TITLE: "How do online and offline sampling compare in a multinational study of drug use and nightlife behavior?"

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ABSTRACT

BACKGROUND

Online sampling is widely used to recruit hard to reach samples such as drug users at nightlife events. We conducted the first study comparing differences in demographics, drug use and nightlife behaviour between an online sample of young adults engaging with the European nightlife scene, and an offline sample recruited at nightclubs and festivals in Europe.

METHODS

Online participants who attended at least six nightlife events in the past 12 months were recruited using social media advertising (May-November 2017). Offline participants were recruited at nightclubs and festivals using a random intercept method (May-November 2017). Samples were compared with respect to age, gender, past year use of alcohol, cannabis, cocaine, ecstasy/MDMA and amphetamines, and past year attendance at nightclubs, licensed festivals, illegal festivals, pubs and house-parties.

RESULTS

6153 online and 3529 offline participants were recruited. When adjusting for differences in age and gender, online participants were less likely to have used each drug and to have attended illegal festivals, pubs and house-parties in the past 12 months. The online sample also used each drug and attended each venue, with the exception of nightclubs, less frequently on average than offline participants. Adjusted odds ratios (range 0.37 to 1.39) and regression coefficients (range -0.84 to 0.07) indicate that the majority of observed differences between the samples were of a small effect size.

CONCLUSIONS

Estimates of drug use and nightlife engagement are more conservative when using online sampling compared to venue based sampling. Observed differences were generally small in effect, indicating good overall representativeness when using online sampling in the European nightlife scene.

KEYWORDS

Representativeness, internet, online sampling, online survey, nightlife, drug use

1. INTRODUCTION

ALAMA-Nightlife (A Longitudinal And Momentary Analysis in the European nightlife scene) is a project investigating drug use amongst young adults engaging with the nightlife scene in five European countries: Belgium, Italy, Netherlands, Sweden and the UK. One core component of the project is an online survey examining drug use and nightlife behaviours.

There are a number of potential advantages to using online survey methods (Barratt, Potter, et al., 2015; Van Gelder, Bretveld, & Roeleveld, 2010), which have seen them being increasingly employed as a research tool. One such advantage is that online surveys allow researchers to access large numbers of participants at a lower cost than traditional methods such as face-to-face interviews or mailed surveys (Al-Salom & Miller, 2017; Barratt & Lenton, 2015; Miller, Johnston, Mcelwee, & Noble, 2007; Riva, Teruzzi, & Anolli, 2003). Furthermore, the internet has been successfully used to access hard to reach, or 'hidden', populations, such as those engaging in illegal or stigmatised behaviours (Barratt, Potter, et al., 2015; Potter et al., 2015; Ramo & Prochaska, 2012; Temple & Brown, 2012). As the internet can provide a greater degree of anonymity for participants disclosing potentially illegal or sensitive information, it is thought there is likely to be a reduction in suspicion or fears about disclosing drug use behaviours (Barratt, Ferris, & Lenton, 2015; Barratt, Potter, et al., 2015; Kalogeraki, 2011; Miller & Sønderlund, 2010; Temple & Brown, 2012; Wardell, Rogers, Simms, Jackson, & Read, 2014).

Despite these advantages, there are potential limitations that should be considered when using the internet for research. The lack of interaction with participants potentially raises questions about whether the target population has actually been reached. Further, the external validity of online samples has also been questioned, and it has been argued that corroborating information is needed to generalise findings from internet-based studies to wider populations (Barratt, Ferris, et al., 2015; Barratt et al., 2017; Miller & Sønderlund, 2010).

There are, however, very few studies validating online samples of alcohol and/or drug users against samples collected using more traditional offline methods, and none amongst a population of young adults engaging with the nightlife scene. Past year and past month cannabis users completing the Global Drug Survey, a large annual online survey about drug use, have been found to be broadly representative in terms of age and gender of probability samples of cannabis users from national household surveys in Australia, the United Stated and Switzerland (Barratt et al., 2017).

