Karden *et al. Harm Reduction Journal* (2025) 22:17
https://doi.org/10.1186/s12954-025-01168-1

Harm Reduction Journal

RESEARCH Open Access

Utilization of drug checking services in Austria: a cross-sectional online survey

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Abstract

Background The use of psychoactive substances is a key public health issue due to its impact on mental, physical, and social health. Integrated drug checking is a well-known harm reduction and addiction prevention measure and is currently implemented in four federal states in Austria. The aim of this study is to investigate the prevalence of drug checking use among a web-survey sample of people who use drugs (PWUD) in Austria and to examine differences in socio-demographic and substance use characteristics between individuals with and without drug checking experience. In addition, reasons for not using these services are explored.

Methods A secondary data analysis of the Austrian data from the European Web Survey on Drugs (EWSD), a targeted survey conducted between March and May 2021 was performed. Based on reported drug checking experience, the data set was divided into two groups - those with and without drug checking experience – and compared.

Results In this web-survey sample of PWUD ($n=1113$), 20.1% reported prior use of a drug checking service in Austria. The groups with drug checking experience ($n=224$) and those without ($n=889$) differed significantly in both univariate and multivariate analyses. Univariate analysis revealed significant differences in terms of age, household composition, highest level of education, employment status, region of residence, substance use prevalences and treatment experience. Participants who used cannabis only had significantly less experience with drug checking. No significant differences were found regarding gender and income. While logistic regression analysis showed a significant relationship between sociodemographic predictors and drug checking experience, this relationship was relatively weak. The main reasons for not having used the services yet included a high level of trust in the source of supply (68%), confidence in receiving high quality of substances (64%), and a lack of service availability near the place of residence (62%).

Conclusions The results indicate that drug checking services are well-accepted and trusted but not equally accessed by and accessible to all PWUD. Specifically, people who use only cannabis and those residing with parents or in rural or small-town areas access services less. In conclusion, there is considerable potential for expanding the availability and accessibility of drug checking services in Austria, particularly to reach underserved groups of PWUD who could benefit from this intervention.

Keywords Drug checking, Harm reduction, Public health, PWUD, Addiction prevention

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Background

In Europe, it is estimated that more than a third of people aged 15–64 have tried an illicit psychoactive substance at some time in their lives [1]. Use of illicit substances constitutes an important public health issue due to its impact on mental, physical, and social health [2]. For example, risks to physical health may occur due to the acute effects of the drug itself, such as cardiac arrests associated with cocaine use [3], the long-term risks of chronic use (e.g. dependency) or the route of administration (e.g. intravenous use). One often underestimated risk is the unintended use of potentially hazardous substances, mixtures, or dosages. For instance, adulteration of ecstasy tablets (expected substance: MDMA; 3,4-Methylenedioxymethamphetamine) with PMMA (paramethoxymethamphetamine), a substance with significantly higher toxicity than MDMA, resulted in several fatal and non-fatal intoxications in many countries worldwide between 2000 and 2014 [4–7]. Other examples include fentanyl detected in heroin [8] and synthetic cannabinoids in cannabis samples [9, 10]. The consumption of unexpectedly large doses of MDMA has also been linked to serious health complications such as hyperthermia, which in extreme cases, can lead to multi-organ failure [11]. Recently, fatal and non-fatal overdoses associated with the unintentional consumption of highly potent opioids from the nitazene-class were reported in the Baltic states, France, the UK, and Ireland [12, 13]. Given the current political situation in Afghanistan, for many years the largest producer of opium, serious concerns about the future developments on the global heroin market have been raised and preparedness—especially with respect to an increase in harm reduction efforts—has been urged [14].

Since the 1990's, drug checking has become a widely adopted harm reduction and public health measure in many countries in order to enable people who use drugs (PWUD) make informed decisions about their own drug use [15]. Drug checking not only refers to the literal chemical analysis of drug samples but includes an integrated process combining analytical and psychosocial measures (therefore also called "Integrated Drug Checking"). It usually involves the provision of non-judgmental and individually tailored information about risks and effects of psychoactive substances along with the analysis result and, if required, further counselling [16].

