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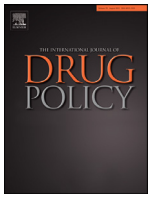

Research Paper

Deal or no-deal? Using administrative data to explore buyer motivation in online drug purchases and its association with community risk factors in Scotland

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ABSTRACT

Background: The expansion of online drugs markets has widened opportunities to purchase drugs, for both personal use and wider distribution, thus creating new potential public health risks. However, there is little research on the motivation of online drug purchasers or the level of risk that such transactions pose to different communities. Greater insights into the intended use of drug parcels arriving by post, and how this varies across communities could help law enforcement and health services develop more effective policies and better allocate resources to reduce drug-related harms.

Methods: We use Scottish administrative data about illegal drug parcels seized by the UK Border Force to create a new classification of 'buyer motivation' (based on type of drug, estimated number of doses purchased, and patterns of drug consumption). We identify three potential types of buyer motivation: personal consumption, heavy use or social dealing, and wholesale dealing; and examine the extent to which each type is associated with a range of drug-related community risk factors, thereby identifying potential variation in levels of public health risk.

Results: Communities to which drug parcels were destined differed significantly from the Scottish average across a range of factors; however, this varied by buyer motivation. Parcels thought to be purchased for heavy use or social dealing appeared to pose a greater risk within communities characterised by general deprivation, but especially health-related deprivation, with a high youth population but low unemployment rates; whereas those purchased for wholesale dealing appear most likely to pose a risk in communities with higher crime and unemployment rates.

Conclusions: Administrative data about intercepted drug parcels could be helpful in classifying the motivation of online drug purchasers and monitoring patterns of variation in potential public health risks at a community level. This could support law enforcement and public health agencies to develop more targeted drug-harm reduction strategies.

Introduction

The rapid development and expansion of the internet has produced a change in many consumer habits. Online markets have opened up the possibility of accessing a wider range of goods and services (Brand et al., 2020; Gupta & Arora, 2017), especially those for whom access to certain products had been limited (Schiffling et al., 2015). Unfortunately, this has also created 'a new channel for global drug diffusion' (Aldridge et al., 2018, p. 789). While the main source of drug supply in the UK remains linked to Organised Crime Groups, mainly from within the country (NCA, 2018), law enforcement agencies have reported a gradual increase in the volume of illegal drugs entering the UK, the majority of which are believed to be purchased through online markets (NCA, 2018; Police Scotland, 2020).

While much has yet to be learned about the way that cryptomarkets are used, and who uses them, the large product range and convenience offered by such markets (Barratt et al., 2014), has improved access to drugs for those who were existing purchasers, and enabled access to those who might not previously have had the opportunity or inclination to buy drugs. Moreover, it has allowed, and in some cases encouraged, the purchase of drugs for more than just personal use, such as social supply or wholesale dealing (Demant et al., 2018). While some harm reduction possibilities have been identified (Aldridge et al., 2018), there is serious concern about the risk that online drug purchasing poses to the communities to which such parcels are destined, both in terms

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of the pharmacological impact of drug misuse and the wider harms associated with the trafficking and distribution of drugs (Caulkins & Reuter, 2009; MacCoun & Reuter, 2001). However, a lack of research on transactions in online drug markets (Bancroft, 2020; Buxton & Bingham, 2015; Martin, 2014) means that relatively little is known about the likely motivation of purchasers and the corresponding public health risks to communities.

Public health risk and drug purchase motivation

A major problem faced by law enforcement is that the same technologies that allow buyers and sellers of drugs to interact on the internet anonymously make it extremely difficult to gather reliable intelligence on drug purchases (Buxton & Bingham, 2015; Martin, 2014). In addition, the expansion of broadband provision means that access to the internet is widespread and not constrained by geographical boundaries that might previously have prevented drugs entering some localities, including rural and remote communities (Matthews et al., 2021). As a result, many aspects of online drug markets remain hidden, including the characteristics of those who use them and what they use them for (Demant et al., 2018), making it difficult to assess the public health risks to individuals and communities.

Studies have shown both similarities and differences between online and offline drug markets, particularly in relation to consumption patterns (Tzanetakis, 2018). For instance, cannabis and its derivatives seem to be the most traded substances both online (Broséus et al., 2017; Christin, 2013; Dolliver & Kenney, 2016; Morelato et al., 2018; Rhumorbarbe et al., 2016; Tzanetakis, 2018) and offline (Black, 2020). However, MDMA, a recreational drug associated with younger people and clubbing, seems to be more popular in online markets (Broséus et al., 2017; Morelato et al., 2018; Moyle et al., 2019; Rhumorbarbe et al., 2016; Van der Gouwe et al., 2017). Importantly, the widespread availability of both 'soft' and 'hard' drugs via online markets (Christin, 2013; Morelato et al., 2018; Van der Gouwe et al., 2017), means that drug parcels are likely to vary in terms of their level of harm to the end users. Understanding the motivation for the purchase of drugs is, therefore, a valuable indicator of potential public health risk since purchases that are likely for wholesale or dealing pose a greater risk to communities than those that are intended only for personal consumption.