An online sample of Australian ecstasy users was found to be comparable to a probability sample from a national survey with regard to demographics and drug use patterns, leading to conclusions that the internet can be successfully used to recruit ecstasy users (Miller, Johnston, Dunn, Fry, & Degenhardt, 2010). However, in a comparison between a different online sample of Australian ecstasy users and a later iteration of the same national survey, Barratt and colleagues (2015) found that the online sample were younger on average, had a higher proportion of males and were more likely to report polydrug use. Furthermore, a study comparing an online sample of cannabis cultivators with one from a national survey found that, while there were many similarities, the online sample were more likely to be male, younger, and not to have used cannabis before the age of 16 (Barratt & Lenton, 2015).

Previous evidence indicating that some online samples of drug users may differ from offline probability samples highlights the need to validate those recruited solely through the internet against those known to be the target population. Furthermore, additional limitations of online research, notably the purposive nature of sampling and the inability to calculate response rates prohibiting the estimation of prevalence in a population, make the need to validate online samples even more important if findings are to be generalised to a wider population. However, to the authors' knowledge, this validation has never been done for an online sample of European adults engaging with the nightlife scene.

As such, the aim of this study was to compare an online survey sample to a venue-based offline sample randomly recruited at nightclubs and festivals with respect to demographics, drug use and nightlife engagement, and to estimate the magnitude of observed differences.

2. METHODS

2.1. Design

This study was a survey validation comparing online convenience and random offline sampling. The online sample completed an internet-based survey about their drug use and nightlife engagement. The offline sample completed a face-to-face questionnaire at nightclubs and festivals that contained a small subset of the questions asked of the online sample.

Ethical approval was granted by each countries' institutional ethics committees.

2.2. Participants

2.2.1. Recruitment

2.2.1.1. Online sample

The online sample was recruited between May and November 2017 using convenience sampling, primarily through paid, targeted advertising on the social media platforms Facebook and Instagram. Adverts were targeted at people who liked or interacted with content related to the nightlife scene, including a range of popular nightclubs, DJs, music genres, events and news groups in each country, and who were within the age range of our inclusion criteria (see below). Online groups, fora and websites focussing on electronic dance music were also contacted to advertise the survey. Survey completers were entered into a prize draw for Macbooks, iPads and Bluetooth speakers as an incentive for participation.

2.2.1.2. Offline sample

The offline sample was recruited at nightclubs and festivals between May and November 2017. Access to nightclubs and festivals to recruit participants could not be agreed in Sweden, thus no offline data were collected. Therefore this study compared the online and offline samples in the Belgium, Italy, Netherlands and the UK.

Nightclubs were selected using Resident Advisor (RA; see www.residentadvisor.net), a website widely used throughout Europe dedicated to reviews, news and ticket sales for electronic dance music events. RA was chosen because it is a common source of information about electronic dance music across all four countries included in this study. The most popular twelve nightclubs in the largest and third largest city in each country according to RA were compiled into a list and verified with 'nightlife experts' to ensure important venues were not omitted. Nightlife experts were individuals heavily involved in the scene in each country, such as DJs, nightclub owners, welfare workers and event promoters. The decision to include the most popular venues was taken to ensure sufficient recruitment at venues and to reach a broad range of participants. Furthermore, popular clubs were considered to be more likely to be comparable between countries than underground events.

RA does not provide statistics on festivals, thus a list of key events was drawn up in consultation with each nightlife expert. The final two lists were then randomised, and nightclubs and festivals contacted in their listed order to explain the study, and for those who agreed, arrange access for recruitment. If a venue refused access, the next on the list was contacted to try and reach each country target of four clubs per city and three festivals in each country.

To reduce the risk of selection bias, participants were selected at nightclubs and festivals using a random intercept method, adapted from previous research (Graham et al., 2014). This required field-workers to stand at a fixed point and approach every second person who entered an unmarked zone covering an area large enough to experience steady foot traffic. Zones in crowded areas were approximately two by four meters, while in less dense areas zones were larger to ensure a regular flow of potential participants. Field-workers noted whether an individual had self-selected to complete the questionnaire, so that these could be removed prior to analyses due to violation of the random sampling method. Additionally, individuals who were visibly intoxicated were not included in order to minimise error when collecting self-report data.

Field-workers recruiting at nightclubs and festivals also informed individuals of the online survey. The online sample in the present study was, therefore, restricted to survey completers who indicated that they heard about the study online, rather than those who heard through either word of mouth or at a nightclub or festival.