Drug checking services (DCS) vary in several aspects, most notable the place where this service is delivered (e.g. music event, counseling center or drug consumption room), what substances can be analyzed, and how much time it takes to receive the analysis results. Austria is one of the few countries in the world with multiple independent services, (i.e. four DCS operating in five cities; Bludenz, Dornbirn, Graz, Innsbruck, Vienna). All services offer stationary drug checking at a counselling facility. Furthermore, mobile drug checking at music events and drug checking via drop-off sites in selected pharmacies are offered in Vienna. The Austrian DCS are comparable in terms of the employed drug checking technologies, their integration into a professional harm reduction organization, as well as their target group [15, 17, 18]. All four Austrian DCS are collaborations between university-based laboratories and harm reduction organizations, enabling the application of an array of advanced analytical techniques such as liquid- or gas chromatography coupled with mass spectrometry for substance identification and quantification [15, 19]. The mobile service in Vienna primarily targets visitors of music events and clubs in and around Vienna and returns the analysis result within an hour [19]. Stationary services, in contrast, cater to a broader audience of PWUD but require individuals to wait several days for the results excluding those who are unable or unwilling to wait [20, 21]. Previous studies have shown that drug checking facilitates access to user groups sometimes referred to as "hidden" populations, that may have never had contact with rather traditional drug support services [22]. Many clients engage in so-called "recreational drug use" (for a recent critical discussion of the term see [23]) and currently do not demonstrate psychological, physical, or social problems due to their drug use. Thus, drug checking can be the first contact to and for some PWUD the only reason to get in touch with a professional counselling service [24]. Despite this, DCS also reach diverse user group including those exhibiting problem and high-risk drug use [25, 26], which has been defined as "injecting drug use or long duration/regular use of opioids, cocaine and/or amphetamines" [27].

However, there are many PWUD who do not engage with DCS and the question arises whether they are able or willing to do so. Cross-sectional studies evaluating the acceptability of drug checking in Australia and Germany have previously shown a high willingness of around 90% to use DCS among the party scene [28–31]. Drug checking was rated as one of the most useful prevention programs among a list of nine prevention concepts/programs by Berlin partygoers in an online survey [32]. Willingness as well as actual service user engagement may be influenced by many factors and may differ extensively between subgroups of PWUD and by context—e.g., by the legal framework in the respective country [20]. Previous studies have shown a comparably limited acceptability and service utilization among marginalized PWUD [21, 33–35]. Barriers in accessing DCS were found to be due to concerns regarding criminal prosecution [29, 36–38], the stigmatization of substance use [37, 39], waiting times [21], geographical and accessibility issues [35, 37, 39] or the mere disinterest in knowing the composition of the sample [35].

The aim of this study is to explore the prevalence of DCS utilization among a web-survey sample of PWUD in Austria and the differences between individuals with DCS experience and those without. To our knowledge, this study represents the first nationwide assessment of this information in Austria. Additionally, we examine what reasons are given for not having engaged with a DCS so far. This is essential to identify regional service provision gaps and understand whether there is untapped potential for DCS to encourage greater or diverse groups of PWUD that may benefit from drug checking, ultimately increasing the accessibility and efficacy of such services.

Methods

Study design

This study was conducted within the larger framework of the European Web Survey on Drugs (EWSD) which is a multi-national web-based targeted survey developed and coordinated by the EUDA (European Union Drugs Agency) and implemented by its national partners in 30 participating European and neighboring countries in 2021. The EWSD was initially developed with the aim of creating a more accurate tool for estimating the size of European drug markets by collecting data from PWUD on their drug use patterns and purchasing behaviors [40]. A secondary analysis of the Austrian data of the European Web Survey on Drugs 2021 was performed. The ethical approval to conduct the analyses was granted by the Ethical Committee of the Medical University of Vienna (1431/2023).

Data collection

This survey was translated and adapted for local use by the Austrian Public Health Institute ("Gesundheit Österreich GmbH") and advertised online between 18 March and 5 May 2021. Data were collected using LimeSurvey software. Due to previous experiences highlighting the benefits of collaborative approaches with local service providers, the recruitment was coordinated and overseen by *checkit!*, which is a part of Vienna Addiction Services ("Suchthilfe Wien gGmbH"), using non-probabilistic techniques, (i.e. convenience and snowball sampling). As data collection occurred amidst the COVID-19 pandemic, participant recruitment focused on online strategies, (e.g., social media advertising via Facebook and Instagram). To participate, respondents were required to provide informed consent, be at least 18 years old and have used at least one of the following substances within the past year: cannabis, cocaine, ecstasy/MDMA, amphetamine, methamphetamine, heroin, and/or (a) new psychoactive substance(s).

Questionnaire

The survey consisted of general modules shown to all participants and specific modules for different substances that were only presented to those indicating previous experience with the respective substance [41]. The module-based questionnaire comprised a total of 225 questions and took on average about 15 min to complete. Survey items covered a variety of themes including sociodemographic information, information on drug use (i.e. type, frequency, amount, setting and method of use), treatment experiences, sources of supply, and prices paid. The Austrian version of the questionnaire further contained an additional module that was created for the use in Portugal, adapted (e.g., rating scales) and translated into German. This additional module contained questions regarding drug checking experience as well as reasons for not using drug checking and perceived usefulness of using a DCS.

Analysis

We included all questions from the sociodemographic module as well as information on drug use prevalence, drug checking (DC)-experience, and adoption of treatment services in the past 12 months.

Based on responses to the question of DC-experience, the dataset was divided into two subgroups for analysis: those with DC-experience and those without. Of the original five response options, two—the use of a DCS outside of Austria and the use of colorimetric self-tests—were excluded from the analysis, as respondents could not be assigned unambiguously to the DC-experienced or inexperienced group for our purposes. Whether the use of colorimetric self-tests can be considered drug checking has been disputed as they have significant technical disadvantages and could convey a false sense of safety [16]. Furthermore, self-testing substances differs significantly from using a professional DCS in multiple aspects, (e.g. contact to a harm reduction professional, barriers in access).

