



MONITORING DRUG USE IN THE DIGITAL AGE: STUDIES IN WEB SURVEYS

Sources of cannabis acquisition by country and frequency of use in the European web survey on drugs

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Abstract: A substantial amount of research has focused on understanding the sources from which individuals acquire illicit substances. To contribute to this area of research, the European Web Survey on Drugs (EWSD) included several questions to assess where individuals obtain the substances that they use. Using data from 16 countries covered in two waves of the EWSD, this paper first explores the four different sources from which the two most commonly used forms of cannabis, herbal and resin, are acquired. In doing such, this paper shows that there is considerable variation in the sources from which people acquire cannabis across these countries. Second, it analyses the relationship between sources of acquisition and frequency of use for these two forms of cannabis. The results of the analysis show that acquiring cannabis from a dealer and growing one's own supply (and to a lesser extent purchasing it online) increases with frequency of use. While this pattern was highly consistent across countries for herbal cannabis, there was some variation for cannabis resin. These results highlight the importance of studying different forms of cannabis separately. As differences still exist between countries, context-specific issues may influence the relationship between patterns of use and sources of acquisition, which require further research.

Introduction

A substantial amount of research and policy effort has focused on understanding and disrupting the sources from which individuals acquire illicit substances. In an attempt to better understand these sources of drug acquisition among a large sample of people who use drugs, the European Web Survey on Drugs (EWSD) included several questions to assess where individuals obtain the substances that they use. By combining this information on drug acquisition with data gathered by the EWSD on frequency of use, we can explore the interaction between these two factors.

The analysis in this study focuses on cannabis, which is the most widely used illicit substance in Europe, and presents an especially interesting case. Despite being widely consumed, cannabis use rates vary significantly between countries. Importantly, there are two commonly used forms of the substance (herbal and resin) that may differ in terms of the sources of acquisition. In addition, cannabis can be acquired from a variety of sources, including those not typical of other substances, such as growing one's own supply or purchasing it in 'coffeeshops' (mostly in the Netherlands).

In this context, this study analyses the data collected in the EWSD on the sources of supply for herbal cannabis and cannabis resin and their relationship to frequency of use. It does so by using data collected from the 16 countries that participated in the first two waves of the survey (2016 and 2017/18). In addition, this analysis aims to fill gaps in the existing literature on this topic: namely, research conducted

prior to the EWSD has largely taken place in the United States, it has only considered a limited number of sources and has not studied cannabis resin separately. Through its examination of sources of cannabis and frequency of use, the EWSD can address these limitations while potentially providing valuable information to practitioners and policymakers.

By using this unique dataset, our line of inquiry can be extended to a large sample of people who use herbal cannabis, cannabis resin or both, at varying frequencies across 16 countries. We begin by providing background information on the most common sources from which individuals acquire cannabis and the limitations of pre-existing research in this area. These sources are (a) from a dealer; (b) sharing/free; (c) growing (in the case of herbal cannabis) or producing (in the case of cannabis resin); and (d) online purchases. Secondly, we describe the probability of using different sources across the countries studied, both descriptively and based on regression modelling, and subsequently study the relationship between sources of acquisition and frequency of use. Although there may be differences across countries, we hypothesise, based on past studies, that the odds of using a dealer will increase with frequency of use, while the odds of sharing/free acquisition will decrease. We also anticipate that the likelihood of growing cannabis and making an online purchase will increase with frequency of use. Ultimately, these analyses are made possible by the large sample of people who use drugs who self-selected for participation in the EWSD — highlighting the usefulness of web surveys in collecting detailed data and conducting in-depth analyses on drug-use-related behaviours.

Sources of drug acquisition and limitations of past research

There are four common sources of acquisition outlined in the literature for drugs generally, as well as for cannabis specifically. The first, which is the focus of most policy and law enforcement efforts (Coomber et al., 2018), is obtaining drugs through a dealer. Although the term dealer often conjures up the image of a street dealer, whose connection to the purchaser is strictly limited to this exchange, dealers may often be friends, social acquaintances or even family members (Bennett and Holloway, 2019; Coomber and Turnbull, 2007; Coomber et al., 2016; Murphy et al., 2018). Indeed, peer social networks act as a primary source of supply (Becker, 1963), with social context determining the availability of drugs (Allen et al., 2017; Vuolo et al., 2014). However, this supply between friends does not always involve a monetary exchange. Thus, the second source we examine is through sharing or receiving cannabis for free. Sharing is common and thought of as completely normative behaviour, especially in the course of social substance use with