2.2.2. Inclusion criteria

Inclusion criteria for participants in both the online and offline samples were: aged 18 to 34; having attended at least six electronic dance music events in the past 12 months; and residing in one of the participating countries.

The age range was chosen to match the upper age limit of the European Monitoring Centre for Drug and Drug Addiction's (EMCDDA) definition of a 'young adult' (e.g. EMCDDA, 2019), while the number of events was chosen to ensure sufficient engagement with the nightlife scene.

2.3. Measures

All participants were asked their age, gender, country of residence and the number of electronic dance music events attended in the past 12 months. Participants were also asked how frequently they used five drugs (alcohol; cannabis; ecstasy/MDMA; cocaine; amphetamines) and attended five venues (nightclubs; licensed festivals/raves; illegal festival/raves; pubs/bars; house-parties) in the past 12 months.

The questions and possible responses are shown in Supplementary Table 1. Offline participants were asked only these questions using a pen and paper questionnaire. Online participants answered these questions as part of a larger internet-based survey about drug use and nightlife engagement.

2.4. Statistical Analysis

2.4.1. Offline sample weighting

One consideration when using venue-based sampling methods is that the probability of being included in the study is related to the frequency that an individual attends such venues (Jenness et al., 2011; MacKellar et al., 2007). In line with previous studies using venue-based recruitment (Fernández-Calderón, Cleland, & Palamar, 2018; Palamar, Acosta, & Cleland, 2019; Palamar, Le, & Cleland, 2018), a sample weight was created based on self-reported frequency of venue attendance to account for the offline sample's different relative selection probabilities. The proportion of days in the past 12 months that an individual attended a venue was calculated by dividing participants' responses to the question "How many times did you attend a dance/electronic dance music event in the past 12 months?" by 365. An individual's selection probability was then estimated by calculating the inverse of this proportion, thus up-weighting those with lower probabilities and down-weighting those with higher probabilities of being recruited to the offline sample.

Using the number of events attended in the past 12 months was deemed the most suitable metric from which to estimate venue-based selection probabilities for the offline sample. Online selection probabilities are likely to be influenced by levels of engagement with the internet rather than event attendance, for which no data were collected. As such, it was not possible to appropriately weight the online sample in this study.

2.4.2. Assessing sample differences

Differences in age between the online and weighted offline sample were assessed using ANOVA, while a chi-square test was performed to test for differences in gender. Multivariate logistic regression, adjusting for age, gender and country of residence, were used to compare the samples in terms of past 12 month drug use and venue attendance. In order to compare the samples' mean frequency of drug use and venue attendance, a series of linear regression models were fitted, also adjusting for age, gender and country of residence. All questions in the online survey were forced responses, therefore there were no missing data for the online sample. However, some offline participants did not fill in all questions on the pen and paper questionnaire, and were therefore omitted from corresponding analyses. Statistical significance was assessed using Bonferroni corrected p-values (0.05 / 22 = 0.0023) to account for multiple comparisons. All statistics were performed using IBM SPSS Statistics 24.

Cohen's d for differences in age and Cramer's V for differences in gender were calculated as effect size estimates, with a value of 0.10 taken to indicate a small effect, 0.30 a medium effect and 0.50 a large effect (Cohen, 1992). The magnitude of observed differences in past 12 month drug use and venue attendance were determined by adjusted odds ratios, while those for average use and attendance frequency were assessed by adjusted regression coefficients.

3. RESULTS

3.1. Sample sizes

The numbers of online and offline participants living in Belgium, Italy, Netherlands and the UK are displayed in Table 1. In total, 6153 eligible participants completed the online survey. The offline sample comprised of 3529 eligible participants recruited from 27 different nightclubs and 19 festivals, at an overall response rate of 75.51%. A greater number of festivals were attended than initially planned following difficulties with agreeing recruitment at nightclubs and lower rates of recruitment than anticipated. In all, 414 offline questionnaires were completed by individuals who self-selected or were invisibly intoxicated, thus were not included in the offline sample.