For the purpose of our analysis, several categories of the original variables assessing education, average income, household composition and the current employment were combined due to small sample sizes or the need for a less detailed breakdown. Gender was assessed with two questions that concerned the gender assigned at birth and the respondents current gender identity [42]. Based on the responses to both questions, participants were assigned to either the cis-female, cis-male, no response, transgender, or non-binary group, with the latter two being combined for the analysis due to small sample sizes.

To assess the prevalence of substance use, participants indicated their use of various substances. Substances were categorized loosely based on the DrugsWheel

classification [43]: Cannabinoids (e.g., cannabis), stimulants (e.g., cocaine, amphetamine and methamphetamine), empathogens (MDMA/ecstasy), psychedelics (e.g., LSD, magic mushrooms and other psychedelics), dissociatives (e.g., ketamine), depressants & opioids (e.g., benzodiazepines, GHB/GBL and opioids), NPS (e.g., new psychoactive substances, synthetic cannabinoid receptor agonists (SCRA), synthetic cathinones).

For the calculation of concurrent polysubstance use within the past 12 months in our study, the two legal substances alcohol and nicotine were excluded. Based on [44] four categories were formed: no polysubstance use (i.e., only one substance), low polysubstance use (i.e., 2–4 substances), moderate polysubstance use (i.e., 5–6 substances) and extensive polysubstance use (i.e., 7 or more substances). Since the analysis revealed group differences in the use of a single substance, and cannabis being the most prevalent, a category of cannabis-only-users was established by calculating the percentage of participants who had used only cannabis in the last 12 months.

Data analysis was conducted using R and RStudio. For numerical variables, including a 7-point Likert scale (variable: usefulness of drug checking), means, medians and standard deviations were calculated, while frequencies and percentages were calculated for categorical variables. To explore differences between groups with and without DC-experience, Chi-squared tests of independence, Fisher's exact test, or Mann-Whitney-U-tests were used, depending on the type and distribution of the data. Logistic regression analysis was used to identify covariates associated with the use of DCS incorporating all sociodemographic variables. Multicollinearity was tested with variance inflation factor (VIF) using the car-package [45]. Odds ratios, confidence intervals as well as significance of variable contribution were calculated for the model. "Inexperience with drug checking" was set as the baseline category of the outcome variable (DC-experience). The category with the lowest expected probability of having DC-experience was selected as the reference for each categorical predictor variable. Model fit was assessed using R^2, Hosmer-Lemeshow R^2, Nagelkerke's R^2 as well as Cox and Snell's R^2.

Results

Participants

In total, the survey including the national module was completed by 1260 participants. Of those, 25.7% ($n = 324$) identified as cis-female, 69.4% ($n = 875$) as cis-male, 4% ($n = 51$) as transgender or non-binary and 0.8% ($n = 10$) preferred to not answer the question. The mean age was 25.6 years (SD = 6.7). Full sociodemographic information for all participants is shown in Table 1.

Of the 1260 participants, 48 did not give an answer to the question about DC-experience and 99 had to be excluded because they had used a DCS outside of Austria ($n = 22$) or indicated that they never used an official DCS, but self-test-kits ($n = 77$). Finally, 1113 participants were included in the subgroup-analysis for DC-experience. Of those, 889 participants (79.9%) were assigned to the DC-inexperienced and 224 (20.1%) to the DC-experienced group. DC-inexperienced participants differed significantly from the experienced ones regarding age, household composition, highest level of education, current employment, and area of residence. No significant differences were identified with respect to gender and average income. Sociodemographic characteristics of the DC-experienced and DC-inexperienced subgroups are displayed in Table 1.

Treatment use in the past 12 months

There was a significant difference between DC-experienced and DC-inexperienced participants regarding the reception of medical or psychosocial treatment ($\chi^2(1) = 14.46$, $p < .001$). DC-experienced users received significantly more frequently treatment because of the use of illicit drugs within the past 12 months (14.3% vs. 6.5%).

Prevalence of substance use and polysubstance use

Barring cannabis and partly NPS, the prevalence of substance use (per category) was significantly higher in the DC-experienced compared to the DC-inexperienced group (Table 2). The groups also differed significantly regarding polysubstance use within the past 12 months ($\chi^2(3) = 81.08$, $p < .001$). Among the DC-inexperienced group significantly more participants have used only cannabis in the past 12 months than in the DC-experienced group ($\chi^2(1) = 40.8$, $p < .001$).