members of one's peer group (Belackova and Vaccaro, 2013; Coomber et al., 2016; Hathaway et al., 2018; Kelly et al., 2017; Murphy et al., 2018). Reciprocation itself can be categorised as sharing at times, since individuals who use drugs share with each other under the typically implicit assumption that others will share in return when they have drugs (Coomber et al., 2016; Murphy et al., 2018). There are two other sources to consider. Compared to other illicit substances, cannabis can be grown relatively easily by those using this substance, and it may be influenced by a variety of factors such as the cost of purchasing cannabis illicitly (Belackova et al., 2015). Therefore, growing cannabis for personal use is also considered as a source of supply. New sources have also expanded in recent years, such as purchasing drugs over the 'clearnet' (the open part of the internet) as well as the 'darknet' (see EMCDDA, 2016 and Karden and Strizek, 2022). Purchasing drugs through these online sources may be perceived as less risky since the personal interaction with dealers is removed (Barratt et al., 2016). Thus, purchases over the internet are also considered in our analysis.

In addition, we examine the relationship between the sources of cannabis acquisition and frequency of use. The limited research on this relationship shows that although sharing and gifting remain important, people who use cannabis increasingly rely on purchases via a dealer as their frequency of use increases (Hamilton, 2005). However, there are four limitations of this pre-existing research worth noting. First, prior to the European Web Survey on Drugs (EWSD), research had only been conducted in the United States, and in English. Second, it did not consider sources such as growing cannabis or online purchases, instead only dealers and 'free' sources were studied. Third, the research only examined herbal cannabis, ignoring cannabis resin — a form of the drug that is more common in Europe than in the United States. Fourth, previous analyses used general population surveys, which limited the sample size of those who use cannabis, especially at higher frequencies of use. In contrast, and as demonstrated elsewhere, the EWSD can be a valuable source of data to examine sources of drug acquisition, such as differences among males and females (Vuolo and Matias, 2020). However, country differences have yet to be scrutinised.

Data and methods

The data used for this analysis come from the 16 countries involved in the EWSD in 2016 and 2017/18. As such, the data comprise the first and second waves of the survey, each of which included a unique set of countries, which were combined for this analysis. The details of the EWSD as well as its advantages and limitations are described in other studies published alongside this report and in other publications (see

Matias, 2022, and also Matias et al., 2019; Škařupová et al., 2019). A main advantage of the EWSD is the inclusion of a large number of respondents who use cannabis at varying levels. This makes it possible to investigate the differences between people who use cannabis at various frequencies.

Our outcome variables consider sources of acquisition for herbal cannabis and cannabis resin. These were determined from a single question: 'How do you usually obtain [substance]?' Respondents could choose as many answers as applied, meaning that our outcomes are not mutually exclusive and are thus modelled separately. For both forms of cannabis, we consider four separate outcomes for the response choices: using a dealer ('Buy it from a drug dealer'); obtained through sharing or for free ('People give it to me or share it with me for free'); growing one's own ('I grow it'); and through online markets ('Buy it from a shop online' or 'Buy it from encrypted markets'). However, online market acquisition was only available as a response option for the 10 countries whose data collection began in 2017 (the second wave of the EWSD). Respondents were also given the option of 'Other (please specify)' and a free-text box, which we do not consider (except in instances where it could be recoded into one of the existing categories). Finally, even though the question on using a dealer explicitly used the term 'drug dealer', it is unclear whether those acquiring cannabis via Dutch coffeeshops would classify such purchases as being from a drug dealer; although given the proportions reported below for the Netherlands, it is probable that some respondents did classify those purchases in this way.

For frequency of use, we utilise categories used in previous EMCDDA publications for cannabis (Matias et al., 2019). These measures create frequency categories based on the question, 'How many days have you used [substance] in the past 12 months?' Four frequency categories were created: infrequent (<11 days), occasional (11–50 days), regular (51–250 days) and intensive (>250 days).

All respondents who stated that they had used cannabis in the past 12 months ($N = 27\,474$) were asked if they would be willing to answer the corresponding module. Of those, 96 % agreed to participate ($N = 26\,273$). Respondents were then asked if they had used herbal cannabis or resin in the last 12 months, in order to direct them to separate modules for the two forms as appropriate. Of those agreeing to participate in the cannabis module, 97 % reported using herbal cannabis ($N = 25\,507$); of those, 95 % answered the source and frequency questions used in this analysis ($N = 24\,168$). For resin, 35 % of those agreeing to participate in the cannabis module had used this form of the drug ($N = 9\,180$); of those, 94 % answered the questions used in this analysis ($N = 8\,667$). The final number reported for each form of cannabis represents the analytic sample for our models ($N = 24\,168$ and $N = 8\,667$ for herbal cannabis and resin respectively).