[TABLE 1]

3.2. Demographics

Online participants were on average approximately one year younger (mean 23.21 years) than offline participants (mean 24.42 years), with the effect size estimate showing this difference to be small ($F_{(1,9681)}$=139.43, p<0.001, Cohen's d=0.24). The online sample also had a lower proportion of women (female=30.29%; male=69.29%; other=0.44%) than the offline sample (female=40.85%, male=58.00%, other=1.15%; χ^2=133.38, p<0.001, Cramer's V=0.11) with a small effect size estimate.

3.3. Drug use

The percentages of the online and weighted offline samples using each drug in the past 12 months are shown in Figure 1. While both samples followed the same pattern with regard to most (alcohol) to least (amphetamines) used drug, lower proportions were observed in the online than the weighted offline sample for all five. Results from multivariate logistic regressions are displayed in Table 2, and show that, after adjusting for age, gender and country of residence, the online sample were at significantly lower odds of having used all five drugs than the weighted offline sample, although the difference in alcohol use was short of significance at the Bonferroni corrected p-value.

[FIGURE 1]

[TABLE 2]

Figure 2 displays the mean use frequencies of each drug by both samples. Both samples again showed the same pattern with respect to most to least frequently used, with the online sample using each drug on average less frequently than the weighted offline sample. Multivariate linear regression coefficients (Table 3) suggest that, after adjusting for socio-demographic traits, the online sample was associated with a mean frequency score of less than one point lower than the weighted offline sample for each drug.

[FIGURE 2]

[TABLE 3]

3.4. Nightlife engagement

Figure 3 shows the proportions of both samples that attended each venue in the past 12 months, while adjusted odds ratios are displayed in Table 2. No difference was observed between the two samples with respect to past year attendance at licensed festivals. The online sample had lower odds of having attended illegal festivals, pubs and house-parties, and higher odds of having attended nightclubs than the weighted offline sample.

[FIGURE 3]

The mean attendance frequencies for each sample are shown in Figure 4. As with drug use frequency, the two samples showed the same pattern in terms of the order of most to least frequently attended venue. When adjusting for socio-demographic characteristics, no differences were observed between the two samples in terms of frequency of attendance at nightclubs. For the remaining four venues, the offline sample was associated with significantly lower mean attendance frequencies, with the largest difference observed for house-parties. The regression coefficients indicate that observed differences were less than one point on a seven point scale.

[FIGURE 4]

4. DISCUSSION

The aim of this study was to compare an online sample of young European adults engaging with the nightlife scene to a randomly recruited offline sample, and to estimate the magnitude of observed differences. Online participants were approximately one year younger on average and had a lower proportion of women than the weighted offline sample, with effect size estimates showing these differences to be small. Although both samples followed the same pattern in terms of most to least used drug in the past 12 months (alcohol, cannabis, ecstasy/MDMA, cocaine then amphetamines), the online sample had lower odds of having used each drug when adjusting for socio-demographic differences. However, upper bound limits of the 95% confidence intervals approached 1, indicating these differences may be small. The online sample also used each drug less frequently on average than the weighted offline sample, although adjusted regression coefficients indicate these differences were less than one point on a seven-point scale for all drugs, and less than half a point for all but cannabis.

No differences were found between the samples for past 12 month attendance at licensed festivals. The online sample were found to have higher odds of having attended a nightclub, but lower odds than the weighted offline sample for past 12 month attendance at illegal festivals, pubs and house-parties. While no differences between the samples with respect to the frequency of nightclub attendance were observed, the online sample had lower mean attendance frequencies for the remaining four venues. As with drug frequencies, adjusted regression coefficients suggest that the magnitude of these differences were less than one point on a seven point scale.

To the authors' knowledge, this is the first validation of an online sample of young adult substance users engaging with the European nightlife scene. Despite finding significant differences with regard to demographics, drug use and nightlife participation, adjusted odds ratios and regression coefficients suggest the magnitude of these to be small. These findings, therefore, suggest that online sampling shows good representativeness of young adults engaging with the nightlife scene.

These findings support previous studies that show the internet can be successfully used to access hidden populations of drug users (Barratt et al., 2017; Barratt & Lenton, 2015; Callas, Solomon, Hughes, & Livingston, 2010; Miller et al., 2010). However, that differences were observed between the online and weighted offline sample highlights the importance of validating online samples against one known to be the target population.