Relationship between sociodemographic variables and DC-experience

Logistic regression was conducted to ascertain the effects of sociodemographic variables (i.e., gender, age, education, income, household composition, area of residence) on the likelihood of previous DC-experience. The logistic regression model was statistically significant, $\chi^2(21) = 75.53$, $p < .001$, but only a weak relationship between sociodemographic predictors and DC-experience could be demonstrated (Table 3). Compared to participants living with (a) parent(s), the odds of having DC-experience are significantly higher for all other living arrangements (2.1 times to 4.41 times). Further, in comparison to students, participants working part-time and those being unemployed have 2.4 times and 2.79 times higher odds of being DC-experienced, respectively (OR = 2.4, 95%CI [1.32–4.34]; OR = 2.79, 95%CI [1.53–5.07]). Lastly, the odds of having DC-experience are 1.73 times higher for participants with secondary education compared to those

Table 1 Overall and subgroup sociodemographics

		Subgroups (*n* = 1113)	
Variables	**Total (*n* = 1260)**	**DC-experienced (*n* = 224)**	**DC-inexperienced (*n* = 889)**
Gender (%)			
Cis-Female	25.7% (324)	29.5% (66)	25.5% (227)
Cis-Male	69.4% (875)	66.5% (149)	69.6% (619)
Transgender or non-binary	4% (51)	4% (9)	3.9% (35)
No answer	0.8% (10)	0% (0)	0.9% (8)
Age ***	Mean = 25.6 (SD = 6.7) Md = 24 *NA* = 2	Mean = 27.9 (SD = 6.4) Md = 26.5 *NA* = 0	Mean = 25.2 (SD = 6.7) Md = 23 *NA* = 1
Average net-income (%)			
High level (3000€+)	3% (38)	4.5% (10)	2.8% (25)
Low medium level (2000–2999€)	17.6% (222)	17.9% (40)	17.8% (156)
Low level (1000–1999€)	39.3% (495)	44.6% (100)	38% (338)
Minimal level (Less than 1000€)	36.7% (462)	32.1% (72)	39.1% (348)
NA	3.4% (43)	0.9% (2)	2.5% (22)
Household (%) ***			
A couple without children	19.1% (241)	25.4% (57)	17.9% (159)
Household with children	6.3% (80)	8.9% (20)	6% (53)
Living alone	27% (340)	30.4% (68)	26.9% (239)
Living with parent(s)	29% (365)	12.9% (29)	32.7% (291)
Sharing home with peers / student accommodation / dorm	15.4% (194)	19.2% (43)	14.6% (130)
Other	0.9% (11)	1.8% (4)	0.8% (7)
NA	2.3 (29)	1.3% (3)	1.1% (10)
Highest Level of Education (%) *			
Tertiary education (ISCED 4 to 8)	19% (240)	23.2% (52)	18.7% (165)
Secondary education (ISCED 2 to 3)	59.8% (754)	62.9% (141)	60.3% (536)
Primary education (ISCED 1)	18.3% (231)	12.5% (28)	19.6% (174)
No formal education (ISCED 0)	0.9% (11)	0.9% (2)	0.8% (7)
NA	1.9% (24)	0.4% (1)	0.8% (7)
Employment (%) ***			
Employed full-time	47.6% (600)	45.5% (102)	48.1% (428)
Employed part-time	9.4% (118)	15.2% (34)	8.1% (72)
Student	29.4% (371)	22.3% (50)	32.5% (289)
Unemployed	9.9% (125)	14.7% (33)	9.1% (81)
Other	0.6% (7)	0.4% (1)	0.1% (4)
NA	3.1% (39)	1.8% (4)	1.7% (15)
Area of Residence (%) **			
City (> 100,000 inhabitants)	44.4% (560)	56.7% (127)	43.2% (384)
Town (10,000-100,000 inhabitants)	16.7% (210)	14.3% (32)	17.3% (154)
Village / Countryside (< 10,000 inhabitants)	36.3% (457)	27.7% (62)	38.1% (339)
NA	2.6% (33)	1.3% (3)	1.3% (12)

Note. The total number of participants (*n* = 1260) includes all survey participants. The subgroups (*n* = 1113) consist only of those unambiguously assigned to the DC-experienced or unexperienced group. DC = drug checking; significance level of univariate analysis of subgroup differences is indicated as follows: **p* < .05, ***p* < .01, ****p* < .001

with primary education (OR = 1.73, 95%CI [1.06–2.92]). In contrast to univariate analysis, this analysis revealed no differences in odds of being DC-experienced for different age groups or people from different sized residential areas.