We began with simple, unadjusted descriptive statistics of the proportion of people reporting use of each of the four sources by country. However, we also modelled each of these binary outcomes with logistic regression in order to make as accurate cross-country comparisons as possible by adjusting for available covariates and including a cluster-correction for country. Regarding the latter, we included cluster-corrected standard errors for country to account for within-country correlation; that is, the possibility of people within the same country providing similar responses. We utilised several control variables. These included categorical variables for gender (female, male), household composition (lives alone, couple with no children, couple with children, one adult with children), education (university degree vs. lower than university degree), work status (full-time, part-time, student, unemployed/other) and locality type (city, town, village). We also used continuous variables for age and income. Income is a six-category measure based on each country involved in the EWSD selecting ranges in their currency that correspond to income levels based on typical incomes in their country.

For the control variables, the questions that were located near the end of the survey had higher levels of missing values. These variables (with percentage of missing values in brackets) included household composition (41 %), education (25 %), employment (29 %), locality type (25 %) and income level (27 %). Age, queried at the beginning of the survey, also had a small amount of missing data (2 %). Using Stata's chained multiple imputation procedure (Royston, 2004), we created 25 imputed datasets, specifying each of the missing variables by the appropriate model type (e.g. regression, logit, multinomial logit). The chained procedure uses each of the variables to estimate the others, but the accuracy can be improved by including additional variables. Thus, in the imputation procedure, we also included how they learned about the survey (web ad, social media, print ad, friends and no answer) and separate binary variables for the last month's use of cannabis, cocaine, MDMA, alcohol, a variable for any other drug (amphetamine, methamphetamine, heroin, GHB, ketamine, LSD, hallucinogens, synthetic cathinone or synthetic cannabis) and country (note that country has no missing information). Stata then used these datasets to estimate the logistic regression models. In order to assess the potential impact of the imputation process, the results of the analysis were compared to the same analysis conducted on the non-imputed data set, and were found to be similar. However, for simplicity, only the results for the imputed dataset are included here as this makes maximum use of the available data. Finally, while we include Cyprus in the analysis, we do not draw undue attention to its results, given the small number of respondents.

Results

Sources of cannabis acquisition

Table 1 shows the results for each source of herbal cannabis and cannabis resin by country. There are two columns for each method of acquisition. The first column is the simple unadjusted average; that is, the raw proportion of respondents in each country using each source of acquisition without any statistical adjustments. The second column is the predicted probability derived from the logistic regression models. Although, as expected, the total marginal mean remains similar comparing

the model and non-model numbers, there are shifts within country, with some numbers increasing and some decreasing in the model-based estimates. However, the overall pattern across countries for any given source remains fairly similar, as exhibited by the colour heat-mapping, where red represents higher proportions and blue represents lower proportions. The heat-mapping is specific to each column and reflects the between-country pattern (as opposed to the mean, for which differences would be driven by sample size differences and outliers). This approach permits the observation of differences between the simple unadjusted average and model-based estimates. Controlling for the covariates and the within-country

TABLE 1
Raw and model-adjusted averages for sources of cannabis acquisition by country

Herbal	Sharing/free		Dealer		Grow/make		Online		N
	Mean	Model	Mean	Model	Mean	Model	Mean	Model	
Austria	55.2	58.2	65.1	58.4	10.0	10.9	2.6	2.2	1 759
Belgium	37.2	41.9	62.9	60.9	11.6	8.9	2.8	3.0	2 894
Croatia	57.6	60.8	68.6	63.4	4.7	4.3			3 506
Cyprus	52.1	56.2	49.3	44.2	4.1	5.6	5.5	10.5	73
Czechia	80.8	83.3	40.5	40.8	25.7	19.9			447
Estonia	63.6	58.1	54.6	65.0	3.0	4.4	1.3	1.3	1 488
Finland	53.9	55.5	49.8	49.0	13.0	11.3	19.8	18.9	2 701
France	57.3	58.0	62.6	60.9	12.5	11.3			1 815
Italy	47.0	48.7	68.8	64.4	5.9	6.1	2.5	2.4	1 392
Latvia	57.0	52.5	51.6	56.7	3.5	5.4	2.4	2.3	2 401
Lithuania	59.7	51.1	19.2	24.8	2.8	4.9	0.7	0.8	682
Luxembourg	46.7	49.7	62.7	61.5	3.2	2.8	3.7	3.6	872
Netherlands	40.2	37.4	76.0	81.1	6.7	6.2			371
Poland	63.5	57.8	54.3	58.8	2.1	3.4	2.1	2.2	2 588
Switzerland	51.6	54.1	62.0	60.1	11.2	9.7			936
United Kingdom	49.4	47.2	65.4	67.7	5.8	6.5			243
Total	54.4	54.4	58.7	58.7	7.6	7.6	5.1	5.1	24 168