Contrary to research suggesting the use of the internet may prompt a greater degree of self-disclosure (Al-Salom & Miller, 2017; Miller et al., 2010; Wardell et al., 2014), our online sample reported lower rates of and less frequent drug use than our offline sample. It is possible this was due in part to our differing methods of data collection. Online participants provided an email address to be contacted for 12 month follow-up, whereas the offline sample were not asked to provide any identifying information on the pen-and-paper questionnaire. Despite guarantees of anonymity in that survey responses were never linked to email addresses and that IP addresses were not collected, this may have led to online participants feeling less anonymous in disclosing illegal behaviours than offline participants.

Beyond confirming that the target population has been reached, estimating the magnitude of differences between the two samples provides an opportunity to assess differences in sampling methods. Such differences can be useful for interpreting and adjusting estimates based on online and offline recruitment methods. Using estimates of the magnitude of differences is also important

studies with large samples such as this, as even apparently trivial differences between the groups can reach statistical significance.

The key strengths of this study include the large sample size, the multinational design and the use of a venue-based random intercept method to recruit the offline sample. However, one limitation is that the offline sample were not asked about their use of drugs other than alcohol, cannabis, ecstasy/MDMA, cocaine or amphetamines. Similarly, additional demographic information such as sexual orientation or education that were included in the online survey were not asked of offline participants. However, the decision to limit the number of questions in the offline questionnaire was advantageous in maximising the number of randomly selected people who agreed to participate.

Although weighting the offline sample in analyses was a strength of the study, the calculation of an individual's selection probability was limited to the number of self-reported events attended in the past 12 months. Other factors, such as the probability that an individual will be approached and how likely they are to agree to participate also influence the probability of selection (Jenness et al., 2011), which other studies weighting venue-based samples have utilised (Palamar et al., 2019; Palamar et al., 2018). However, accounting for this using sample weights requires an estimate of the number of eligible participants that were at a venue on all recruitment occasions, which are not available for our sample as capacity was not recorded in order to guarantee anonymity of venues. This also meant that the potential clustering effects of venues could not be accounted for in analyses.

Another limitation is that while we were able to estimate the differing probabilities in selection inherent to venue based sampling to weight our offline sample, no such data were available to do so for the online sample. It is likely that an individual's likelihood of responding to an online survey would be influenced by their level of engagement with the internet, such as the number of hours spent online or their propensity to respond to targeted advertising. No such data were collected in this study, thus we were unable to estimate and account for differing probabilities of selection and weight our online sample accordingly. Future studies might consider investigating measures that could be used to estimate online selection probabilities to compliment those existing for more traditional recruitment methods.

Finally, our results cannot be extended to other nightlife scenes beyond electronic dance music, nor to underground scenes.

4.1. Conclusion

In the first validation of an online sample of young adult substance users engaging with the European nightlife scene, small differences were observed with regard to age, gender, drug use and nightlife engagement when compared to an offline sample randomly recruited at clubs and festivals. These findings show that the internet can be used to access substance users engaging with the European nightlife scene, while highlighting the importance of validating online samples through comparison with a sample known to be the study target population. These findings may also prove useful for interpreting and adjusting estimates based on online and offline recruitment methods.

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Table 1: Numbers of online and offline participants in each country

	Online		*Offline*	
Country	*N*	*% of sample*	*n*	*% of sample*
UK	1944	31.59	1351	38.28
Netherlands	1892	30.75	1077	30.52
Belgium	1274	20.71	642	18.19
Italy	1043	16.95	459	13.01
TOTAL N	6153	100	3529	100

Table 2: Results from multivariate logistic regression comparing online sample with weighted offline sample with respect to past 12 month drug use and venue attendance, adjusting for age, gender and country of residence

	aOR[a]	(95% CI)	p
Past 12 month drug use			
Alcohol	0.66	(0.49, 0.90)	0.009[b]
Cannabis	0.71	(0.64, 0.80)	<0.001
Ecstasy / MDMA	0.61	(0.55, 0.69)	<0.001
Cocaine	0.70	(0.63, 0.78)	<0.001
Amphetamines	0.68	(0.60, 0.76)	<0.001
Past 12 month venue attendance			
Nightclubs	1.39	(1.14, 1.70)	<0.001
Licensed festivals / raves	0.96	(0.77, 1.18)	0.68
Illegal festivals / raves	0.66	(0.60, 0.73)	<0.001
Pubs / bars	0.37	(0.29, 0.47)	<0.001
House-parties	0.59	(0.50, 0.70)	<0.001