Reasons for not using drug checking

The most frequently stated reason for not having used a DCS was trust in the source or the dealer (68.2%) followed by the confidence receiving high quality substances (64.4%) and a lack of service availability near the place of residence (61.6%) as shown in Fig. 1. For two of these reasons, significant differences were observed

Table 2 Overall and subgroup substance use prevalence and polysubstance use rates

		Subgroups ($n=1113$)		
Last-month prevalence	**Total ($n=1260$)**	**DC-experienced ($n=224$)**	**DC-inexperienced ($n=889$)**	
Cannabinoids	80.6% (1016)	77.2% (173)	81.1% (721)	
Stimulants	34.1% (429)	59.8% (134)	26.8% (238)	***
Empathogens	12% (151)	18.8% (42)	9.7% (86)	***
Psychedelics	13.3% (167)	20.1% (45)	10.8% (96)	***
Dissociatives	8.8% (111)	18.8% (42)	5.7% (51)	***
Depressants & Opioids	11.4% (144)	19.6% (44)	8.8% (78)	***
NPS	6.8% (86)	7.6% (17)	6% (53)	
Last-year prevalence				
Cannabinoids	95% (1197)	92.7% (208)	95.6% (850)	
Stimulants	58.2% (733)	78.6% (176)	51.6% (459)	***
Empathogens	41% (517)	56.3% (126)	35.7% (317)	***
Psychedelics	37.5% (472)	50.9% (114)	32.9% (292)	***
Dissociatives	23.7% (298)	38% (85)	19.5% (173)	***
Depressants & Opioids	20.8% (262)	29.9% (67)	17.7% (157)	***
NPS	19.2% (242)	25% (56)	16.2% (144)	**
Lifetime prevalence				
Cannabinoids	99.7% (1256)	100% (224)	99.6% (885)	
Stimulants	73.3% (924)	93.8% (210)	66.9% (595)	***
Empathogens	70.7% (891)	96% (215)	63.2% (562)	***
Psychedelics	69.1% (871)	92% (206)	62.1% (551)	***
Dissociatives	39.1% (493)	68.8% (154)	31% (275)	***
Depressants & Opioids	36% (454)	58.5% (131)	28.5% (253)	***
NPS	43.1% (543)	64.7% (145)	36.2% (322)	***
Polysubstance use (last year)				
One substance	27.7% (349)	10.7% (24)	33.9% (301)	***
Low polysubstance use (2–4 substances)	38.4% (484)	34.4% (77)	38.7% (344)	
Moderate polysubstance use (5–6 substances)	18.3% (231)	25.9% (58)	16.2% (144)	
Extensive polysubstance use (7+)	15.6% (196)	29% (65)	11.2% (100)	
Use of cannabis only (last year)	25% (315)	9.4% (21)	30.7% (273)	***

Note. The total number of participants ($n=1260$) includes all survey participants. The subgroups ($n=1113$) consist only of those unambiguously assigned to the DC-experienced or unexperienced group. Significance level of univariate analysis of subgroup differences is indicated as follows: *$p<.05$, **$p<.01$, ***$p<.001$

between participants based on the size of their residential area: 48.9% ($n=161$) of participants from rural areas, 43.2% ($n=64$) of those living in towns and only 34% ($n=127$) city-based participants indicated that they have no knowledge about DCS ($\chi^2(2)=16.45$, $p<.0003$). Further, 82.6% ($n=271$) from rural areas and 73.4% ($n=105$) from towns agreed with the statement that there are no services near to where they live, while only 37% ($n=139$) from those living in cities agreed ($\chi^2(2)=158.59$, $p<.001$).

Perceived usefulness of drug checking

DC-experienced individuals rated drug checking on a numerical 7-point Likert scale from 1 (not useful at all) to 7 (extremely useful) as very useful for the following five queried statements. It was rated most useful for obtaining information on unexpected substances and adulterants ("*To have more information on unexpected substances and adulterants*"; *Mean* = 6.5; *SD* = 1.2), followed by gaining knowledge about the actual composition of the substance ("*To know the actual composition of my substances*"; *Mean* = 6.5; *SD* = 1.2), testing the trustworthiness of the source ("*To know how trustworthy my source of supply is*"; *Mean* = 6.1; *SD* = 1.6), obtaining information on drugs and risks ("*Getting information on drugs and potential health risks*"; *Mean* = 5.6; *SD* = 1.8) and changing drug use for harm and risk reduction purposes ("*Changing the way I use drugs in order to reduce eventual negative effects on your health*"; *Mean* = 5.2; *SD* = 2.2).

Discussion

The first aim of this study was to explore the prevalence of drug checking service (DCS) utilization among a web-survey sample of people who use drugs (PWUD) in Austria and the characteristics associated with its utilization. Our analysis showed that among the 1113 participants in the Austrian EWSD-sample that were eligible for subgroup analysis, one in five (20.1%) had previously consulted a DCS. Furthermore, our results showed that DC-experienced participants differed significantly from DC-inexperienced participants in univariate analysis with respect to age, employment, household composition, highest level of education, area of residence, drug use prevalences, polysubstance use, and treatment use. There were no differences with regard to gender or income. It must be noted that some of these sociodemographic characteristics are likely related to age. However, detailed multivariate regression analysis showed no effect of age, but increased odds of being DC-experienced for all those not living with their parent(s), working part time or being unemployed as opposed to being a student and having completed secondary education as opposed to primary education. The somewhat contradictory findings regarding employment status suggest a potential diversity within the DC-experienced group indicating that this population may not be homogeneous. This warrants further investigation to better understand the characteristics of this population.

