620)	-	-		
5 Class	27421	27608	202	.2040	0.796	21 (680)	46 (1519)	6 (193)	7 (223)	21 (693)	-		
6 Class	27268	27493	178	.0342	0.827	19 (620)	7 (227)	21 (687)	2 (59)	46 (1527)	6 (189)		
7 class	27219	27482	74	.5031	0.809	6 (212)	2 (59)	21 (691)	45 (1496)	14 (454)	6 (215)	6 (182)	
8 class	27162	27464	82	.6962	0.875	11 (353)	6 (199)	21 (696)	5 (179)	47 (1546)	5 (179)	3 (101)	2 (56)

Note. AIC: Akaike Information Criterion; ssaBIC: sample-size adjusted Bayesian Information Criterion; LMR-ALRT: Lo-Mendell-Rubin Adjusted Likelihood Ratio Test.

Table S4: Demographics and risk behaviours according to group, with *polysubstance consumers* and *amphetamine and cannabis consumers* as the referent groups: Bivariate models.

	Polysubstance consumers vs.					Amphetamine and cannabis consumers vs.				
Outcome	Cannabis consumers OR (95% CI; *p*)	Pharmaceutical consumers OR (95% CI; *p*)	Ecstasy and cocaine consumers OR (95% CI; *p*)	Amphetamine and cannabis consumers OR (95% CI; *p*)	Inhalant consumers OR (95% CI; *p*)	Cannabis consumers OR (95% CI; *p*)	Pharmaceutical consumers OR (95% CI; *p*)	Ecstasy and cocaine consumers OR (95% CI; *p*)	Polysubstance consumers OR (95% CI; *p*)	Inhalant consumers OR (95% CI; *p*)
<u>Demographics and Mental Health:</u>										
Mean age (years)	1.06 (1.04-1.07)***	1.11 (1.10-1.13)***	1.03 (1.02-1.05)***	1.03 (1.02-1.05)***	1.14 (1.11-1.17)***	1.02 (1.01-1.04)***	1.08 (1.06-1.09)***	1.00 (0.99-1.01; 0.90)	0.97 (0.95-0.98)***	1.10 (1.07-1.13)***
Male %	0.68 (0.44-1.07; 0.09)	0.40 (0.25-0.64)***	0.72 (0.45-1.15; 0.17)	0.69 (0.41-1.16; 0.16)	0.69 (0.34-1.43; 0.32)	0.99 (0.71-1.37; 0.95)	0.58 (0.41-0.84; 0.004)**	1.04 (0.71-1.54; 0.83)	1.45 (0.86-2.44; 0.16)	1.01 (0.52-1.94; 0.99)
Completed trade/qualification %	0.55 (0.34-0.88; 0.01)*	0.56 (0.34-0.90; 0.02)*	0.93 (0.56-1.55; 0.78)	0.38 (0.20-0.69; 0.002)**	0.36 (0.17-0.75; 0.006)**	1.46 (0.97-2.19; 0.07)	1.48 (0.97-2.27; 0.07)	2.47 (1.56-3.90)***	2.66 (1.44-4.89; 0.002)**	0.96 (0.48-1.93; 0.90)
Unemployed %	0.65 (0.34-1.26; 0.20)	0.40 (0.19-0.84; 0.02)*	0.47 (0.22-0.97; 0.04)*	1.29 (0.60-2.78; 0.52)	0.74 (0.19-2.99; 0.68)	0.51 (0.31-0.83; 0.007)**	0.31 (0.17-0.57)***	0.36 (0.20-0.66)***	0.78 (0.36-1.68; 0.52)	0.58 (0.15-2.20; 0.42)
Gross annual income <$52,000 %	1.23 (0.77-1.95; 0.39)	1.08 (0.66-1.76; 0.76)	0.74 (0.45-1.22; 0.23)	1.96 (1.03-3.74; 0.04)*	0.93 (0.40-2.18; 0.87)	0.62 (0.41-0.94; 0.02)*	0.55 (0.35-0.87; 0.01)**	0.38 (0.24-0.59)***	0.51 (0.27-0.97; 0.04)*	0.47 (0.20-1.11; 0.08)
Low SES %	1.66 (1.07-2.57; 0.02)*	1.79 (1.12-2.84; 0.01)*	0.86 (0.55-1.37; 0.53)	2.77 (1.63-4.70)***	2.42 (1.15-5.10; 0.02)*	0.60 (0.42-0.86; 0.005)**	0.64 (0.43-0.96; 0.03)*	0.31 (0.21-0.47)***	0.36 (0.21-0.61)***	0.87 (0.43-1.77; 0.71)
K10 score ≥22 %	0.59 (0.37-0.93; 0.02)*	0.78 (0.49-1.24; 0.29)	0.61 (0.38-0.98; 0.04)*	1.57 (0.90-2.75; 0.11)	0.31 (0.12-0.84; 0.02)*	0.38 (0.25-0.56)***	0.50 (0.32-0.77; 0.002)**	0.39 (0.25-0.61)***	0.64 (0.36-1.12; 0.11)	0.20 (0.08-0.52; 0.001)**