Resin	Sharing/free		Dealer		Grow/make		Online		N
	Mean	Model	Mean	Model	Mean	Model	Mean	Model	
Austria	59.3	57.8	59.2	60.1	5.3	6.0	3.9	3.9	676
Belgium	40.9	41.3	57.9	59.5	5.1	4.7	3.6	4.0	1 246
Croatia	59.2	58.5	61.5	61.7	3.6	3.8			1 043
Cyprus	39.1	46.7	52.2	52.0	17.4	23.0	4.4	17.5	23
Czechia	75.6	76.7	33.7	32.6	19.2	21.8			172
Estonia	61.5	60.5	50.3	53.1	2.1	3.5	3.7	5.5	187
Finland	60.6	60.6	56.0	56.0	7.1	7.7	19.6	20.5	840
France	52.4	60.6	70.4	58.1	5.9	4.8			1 344
Italy	48.9	53.1	73.3	66.2	3.9	3.7	1.4	1.2	814
Latvia	57.2	54.2	45.1	51.3	3.1	4.6	4.1	5.3	388
Lithuania	55.8	51.8	29.0	36.3	1.5	10.0	0.7	6.9	138
Luxembourg	43.9	47.6	74.2	69.4	2.6	2.8	3.7	2.9	383
Netherlands	40.4	40.3	78.7	79.7	1.3	4.5			235
Poland	62.1	58.9	43.7	53.1	0.5	0.8	4.9	5.4	639
Switzerland	52.9	58.0	62.0	56.2	7.6	6.0			473
United Kingdom	33.3	39.4	74.2	68.6	4.6	8.3			66
Total	53.3	53.3	60.5	60.5	4.8	5.0	5.9	6.1	8 667

Mean column represents the raw, unadjusted mean. Model column represents the average predicted marginal probability for each source of acquisition in a model, with controls for gender, frequency of use, household composition, education, employment, locality size, income and age, using multiple imputation and a cluster-corrected standard error for country. In the heat mapping, red refers to higher proportions, while blue refers to lower proportions. Heat-mapping is specific to each column to demonstrate differences in the distribution between the adjusted and unadjusted estimates and reflects across-country differences and not differences from the total. The countries with figures for online sources of acquisition reflect those that participated in the second wave of the EWSD (Austria, Belgium, Cyprus, Estonia, Finland, Italy, Latvia, Lithuania, Luxembourg and Poland), as this information was not collected from the countries in the first wave (Czechia, Croatia, France, Netherlands, Switzerland and United Kingdom).

correlation adjusts the probability to make it more comparable across countries, and thus we use the model-based probabilities in the following discussion of Table 1.

We begin with the model-based probabilities for herbal cannabis. The overall adjusted probability of acquisition through sharing/free is 54 %, but this varies across countries, from a low of 37 % in the Netherlands to a high of 83 % in Czechia, with the latter considerably separated from the next highest country (Croatia, at 61 %). On average, the percentage of people who purchased through a dealer is 59 %. With respect to this method of acquisition, the situation in the Netherlands is the opposite of that seen for sharing/free acquisition, as it has the highest percentage of any country for use of a dealer at 81 %. As noted earlier, residents of the Netherlands are likely classifying coffeeshop purchases as acquiring cannabis through a 'dealer', even though this use of the term does not quite fit with its generally understood meaning. Czechia again presents a contrasting picture, with only 41 % acquiring cannabis by using a dealer. Notably, this is the second lowest percentage, with only Lithuania showing a lower proportion of participants purchasing from a dealer, at a rate of 25 %. In general, a relatively small percentage of respondents report growing their own cannabis, with a bimodal distribution — one group of countries at about 6 % and below, and another at 10 % or above. Czechia is at the top of the latter list of countries at 20 %, but France (11 %), Finland (11 %) and Austria (11 %) are also on the higher side of the distribution. Finally, online purchases are fairly uncommon, at an average of 5.1 % across all countries. However, there is a clear outlier, with this source of cannabis acquisition used by 19 % of respondents in Finland.