The absence of a gender effect contrasts with previous studies in festival settings that reported that DCS users were significantly more often male than female [46, 47]. The reason for this difference is unknown but might be related to the study design or recruitment method. Our study assessed lifetime DC-experience, whereas the other studies investigated actual on-site DCS-use. Thus, an

Table 3 Logistic regression with sociodemographic variables

Variable	Category	B (SE)	DC experience (inexperience as baseline) Odds Ratio (95% CI)
Gender	Female (ref)	1	
	Male	-0.03 (0.19)	0.97 (0.68–1.4)
	Transgender / non-binary	-0.08 (0.44)	0.92 (0.36–2.11)
	No answer	-13.73 (487.47)	0.0000 (NA)
Age		0.02 (0.01)	1.02 (0.99–1.05)
Area of residence	Village/ countryside (ref)	1	
	Town	0.02 (0.25)	1.02 (0.62–1.66)
	City	0.37 (0.20) °	1.45 (0.99–2.14)
Household composition	Living with parent(s) (ref)	1	
	A couple without child(ren)	**1.12 (0.29) *** **	**3.06 (1.74–5.47)**
	Household with child(ren)	**1.06 (0.39) ** **	**2.88 (1.33–6.22)**
	Living alone	**0.74 (0.27) ** **	**2.1 (1.24–3.63)**
	Sharing home with peers / student accommodation / dorm	**1.04 (0.29) *** **	**2.83 (1.6–5.09)**
	Other	**1.48 (0.71) * **	**4.41 (1-17.22)**
Employment	Student (ref)	1	
	Unemployed	**1.03 (0.3) *** **	**2.79 (1.53–5.07)**
	Part-time	**0.87 (0.3) ** **	**2.4 (1.32–4.34)**
	Full-time	0.26 (0.27)	1.3 (0.77–2.2)
	other	0.08 (1.12)	1.08 (0.05–8.03)
Education	Primary (ref)	1	
	Secondary	**0.55 (0.26) * **	**1.73 (1.06–2.92)**
	Tertiary	0.28 (0.31)	1.32 (0.73–2.46)
	None	0.511 (0.93)	1.67 (0.21–9.53)
Income	Minimal level (less than 1000€) (ref)	1	
	Low level (1000–1999€)	-0.02 (0.24)	0.98 (0.62–1.56)
	Medium level (2000–2999€)	-0.11 (0.31)	0.89 (0.48–1.64)
	High level (more than 3000€)	0.29 (0.46)	1.33 (0.52–3.19)

Note. B: regression coefficient. $R^2 = 0.07$ (Hosmer-Lemeshow), $R^2 = 0.07$ (Cox-Snell), $R^2 = 0.11$ (Nagelkerke). Model $\chi^2(21) = 75.53$, $p < .001$. °$p < .1$, *$p < .05$, **$p < .01$, ***$p < .001$. Variables with $p < .05$ are displayed in bold

effect of gender on the frequency of DC-use generally or in different settings is possible and remains to be investigated in future studies. Further, while these studies compared DCS users with festival attendees, data presented in this study are derived from a web-survey, targeting recent users of psychoactive substances. Therefore, our sample is homogenous in the sense that all participants have current experience with illicit substance use.

As the survey was thus targeted at PWUD, drug use prevalences are expectedly higher than those of representative surveys [48]. Interestingly, substance use prevalences were almost consistently higher among DC-experienced individuals than among the inexperienced. For many substances, they are comparable to prevalence rates measured among DC-users in other countries such as Portugal [49], the Netherlands [50] or Switzerland [51]. Cannabis use was generally high in both subgroups. Since most European DCS focus primarily on synthetic party drugs and the analysis of the natural cannabis requires additional technical and professional expertise and resources, cannabis samples are rarely analyzed. However, since the rise of synthetic cannabinoid receptor agonist (SCRA) adulteration around 2020, some DCS have increased their cannabis testing capacities and capabilities with a focus on qualitative analysis of synthetic substance adulteration [10]. Although some Austrian DCS have expanded their cannabis analysis capabilities and capacities, all of them currently screen samples solely for the presence of SCRA [18, 52–54]. In light of this, it is plausible that almost a fifth of the DC-inexperienced participants indicated that the kind of drugs they use are not tested by DCS. Moreover, a third of DC-inexperienced participants used only cannabis within the past 12 months and no other illegal substance, compared to only a tenth of the DC-experienced. Thus, limited testing possibilities of cannabis and a lacking familiarity of cannabis users with DCS might also be related to the difference in concurrent polysubstance use between groups.