Risk Behaviours:										
AUDIT-C score ≥9 %	0.31 (0.20-0.49)***	0.12 (0.07-0.22)***	0.59 (0.37-0.95; 0.03)*	0.67 (0.39-1.18; 0.17)	0.14 (0.04-0.50; 0.003)**	0.46 (0.30-0.71)***	0.18 (0.10-0.33)***	0.88 (0.55-1.41; 0.60)	1.49 (0.85-2.60; 0.17)	0.20 (0.06-0.75; 0.02)*
Dangerous activity whilst under AOD influence past year %	0.15 (0.09-0.27)***	0.04 (0.02-0.08)***	0.26 (0.14-0.47)***	0.53 (0.27-1.05; 0.07)	0.05 (0.02-0.14)***	0.29 (0.19-0.42)***	0.08 (0.05-0.13)***	0.48 (0.32-0.74)***	1.88 (0.95-3.72; 0.07)	0.10 (0.05-0.23)***
Missed work/school/TAFE/uni for AOD reason in past 3 months %	0.21 (0.12-0.35)***	0.11 (0.06-0.22)***	0.43 (0.25-0.74; 0.003)**	0.46 (0.23-0.91; 0.03)*	0.07 (0.01-0.52; 0.01)*	0.45 (0.24-0.83; 0.01)*	0.24 (0.11-0.52)***	0.93 (0.50-1.71; 0.80)	2.17 (1.09-4.30; 0.03)*	0.14 (0.02-1.15; 0.07)
Trouble ceasing drug use in past year %	0.47 (0.30-0.73)***	0.35 (0.22-0.56)***	0.41 (0.25-0.67)***	2.63 (1.47-4.70; 0.001)**	0.26 (0.11-0.60; 0.002)**	0.18 (0.12-0.27)***	0.13 (0.09-0.21)***	0.16 (0.10-0.25)***	0.38 (0.21-0.68; 0.001)**	0.10 (0.04-0.22)***
Injected any drug in past year %	0.05 (0.02-0.13)***	0.07 (0.03-0.212)***	0.14 (0.05-0.40)***	1.64 (0.78-3.46; 0.20)	<0.001***	0.03 (0.01-0.07)***	0.04 (0.02-0.13)***	0.08 (0.03-0.24)***	0.61 (0.29-1.30; 0.20)	<0.001***

Note. An odds ratio (OR) or adjusted odds ratio (AOR) of 1 indicates the event is equally probable in each group, > 1 indicates the event is more likely to occur in the non-reference group relative to the reference group, and <1 indicates the event is less likely to occur in the non-reference group relative to the reference group.
*p<.050; **p<.010; ***p<.001; exact p values not presented where <0.001.
CI: confidence interval; AOD: alcohol and/or drugs; AUDIT-C: Alcohol Use Disorders Identification Test; K10: Kessler Psychological Distress Scale; SES: socio-economic status.

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