Differences in the volume and price displayed on cryptomarkets indicate that some buyers purchase in quantities with the clear intention of selling drugs to other people (Aldridge & Décary-Hétu, 2016; Demant et al., 2018). Therefore, most classification schemes for buyer motivation are based on volume of purchase. However, distinguishing between transactions that are purchased for personal consumption and those for onward sale can be complicated Demant et al. (2018). point out that some users buy larger parcels of certain types of drug (such as Cannabis) for both frequent personal consumption and for sharing with friends and acquaintances in the expectation that they will return the favour in the future or to derive a small profit (i.e. social dealing). Whereas larger purchases of other types of drug which are often used in social settings, including parties and clubs, (such as MDMA) are more likely to be linked to wholesale dealing activities (Aldridge & Décary-Hétu, 2016; Van Buskirk et al., 2016). Intelligence shared by Police Scotland also suggests that some online buyers purchase drugs on a large scale with the intention of having a supply for a longer period, aiming to reduce the risks of attracting the attention of law enforcement (i.e. one larger parcel may be less liable to interception than multiple smaller ones). While others may buy a large number of smaller parcels, even when their purpose is dealing, in an effort to evade the attention of law enforcement (Décary-Hétu & Quessy-Doré, 2017). Added to which, 'bulk buying' discounts and the fact that some vendors do not allow the purchase of small amounts of drugs, particularly single doses, may force personal users to buy more than they need (Aldridge et al., 2018; Aldridge & Décary-Hétu, 2014).

While all drug transactions carry potential risks at the individual level, some purchases could pose a greater public health risk to the wider community than others, both in terms of the harmfulness of the drugs themselves and the underlying vulnerability of the community. Previous analysis of drug parcels intercepted en route to Scotland found that there was significant spatial concentration in parcel destinations, which indicated that some communities were likely to be at greater risk of harm as a result of online drug purchases than others (Matthews et al., 2021). For example, drug parcels entering more deprived communities or areas where drug dependence represents a significant public health problem could be at particular risk. Although many parcels are likely to enter the country undetected (Aldridge et al., 2018; Martin, 2014), examining the characteristics of those that are intercepted provides an opportunity to appraise likely buyer motivation. Furthermore, linking this to community-level information about the intended destination enables more detailed analysis of levels of risk which could prove valuable to both law enforcement and public health organisations.

The drug problem in Scotland

The issue of illegal drugs entering vulnerable communities is of particular significance in Scotland, which is in the midst of a drugs crisis. Since 2012, drug-related death rates have increased sharply, reaching 1,339 deaths in 2020, the largest number ever recorded (National Records of Scotland, 2021). This is 3.6 times higher than that for the UK as a whole and the highest for any EU country (National Records of Scotland, 2021), prompting the Scottish Government (2021) to announce a 'national mission' to reduce Scotland's drug-related deaths. While the reasons for the high rate of drug-related deaths in Scotland are not entirely clear, reports suggest that it could be connected to higher levels of certain types of drugs, particularly cocaine, opioids and benzodiazepines (Department for Health and Social, 2021; SDF, 2018), all of which are increasingly likely to be entering the UK via postal services (NCA 2021).

Although Scotland has a significant drug problem at a national level, not all communities in Scotland are affected equally by drugs. Levels of drug dependence are highest in Scotland's most socially and economically deprived communities (ISD Scotland, 2019; Scottish Government, 2016a); and people living in the most deprived parts of Scotland are 18 times more likely to die of a drug-related death than those in the least deprived parts (National Records of Scotland, 2021). Reports indicate that problematic drug use in Scotland is also associated with a range of other social vulnerabilities within communities, including high crime rates, poor physical and mental health, unemployment and homelessness (Public Health Scotland, 2021; ScotPHO, 2021). However, there is surprisingly little empirical research on patterns of drug use at a community level in Scotland.