Moving on to the model-adjusted proportions for cannabis resin, we see several examples of the same patterns, but some differences worth noting. For the proportion obtaining the drug from sharing/free sources, at 77 % Czechia is again much higher than the next highest countries (France and Finland, both at 61 %). While the Netherlands is again quite low, with only 40 % of resin acquisitions coming from sharing/free sources, the United Kingdom is lowest at 39 % with Belgium (41 %) following closely. For using a dealer, Czechia has the lowest rate, at 33 %, with Lithuania again quite low at 36 %. As with herbal cannabis, the Netherlands also has the highest probability of using a dealer for resin, at 80 %, and again it is likely that respondents there are classifying coffeeshop purchases as 'dealer' acquisitions. High probabilities of using a dealer to obtain resin are also found for Luxembourg (69 %), the United Kingdom (69 %) and Italy (66 %). The estimated proportion of individuals making their own resin is high in a smaller number of countries compared to herbal cannabis. This includes Czechia, where the proportion making one's own resin is one of the highest, at 22 %. Cyprus is higher at 23 %, but we express caution here due to the small sample size ($N = 23$ respondents providing valid answers

to the cannabis resin module). Other countries reporting relatively high values are Lithuania (10 %), the United Kingdom (8.3 %) and Finland (7.7 %). Finally, we find the same pattern for online purchases of resin as for herbal cannabis: most countries have rather low rates, while Finland (21 %) is an outlier. Next, we turn to the question of whether sources of cannabis differ based on respondents' reported frequency of use.

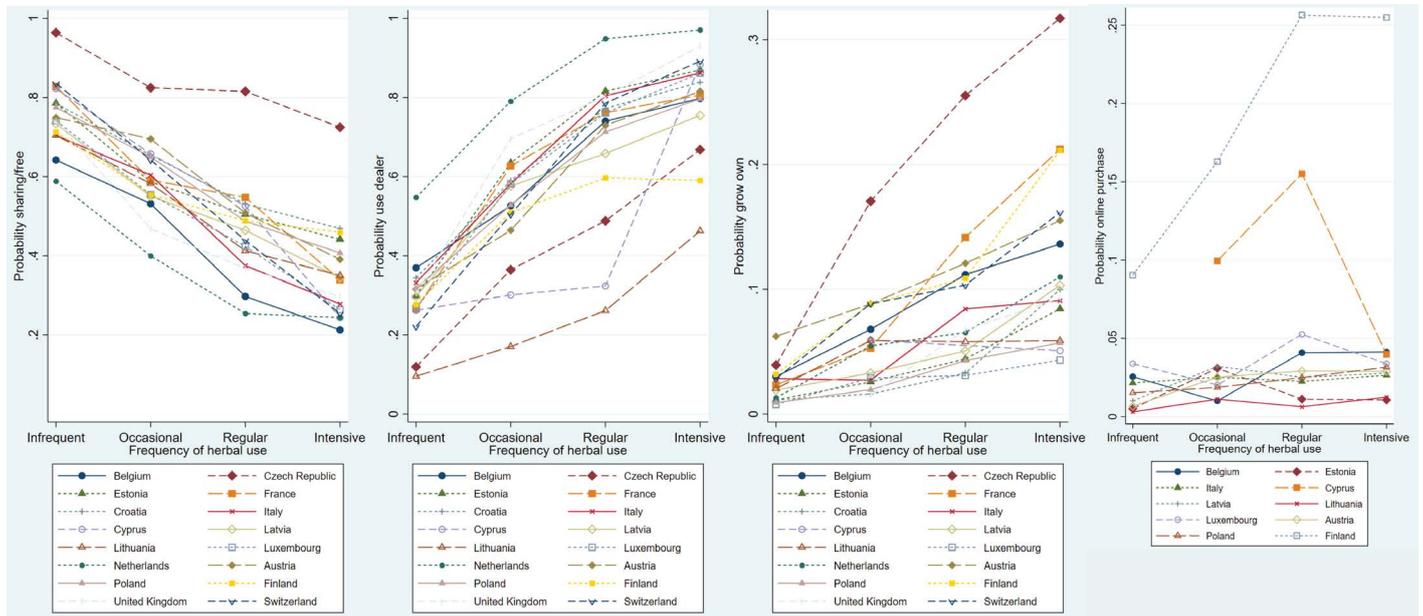
Relationship with frequency of use

We used marginal predicted probabilities derived from an interaction between country and frequency of use to demonstrate how these two factors are associated with sources of cannabis acquisition. We display these probabilities graphically (Figure 1), rather than in tabular form, for ease of interpretation, given the 64 possible predicted values (i.e. 16 individual countries times four different sources). Where an estimate is not displayed, this is due to sparse data at that combination of country, frequency of use and specific cannabis source. For 'sharing/free' and 'use of a dealer', we show the full range of probability on the y-axis, but give a smaller range for 'growing/making' and 'online purchases' in order to demonstrate important differences obscured by a larger scale.