[a]Offline sample set as reference

[b]Non-significant at Bonferroni corrected significance level (p = 0.0023)

aOR – adjusted odds ratio, adjusting for age, gender and country of residence; 95% CI – 95% confidence interval for adjusted odds ratio

Table 3: Results from multivariate linear regressions comparing online sample with weighted offline sample with respect to past 12 month drug use and venue attendance frequency, adjusting for age, gender and country of residence

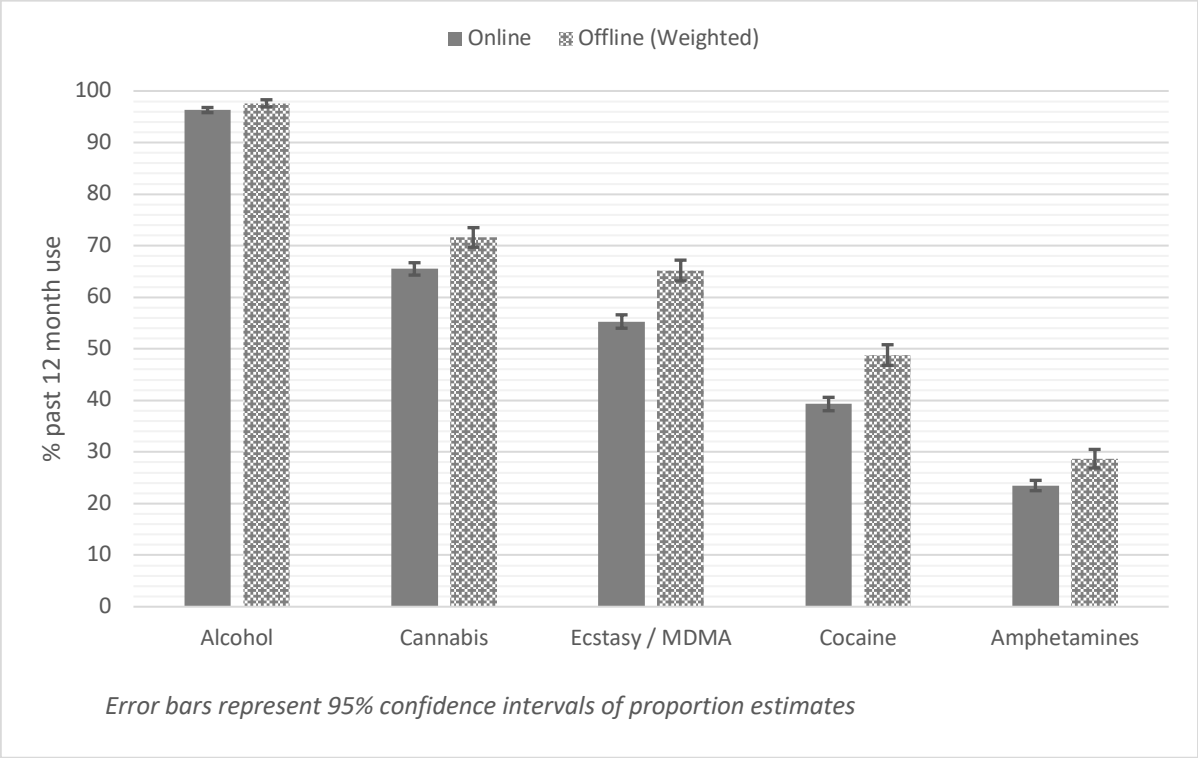
	B[a]	(95% CI)	p
Past 12 month drug use frequency			
Alcohol	-0.29	(-0.36, -0.23)	<0.001
Cannabis	-0.74	(-0.85, -0.63)	<0.001
Ecstasy / MDMA	-0.31	(-0.37, -0.25)	<0.001
Cocaine	-0.40	(-0.49, -0.33)	<0.001
Amphetamines	-0.23	(-0.28, -0.17)	<0.001
Past 12 month venue attendance frequency			
Nightclubs	0.07	(0.001, 0.14)	0.05[b]
Licensed festivals / raves	-0.24	(-0.30, -0.18)	<0.001
Illegal festivals / raves	-0.26	(-0.32, -0.20)	<0.001
Pubs / bars	-0.42	(-0.50, -0.35)	<0.001
House-parties	-0.84	(-0.91, -0.76)	<0.001