Having a better understanding of the potential public health risks posed by illegal drug parcels arriving into local communities in Scotland could prove valuable to both law enforcement and public health organisations. For example, distinguishing between drugs that were purchased for personal consumption and those that were bought with a view to distributing them more widely may help to identify otherwise hidden communities where drug-related harms are greater. This could inform more effective enforcement practices aimed at disrupting hidden drugs markets, and support public health efforts to reduce drug-related harm at a community level, which would ultimately contribute to the Scottish Government's mission of reducing drug-related deaths in Scotland.

Aims and methods

The overarching aim of this paper is to examine how drugs purchased in online markets may pose a risk to different types of Scottish communities based on the potential underlying motivation of the buyer. It has two specific objectives:

1. To use administrative data to classify the most likely 'buyer motivation' for illegal drug parcels that were intercepted by the UK Border Force en route to Scotland.
2. To determine whether the spatial distribution of drug parcels was associated with drug-related risk factors at a community level and, if so, what risk factors were associated with different types of buyer motivation.

The research uses a dataset provided by the National Crime Agency (NCA) containing information about illegal drug parcels that entered the UK via the postal service, destined for Scotland, and were seized by the UK Border Force between April 2011 and January 2016. The dataset was de-identified, so it did not contain any information about the purchaser; however, it did include details of the *type and quantity of drug* contained in the parcel which was used to develop a method for classifying drug purchases based on likely buyer motivation. It also included information about the Scottish *datazone* to which parcels were destined, which enabled analysis of community-related risk factors.[1] (For a detailed description of the dataset see Matthews et al., 2020). The limitations of this dataset are discussed at the end of the discussion section.

The study was conducted in two stages to address each research objective. Stage one involved developing a new classification of 'buyer motivation' based on the estimated number of individual doses contained in each drug parcel; while stage two involved determining the association between type of illegal drug parcel (based on buyer motivation) and different types of community level risk factors known to have associations with drug use. These two stages are described in detail below.

Stage 1: Classification of parcels based on likely buyer motivation

Previous approaches to classifying the motivation of drug purchasers have used either the price or the weight of drugs displayed on Cryptomarkets to distinguish between transactions that are likely to be for personal consumption and those likely to be for wholesale (Aldridge & Décary-Hétu, 2016; Demant et al., 2018; Morelato et al., 2018). Such approaches take advantage of the 'public' information displayed on these sites, but cannot reflect the actual drugs or quantities that are purchased. In addition, creating a binary distinction between self-consumption and wholesale is problematic, because some users of online markets buy larger quantities of drugs either because they are heavy personal users or for the purpose of social dealing (Demant et al., 2018). In previous classification schemes, purchases for heavy use and/or social dealing are most likely to have been encompassed under personal consumption. However, adding an additional category for this type of buyer motivation is important in terms of policing and public health because these packages are likely to be more harmful at a community level than those purchased for self-consumption.

Analysing the NCA dataset, our classification of buyer motivation used information about the type of drug and the estimated number of doses purchased to determine whether drugs purchased online were most likely to be for personal consumption, heavy use/social dealing, or wholesale dealing. This varies from previous approaches as it is based on data about the quantity and type of drugs actually purchased. We also drew extensively on police intelligence about patterns of drug use in Scotland and the most likely profile of user consumption for each drug type in order to validate our method of estimating dosage. A drugs expert from Police Scotland shared intelligence about the estimated street value for different drug types,[2] their common frequency of use (e.g. daily, weekly, monthly), and estimates of the average amount taken per dose in grams, millilitres and/or tablets (depending on the type of drug). For security and integrity reasons, we cannot disclose this intelligence; however, the dosage for each drug type was broadly defined as the typical amount that an average user would be expected to consume in a single episode (e.g. 0.25 g of Cannabis, 0.2 g of Cocaine, 1ml of GBL, etc.). The drug type, quantities and units of measurement for each parcel varied considerably; therefore, the estimated number of doses was obtained by applying an appropriate 'conversion factor' provided by Police Scotland to each parcel.[3]

Estimating the number of doses provides a reasonable basis for distinguishing between packages that were most likely purchased for self-consumption and those most likely for onward distribution than simply relying on weight or price alone because it is less likely to be affected by external factors, such as temporal or spatial variation in drug markets. Moreover, our estimates take account of consumption patterns for each type of drug, which has not been considered in previous attempts to distinguish between different motives for purchasing drugs online. However, it is important to acknowledge that there will be a degree of error around our estimated number of doses (as this can vary widely from user to user), which is a limitation of our approach.

Stage 2: Potential levels of risk and harm posed to Scottish communities

Having constructed our classification for buyer motivation, the second stage of analysis involved exploring the characteristics of the communities to which intercepted drug parcels were destined and determining whether different types of drug-related risk factors may be associated with buyer motivation. This enabled us to address our second objective, which was to determine whether patterns of online drug purchasing were associated with community vulnerability and public health risk.