Figure 1 shows the results for the four sources of herbal cannabis. Any country's average position relative to the other countries will be close to its overall marginal average as shown in Table 1. Thus, taking the first panel displaying the probability of 'sharing or for free', we see Czechia at the top and the Netherlands at the bottom. Nevertheless, despite the considerable difference between countries in the proportions of respondents reporting use of different sources, the results regarding the association between frequency of use and source of supply are clear: in every country, the probability of acquiring herbal cannabis through sharing or for free decreases with frequency of use. Looking at the two outlier countries at the upper and lower ends of the predicted probabilities, in Czechia the probability of acquiring herbal cannabis through sharing or for free decreases from 96 % for those using infrequently to 73 % for those using intensively. In the Netherlands, the probability decreases from 59 % with infrequent use to 24 % with intensive use, with the latter figure much closer to several other countries' estimates for individuals using intensively. On the other hand, in the panel showing data for buying cannabis from a dealer, the relationship is in the opposite direction: in all countries, the probability of using a dealer increases with frequency of use (except for Finland, where there is a very slight decrease in this probability between regular and intensive use). Although the overall marginal probabilities in Table 1 were lower, when only those classified as intensive users are considered, most countries have probabilities approaching 80 % for using a dealer. In the Netherlands, the probability of using a dealer

FIGURE 1

Predicted probabilities of herbal cannabis acquisition via sharing/free, dealer, growing and online by country and frequency of use



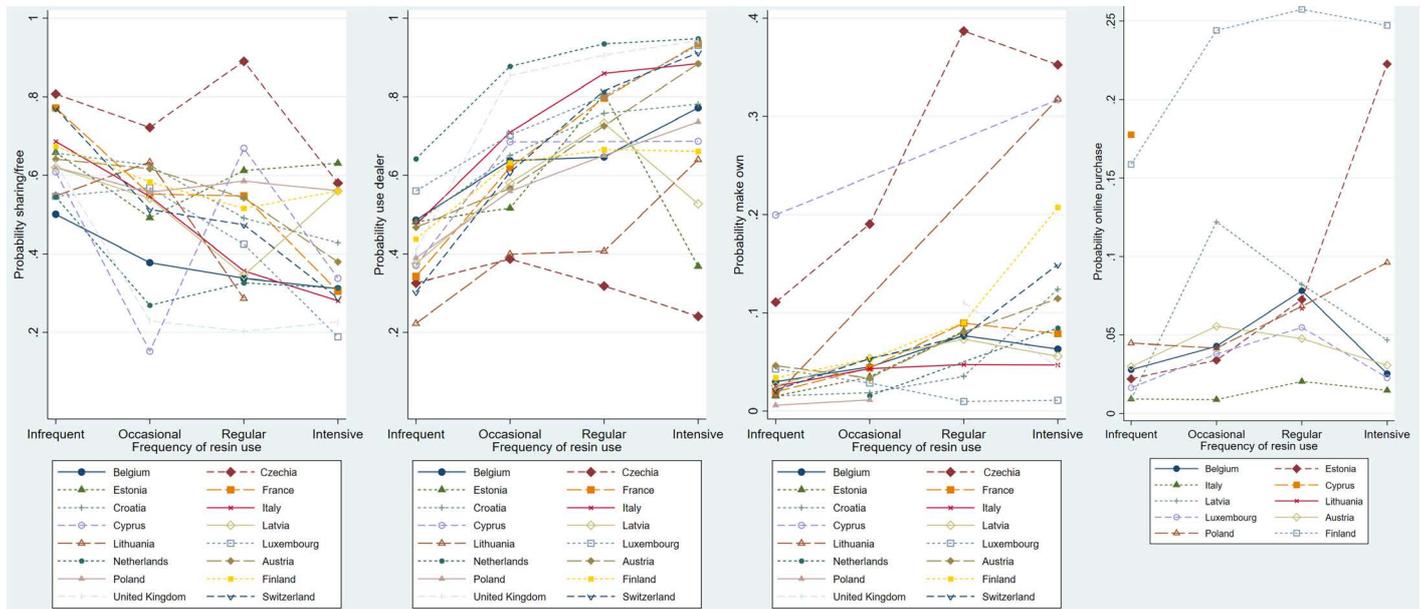
Figures are on different scales on y-axis to demonstrate patterns.

for those who use cannabis regularly (95 %) and intensively (97 %) is almost a certainty. Turning to growing herbal cannabis, the pattern is also generally one of likelihood increasing with frequency of use. This pattern is clearly most dramatic for Czechia, where growing for personal use is close to the other country estimates for infrequent use (3.9 %), but increases

with each category up to 32 % for intensive use. Finally, there is no clearly discernible pattern for online purchases, with the exception of the country that utilises online purchasing the most, Finland, where the predicted probability increases from 9.0 % for infrequent use to 26 % for regular use, with no further increase for intensive use.

FIGURE 2

Predicted probabilities of cannabis resin acquisition via sharing/free, dealer, making one's own and online by country and frequency of use



Figures are on different scales on y-axis to demonstrate patterns.