[a]Offline sample set as reference

[b]Non-significant at Bonferroni corrected significance level (p = 0.0023)

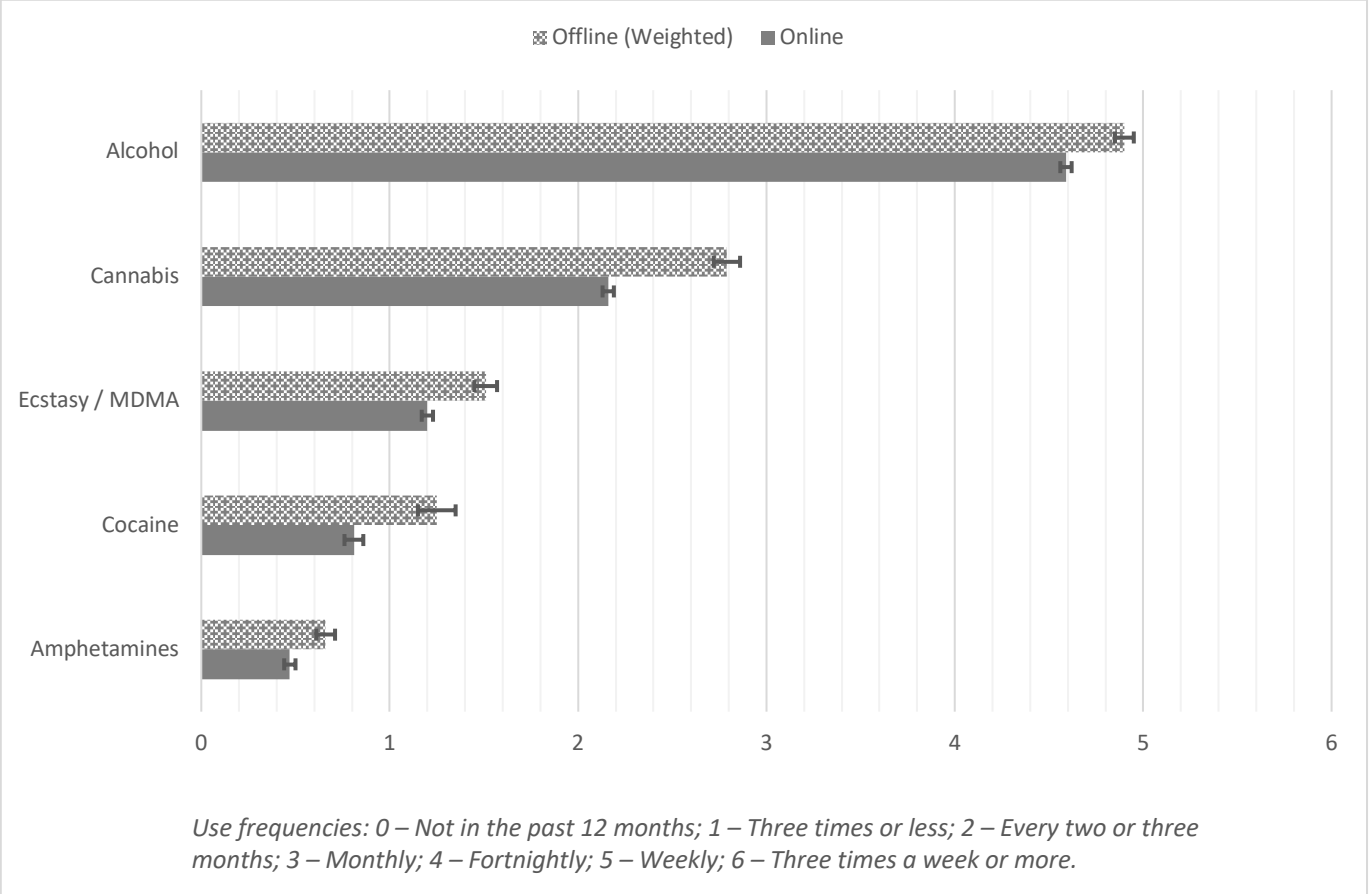
B – linear regression coefficient, adjusted for age, gender and country of residence; 95% CI – 95% confidence interval for regression coefficient