Identifying suitable variables to include in the analysis required a trade-off between taking advantage of the small spatial scale of our data (datazones) and identifying a suitable range of risk factors (at the community level). In order to ensure that the analysis took sufficient account of 'communities', we identified eight variables that are known to be associated with drug use in Scotland and linked these to the NCA dataset at datazone level. Four of these variables were taken from the Scottish Index of Deprivation (SIMD) ,[4] while the other four were taken from the 2011 Census.[5] The variables are summarised below:

SIMD 2016 (overall deprivation)

Deprivation has been recognised as '*the single biggest structural driver of problem drug use*' in Scotland (House of Commons, 2019). The age-adjusted drug-related death rate in Scotland's 10% most deprived datazones is 18 times higher than that in the 10% least deprived datazones (National Records of Scotland, 2021). Therefore, we used the overall measure of deprivation from the SIMD in our analysis. We standardised SIMD rankings from 0 (lowest level of deprivation) to 1 (highest level of deprivation).

[1] Datazones are a statistical geography unit used in Scotland, designed to help monitor and develop policy at a small area level. Each datazone has a population size between 500 and 1000 based on the 2011 Census.

[2] We also conducted the analysis using the estimated street price of each package. However, we concluded that using an estimate for the number of doses was a better approach due to large variations in price and consumption patterns between different types of drugs.

[3] Conversion factors are used by the Home Office and Scottish Government to obtain comparable units of drug quantities or doses, but are not in the public domain. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/941659/seizures-drugs-user-guide.pdf; https://www.gov.scot/publications/drug-seizures-scottish-police-forces-2011-12/pages/17/.

[4] SIMD is a ranked scale of deprivation across Scottish datazones constructed from 38 indicators, including the following domains: income; employment; health, education, skills and training; geographic access to services; crime; and housing (Scottish Government, 2016b).

[5] The variables taken from the Census (2011) do not show the average for the Scottish population but the proportion of people that lived in each datazone and that belong to specific sociodemographic groups.

SIMD 2016 crime domain

Illicit drug use is associated with high crime rates at the local area level (House of Commons, 2019) and probability of victimisation at the national level (Robertson, 2016). The crime domain is based on police recorded crime rates per 10,000 population. It includes crimes of violence, sexual offences, domestic housebreaking, vandalism, drug offences, and common assault. We also standardised this variable from 0 (lowest crime rates) to 1 (highest crime rates).

SIMD 2016 health domain

Drug use in Scotland is associated with various aspects of ill-health (Black, 2020), especially mental health problems which are often caused by traumatic experiences (House of Commons, 2019). We included a standardised index (ranging from 0 to 1) of the SIMD health domain to reflect population health at a community level. This is comprised of several health indicators including illness, mortality, mental health, hospital admissions, emergency stays in hospital and low birth weight (Scottish Government, 2016b).

SIMD 2016 access domain

Reports suggest that recreational drug use in the UK is *"most prevalent in cosmopolitan areas and least prevalent among suburbanites and rural residents"* (Black, 2020); and drug-related death rates are highest in Scottish cities, including Glasgow and Dundee (National Records of Scotland, 2021). However, rates of problematic drug use are high in some of Scotland's most rural and remote local authorities (National Records of Scotland, 2021); and prior analysis of the NCA data found higher than expected rates of intercepted drug parcels were destined for remote and rural locations (Matthews et al., 2021). Therefore, we included a standardised index of the SIMD access domain, which evaluates ease of access to essential services (where 0 represents good access and 1 poor access) and acts as a proxy scale from urban to rural.

NSSEC 8 (people never employed or in long-term unemployment)

Unemployment is a known risk factor for drug use, especially amongst problematic users in Scotland (House of Commons, 2019). We used the National Statistics Socio-economic Classification (NS-SEC) to include in our analysis the proportion of the adult population within datazones that had never worked or were in long-term unemployment,[6] which ranged from 0 to 37%.

Population aged 18 to 29

Previous studies about Cryptomarket users (Kruithof et al., 2016; Tzanetakis, 2018) have indicated that younger people are more likely to buy drugs online compared to other age groups. Survey data also indicates that drug use in Scotland is most prevalent amongst younger adults (Robertson, 2016). Therefore, we included the proportion of people aged between 18 and 29 for each datazone (which according to the 2011 Census, ranged from almost 0 to around 85 percent).