Figure 2 displays the analogous graphs for cannabis resin. The patterns are not identical to those for herbal cannabis, but it should be borne in mind that sample sizes are smaller for resin use ($N = 8\,667$). Notably in the first panel, there is no clear pattern across countries for acquiring resin through sharing or for free. Several countries do exhibit a pattern of decreasing probability with increasing frequency of use, as observed for herbal cannabis (Austria, Belgium, Croatia, Italy, Switzerland), but many do not. The results for using a dealer to obtain resin are more consistent, with most countries' probability increasing across frequency of use, but there are exceptions (Czechia, Estonia, Latvia). The pattern regarding making resin is also inconsistent, although notable increases with rising frequency of use occur for Austria, Croatia, Czechia, Finland, Poland and Switzerland. For online purchases, we again see an increase in probability with increasing frequency of use in Finland, although the main increase is from infrequent (16 %) to occasional (24 %) use. Estonia also exhibits a large increase in the use of online purchases, from regular (7.3 %) to intensive (22 %) use. Overall, the resin results are less clear than those for herbal cannabis. This difference highlights the importance of studying the relationship between frequency of use and sources of acquisition for individual cannabis products and types.

Discussion

In this paper, we sought to examine four sources through which people may obtain cannabis (sharing/free, buying from a drug dealer, growing/making and online purchasing) across 16 European countries. In addition, our aim was to explore how the use of these sources varies by frequency of use in relation to two forms of cannabis (herbal and resin). A main finding of our analysis is that, regardless of country, the use of dealers and growing one's own supply (and to a lesser extent online purchasing) increases with frequency of use, while sharing/free acquisition decreases with greater frequency of use. This pattern is highly consistent across countries for herbal cannabis, but shows some variation for cannabis resin. Importantly, there are still differences between countries, such that context-specific issues may influence the relationship between patterns of use and sources of acquisition. In the following paragraphs, we revisit the limitations of prior studies, and elaborate how our analyses contribute to filling existing research gaps, while also demonstrating the advantages of the EWSD specifically, and web surveys more broadly, in studying the relationship between patterns of use and sources of supply for illicit drugs.

First, previous studies of sources of cannabis acquisition, and of other illicit drugs generally, have not covered a wide variety of countries (Coomer et al., 2018). Analysis based on EWSD

data has shown that extending this research to a broader range of countries can yield novel insights. This includes our earlier research (Vuolo and Matias, 2020), which examined gender differences in relation to sources of drug acquisition and frequency of use, and also included MDMA and cocaine in the analysis. Across all substances, females who use drugs at low frequencies showed a significantly lower probability of using dealers than males; however, females were equally likely to use dealers when use was frequent. Except for the highest frequency of use, where, apart from herbal cannabis, the difference in sources of acquisition between men and women became non-significant, females are typically more likely than males to acquire drugs through sharing or for free. These results provide evidence that women and men use dealers to acquire illicit drugs at similar rates when use is more frequent (Vuolo and Matias, 2020).

The focus of the analysis in this study has been on country differences, with our study demonstrating wide variability across European countries in the use of the four most common sources for obtaining cannabis. Some consistent differences across countries emerged that are worth noting. For both herbal cannabis and resin, people who use cannabis in Czechia had a relatively high probability of using sharing/free sources, and a low probability of using a dealer. By contrast, residents of the Netherlands had a low probability of using sharing/free sources and a high probability of reporting that they buy their cannabis from a 'dealer'. The patterns of acquisition observed in the Netherlands are likely influenced by the country's coffeeshop system, through which primarily Dutch residents can buy and consume cannabis 'legally' (1).

Second, prior to the launch of the EWSD, studies that examined frequency of use and sources of acquisition were also highly limited in their geographic applicability, with most emanating from the United States (see, e.g. Hamilton, 2005). Here we confirm that while patterns can vary considerably if one considers a large group of countries, and even taking into account differences between countries' averages, increasing frequency of use reduces the likelihood of obtaining herbal cannabis from sharing/free sources. Meanwhile, increasing frequency of use also raises the likelihood of using a dealer across a wide range of countries. However, the differences observed between countries show that further research is still needed to understand some of the context-specific factors that may influence these patterns.

Third, we improve upon past studies by including additional important sources that apply specifically to cannabis (namely growing herbal cannabis or producing it in the case of resin), and to illicit drugs more broadly (online purchases). Growing

(1) Discussion on the legality of Dutch coffeeshops and cannabis sales is outside the scope of this paper. For further information see for example EMCDDA (2019).

herbal cannabis and producing cannabis resin did not always exhibit similar patterns in relation to frequency of use, with the exception of the high probability of both with increasing frequency of use in Czechia. In general, within each country, the probability of growing herbal cannabis or making resin tended to increase with frequency of use in a similar way to that seen for using a dealer, although the average rates were much lower. For online purchases, people who use cannabis in Finland had an unusually high probability of making online purchases, and this increased with frequency of use.