Given the higher drug use and concurrent polysubstance use prevalences in the DC-experienced group, it

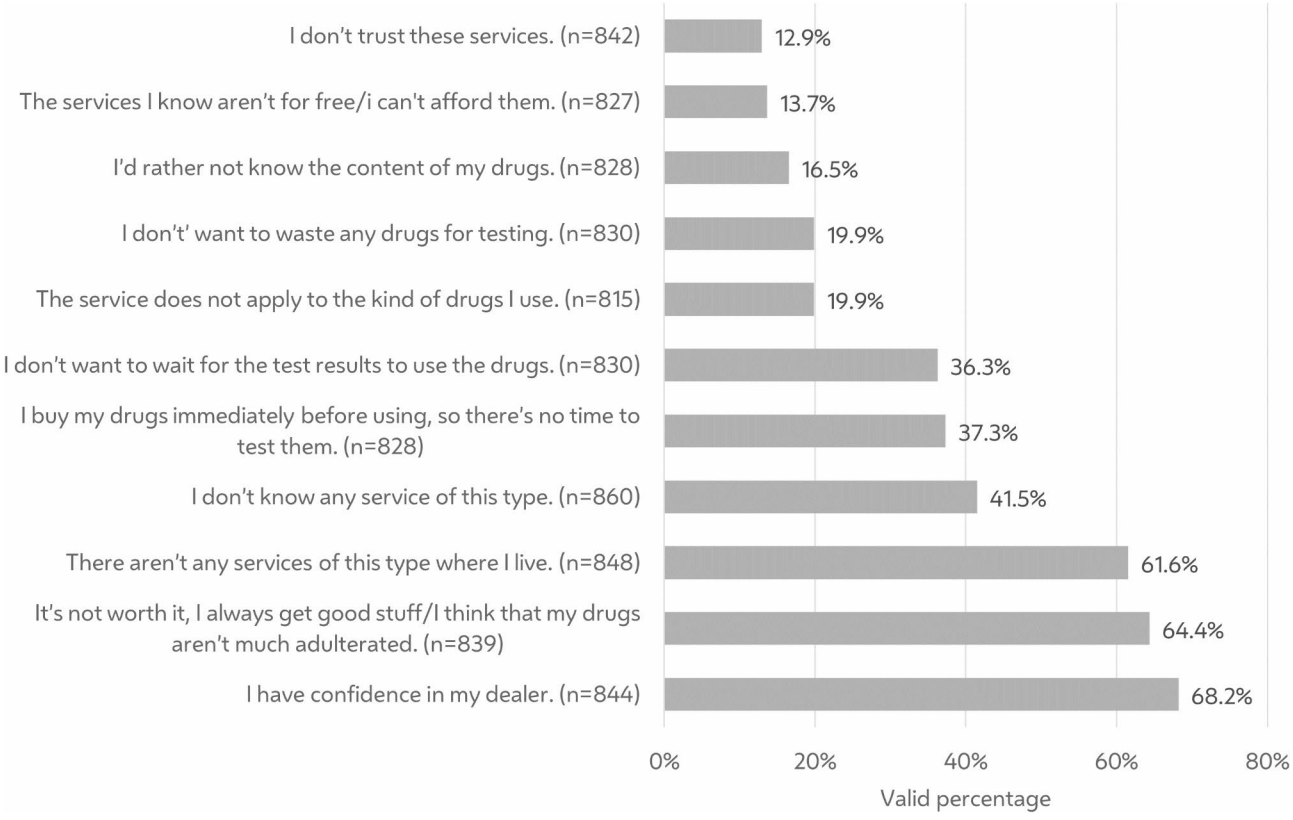

Fig. 1 Reasons for not using drug checking given by individuals inexperienced with drug checking in valid percentages

has to be noted, that drug checking has not been shown to encourage drug use [24, 55]. In fact, recent studies have indicated that DCS use may result in increased harm reduction and safer use behavior. Users reported a reduction of dose taken or disposal of the substance when high doses or unexpected adulterants or substitutes were detected by drug checking [56–58]. Furthermore, individuals with higher levels of drug use may be more aware of harm reduction services, feel a greater need to mitigate their drug use behavior or more concerned about safer use. A study from North America showed that PWUD who had witnessed an overdose were more likely to use a DCS than those who had not [59]. DC-experienced participants in our sample were more often in drug treatment in the past 12 months than DC-inexperienced participants. This is in line with research suggesting that drug checking can be a valuable tool to establish contact to "hidden" groups of PWUD that are hard to reach and facilitate referral to other health services if needed [22]. Notably, the cross-sectional design of the present study does not allow any causal interpretation of the association between DC-experience and the uptake of drug treatment.

The second aim of our study was to investigate reasons for not using DCS. The most frequently indicated reasons were a high trust in the source or dealer and a confidence of receiving high quality substances. This is generally comparable with previous studies on barriers and facilitators to the hypothetical use of DCS [20, 21, 29]. For example, a high trust in the source of supply was associated with a lower subjective relevance for using drug checking in previous studies [60]. In times of very dynamic and unpredictable drug markets [14] and a high availability of a diverse range of substances facilitated amongst others by online drug markets [61], this trust needs to be challenged and provision of reliable information on substance composition to PWUD increased.