Figure 1: Past 12 month drug use within online and offline weighted samples



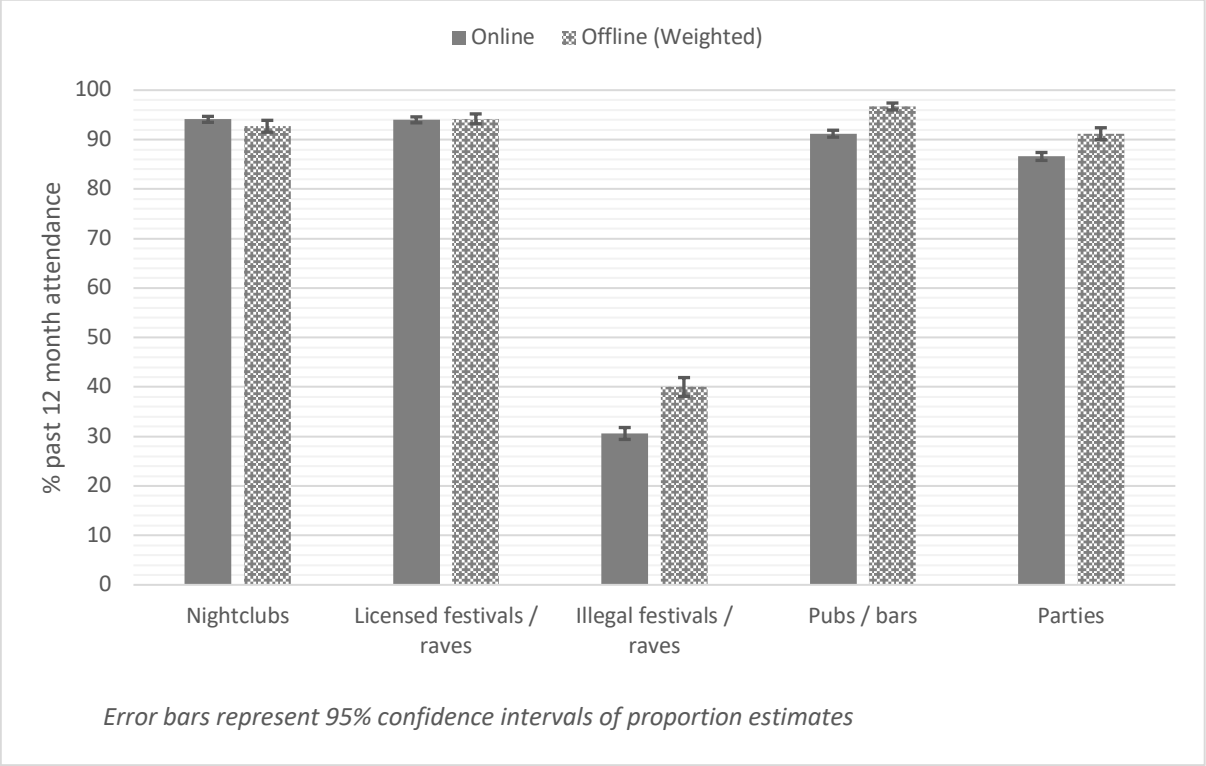
Error bars represent 95% confidence intervals of proportion estimates

Figure 2: Mean past 12 month drug use frequency within online and weighted offline samples



Use frequencies: 0 – Not in the past 12 months; 1 – Three times or less; 2 – Every two or three months; 3 – Monthly; 4 – Fortnightly; 5 – Weekly; 6 – Three times a week or more.

Figure 3: Past 12 month venue attendance within online and offline weighted samples



Error bars represent 95% confidence intervals of proportion estimates

Figure 4: Mean past 12 month venue attendance frequency within online and weighted offline samples