Fourth, prior research on sources of acquisition, including studies on their relationship to frequency of use, have typically only examined herbal cannabis (Hamilton, 2005), whereas we also included findings in relation to cannabis resin (see also Vuolo and Matias, 2020 for other EWSD research in this area). As noted above, the pattern of country averages for resin acquisition was relatively similar to that for herbal cannabis across the four sources. However, this consistency did not apply to the relationship with frequency of use. Unlike the straightforward trends across frequency of use for herbal cannabis relative to sources of supply (particularly sharing/free and use of a dealer), the pattern was not consistent for resin. Thus, our study underscores the importance of examining these two forms of the substance individually, although we additionally note that resin may be less readily available in some countries compared to herbal cannabis and there are fewer resin users overall.

Lastly, relative to general population surveys, our use of data from the EWSD provides a larger pool of individuals who use cannabis, especially at higher frequencies. This research took advantage of a novel web survey with a collaborative cross-country design. As such, the survey design allowed us to collect data from a sufficiently large sample of people who use drugs to conduct comparative analysis. Another advantage of the web-survey approach is the ability to collect comparable information across multiple country contexts, and our modelling approach took additional steps to increase comparability.

However, we also note a number of limitations with respect to our study. The limitations of the EWSD have been described in detail in other studies published alongside this report and also elsewhere (see Matias, 2022; and also Matias et al., 2019; Škařupová et al., 2019), but some specific issues relevant to our study are highlighted here. First, as expected in a web survey of people who use drugs, the EWSD attracted a higher proportion of participants reporting frequent use than is found in the general population, indicating that occasional or infrequent users may be less likely to feel that a survey about patterns of drug use applies to them. We again emphasise that the results are not generalisable to the population at large, but are useful for comparing characteristics of people who use drugs (Barratt et al., 2017). Second, we caution that our

country-specific estimates might be influenced by differences in respondent recruitment methods, to the extent that a certain recruitment technique could result in a disproportionate sample of individuals who acquire cannabis through one of the four sources studied here. We attempted to adjust for this possibility through the inclusion of covariates and a country cluster-correction. Still, we recognise that there may be other variables affecting the probability of sources of drug acquisition, and that even with those variables, differences in recruitment might still affect the results. In our figures, however, this would likely affect only the relative position of any given country, while the overall pattern across frequency of use would remain the same. Third, we highly encourage additional questions and response categories that investigate what it means to 'buy from a dealer'. Some people might not consider their friends to be dealers, even if they exchange money for cannabis, and thus they might not have selected this response. Similarly, those who purchase cannabis in Dutch coffeeshops might not categorise these exchanges as 'dealer' transactions, although the large number of responses for this source of acquisition in the Netherlands implies otherwise. Even the definition of a 'friend' with regard to being given (or sharing) cannabis for free could be context-dependent. Thus, future research should further probe the meaning of the responses to the questions on sources within and across countries.

Conclusion

In this study, we showed that there is considerable variation in the sources from which people who use drugs acquire cannabis across the 16 countries involved in the European Web Survey on Drugs (EWSD). Our results demonstrate the utility of an international approach to studying these sources of cannabis acquisition and their relationship with frequency of use. As such, we encourage researchers to consider additional countries and other substances besides cannabis. We also note the importance of looking at resin separately, as for this form of the drug the relationship between source and frequency of use was not as clear when compared to those for herbal cannabis. As the results of our analysis show, acquiring cannabis from a dealer and growing one's own supply (and to a lesser extent purchasing it online) increases with frequency of use, while obtaining it through sharing or for free decreases with higher frequency of use. While this pattern was highly consistent across countries for herbal cannabis, there was some variation for cannabis resin. Importantly, differences still exist between countries. As such, context-specific issues may influence the relationship between patterns of use and sources of acquisition, and thus require further research.

As the cannabis market continues to diversify, with the inclusion of edibles, tinctures, oils and concentrates, additional analyses should consider these novel forms. As this paper shows, web surveys can be a highly useful tool in collecting the data needed to conduct such studies.

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The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) is the central source and confirmed authority on drug-related issues in Europe. For over 25 years, it has been collecting, analysing and disseminating scientifically sound information on drugs and drug addiction and their consequences, providing its audiences with an evidence-based picture of the drug phenomenon at European level. Based in Lisbon, the EMCDDA is one of the decentralised agencies of the European Union.

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