Over a third of participants stated a lack of knowledge about DCS as a reason not to use them, while more than half stated a lack of service availability. At the time of data collection, DCS were only available in two cities in Austria (Vienna and Innsbruck). Importantly, the missing availability was indicated by the majority (82.6%) of those that lived in rural areas compared to 37.7% from Austrian cities. Recent studies from North America highlight the need for both centralized and remote DCS suggesting non-contact options as well as commonly accessible locations such as clinics, laboratories, or pharmacies to enhance anonymity and reach diverse user groups [37]. Although DCS in Austria currently primarily cater to a different demographic compared to those in North America, which focus on harm reduction during acute

public health crises, it is important to explore strategies to expand access. This is particularly critical as more than half of the survey respondents reside in rural or small-town areas where such services are hardly available.

An unwillingness to wait for the analysis result was indicated by a third of participants. Specific user groups (e.g., people who inject drugs or people who use drugs on a daily basis) or settings that provide an opportunity to drug use (e.g., drug checking at a music festival or a drug consumption room) require the result to be issued especially fast [19–21]. Therefore, it is important to ensure that the service design (e.g. setting, analysis techniques) caters to the targeted PWUDs to effectively reduce the use of untested substances and increase informed decision-making.

The least frequently indicated reasons for not having used a DCS are a lack of trust in these services and an unwillingness to pay for them. Because all DCS in Austria are mainly publicly funded, they are free of charge for PWUD and allow an anonymous access. Nevertheless, indirect costs may arise such as costs for transportation, parking tickets or ticket fees to enter a music event where drug checking is offered [37]. The results suggest that DCS are well-trusted in Austria. This is crucial for their effectiveness, since the credibility of their information and communication may determine the reaction to the intervention [62]. Considering that it can take a long time to build trust, the continuous availability for more than 25 years of DCS in Austria is certainly beneficial.

Limitations

The data were gathered amidst the COVID-19 pandemic during a period of lockdown in the east of Austria, which might have affected participation rates and participant composition. It may have also affected drug use prevalences and patterns such as the location and settings of use [63, 64]. Furthermore, the pandemic affected DCS delivery. As nightlife was heavily restricted for more than a year, mobile drug checking was rarely offered, and direct-contact harm reduction and counselling services were closed during lockdowns. The recruitment for the survey was undertaken by a DCS, which might have biased the sample. However, the yet high numbers of participants being unaware of DCS contradicts a strong bias and might be the result of a recruitment predominantly based on paid ads than on dissemination among DC-clients.

Given the cross-sectional design and the non-representative sample, the results and prevalences are not generalizable to the Austrian population and no causal conclusions can be drawn on the impacts of using a DCS or the underlying reasons for the presented group differences. Finally, it must be noted that the EWSD is a web-survey whose participants constitute a self-selected sample. Participation requires some level of trust, literacy, and technological equipment. The data is therefore not representative of PWUD in general. However, to research the often so-called "hidden population" of PWUD [22], web-surveys can be a useful tool and allow collection on otherwise inaccessible information about this user group [65].

Conclusion

Drug checking is a well-accepted and well-trusted harm reduction measure. In the EWSD sample, one in five participants (20.1%) have prior experience with it and consider it to be very useful. However, substantial differences between DC-experienced and inexperienced participants suggest that there are gaps in service use, availability, and accessibility. In particular, for PWUD living in rural or small-town areas limited availability presented a major barrier to accessing a DCS. Moreover, and despite the underlying technical challenges, further expanding cannabis testing capacities and capabilities could enhance the harm reduction potential of DCS and reach groups that are currently less familiar with DCS. Given that these groups are not negligible in size, options to enable all PWUD in Austria to make use of DCS should be discussed.

Abbreviations

DC	Drug checking
DCS	Drug checking service
EUDA	European union drugs agency
EWSD	European web survey on drugs
PWUD	People who use drugs

Acknowledgements

The authors would like to thank all survey respondents for their time and willingness to share their experiences. We further thank Anton Luf for providing feedback on the initial study idea.

Author contributions

AK and IG conceptualized the secondary analysis. Data analysis was performed by AK. IG, CF and TF consulted on initial data analysis. AK led the drafting of the manuscript with substantial support from IG. All authors (CF, TF, IG, AK, DM, JS) provided constructive input into the manuscript. All authors read and approved the final manuscript.

Funding

This project was awarded a Research Prize by the Stiftung Anton Proksch-Institut Wien for student theses focusing on addiction. The sole responsibility for the study lies with the awardee (Alexandra Karden).

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The ethical approval to conduct these secondary analyses was granted by the Ethical Committee of the Medical University of Vienna (1431/2023).

Consent for publication

Not applicable.

Competing interests
The authors declare the following potential conflicts of interest with respect to the research: Alexandra Karden is employed by the Viennese drug checking service. The remaining authors have no conflicts of interest to disclose.

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Received: 17 August 2024 / Accepted: 4 February 2025
Published online: 15 February 2025

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