Male population

In Scotland, 73% of drug-related deaths in 2020 involved males (National Records of Scotland, 2021). Information about the characteristics of drug offenders in Scotland was not available; however, data for England and Wales shows that around 88% of those arrested for drug offences were male (Allen & Tunnicliffe, 2020). According to the Census (2011), the proportion of male population at datazone level across Scotland ranged from 37% to 78%.

[6] The categories used by the NS-SEC are: 1) Higher managerial, administrative and professional occupations; 2) Lower managerial, administrative and professional occupations; 3) Intermediate occupations; 4) Small employers and own account workers; 5) Lower supervisory and technical occupations: 6) Semi-routine occupations; 7) Routine occupations; and 8) Never worked and long-term unemployed.

Non-white UK population

The link between drug use and ethnicity has not been studied in Scotland. In England, some ethnic minority groups seem to have higher drug use rates compared to white groups (Roberts, Lepps, Strang, & Singleton, 2016). Non-white ethnic groups are also overrepresented in arrests associated with drug offences relative to the population in England and Wales (Allen & Tunnicliffe, 2020). Although the proportion of Scottish residents from minority ethnic backgrounds is very small (around 5%), we included the proportion of non-white UK residents for each datazone which, according to the 2011 Census, ranged from 0% in some areas to 87% in others.

We aggregated the intercepted parcels by datazone and conducted descriptive analysis using our eight 'drug-related risk variables'. We then compared this to the Scottish average for all datazones to determine whether the profile of our 'parcel datazones' was more likely to include drug-related community risk factors. This allowed us to see whether there was evidence of geographical clustering that might indicate a higher level of public health risk within those communities to which online drug purchases were destined. We then used a multinomial logistic regression to predict the relative probability of each type of buyer motivation based on our drug-related community risk factors. A multinomial logistic regression is a 'series of binary logistic regressions, each comparing one particular group with each other group' (Osborne, 2017). The dependent variable for our analysis was the classification of buyer motivation (created at stage one), with the reference category being those parcels that were classified as being most likely for personal consumption. Thus, the results show whether certain drug-related community level risk factors were associated to a greater or lesser extent with the number of intercepted drug parcels believed to be motivated by heavy use/social dealing compared to those motivated by personal use, and the same for the number of drug parcels believed to be motivated by wholesale dealing. The multinomial model also controlled for drug type, but those results are not presented here.

Results

Stage 1: Classification of parcels based on likely buyer motivation

The NCA dataset contained information about 1,374 parcels, which contained 17 types of substance.[7] For ease of analysis, parcels were grouped into five broad types based on both seriousness (using the Misuse of Drugs Act 1974) and typical usage: Cannabinoids (typically used for recreational purposes); Benzodiazepines (typically used to relax and often referred to as 'downers'); Class A Stimulants (used to create euphoric feelings and often referred to as 'uppers'); Other Class A drugs; and Other drugs. Any parcels containing rare drugs, non-drug substances, and drugs in units for which we had insufficient information to estimate dosage were excluded from the analysis.[8] Table 1 shows the number of parcels included in the analysis (n = 1,129) by drug type and the units in which they were purchased. The most commonly intercepted drugs were Cannabinoids (32.4% of packages), Benzodiazepines (31.5%) and Stimulants (17.5%). Only 2.6% of parcels contained Other Class A drugs; however, a variety of other drugs were found in 13.0% of parcels.

Fig. 1 shows the estimated average number of single doses by drug type. The average for parcels containing Benzodiazepines, other Class A

[7] Note that no parcels were recorded as containing more than one type of substance.

[8] 245 parcels were excluded, including those containing: cutting agents (as these substances are used in the adulteration of drugs and the amount used depends on the purity of the final product); drugs rarely trafficked in Scotland (e.g. Khat and Methylphenidate); substances that were difficult to categorise in terms of dosage (e.g. New Psychoactive Substances, some opioids and steroids); and substances that were recorded in quantities for which dosage could not be ascertained (e.g. ampoules and some types of tablet).

Table 1
Types of drug parcels used in analysis.

Drug type	No. of packages	Specific drugs included	Units	ClassificationMisuse of Drugs Act
Cannabinoids	366	Cannabinoids	Grams	B
Benzodiazepines	356	Benzodiazepines	Grams/Tablets	C
Stimulants	198	Hallucinogens	Grams	A
		MDMA	Grams/Tablets	A
Other Class A drugs	30	Cocaine	Grams	A
		MDMA	Grams	A
		Heroin	Grams	A
Other drugs	179	Amphetamines	Grams	B
		Cathinones	Grams	B
		GBL	Grams/ML	C
		Ketamine	Grams/ML/Tablets	B
		Mephedrone	Grams	B

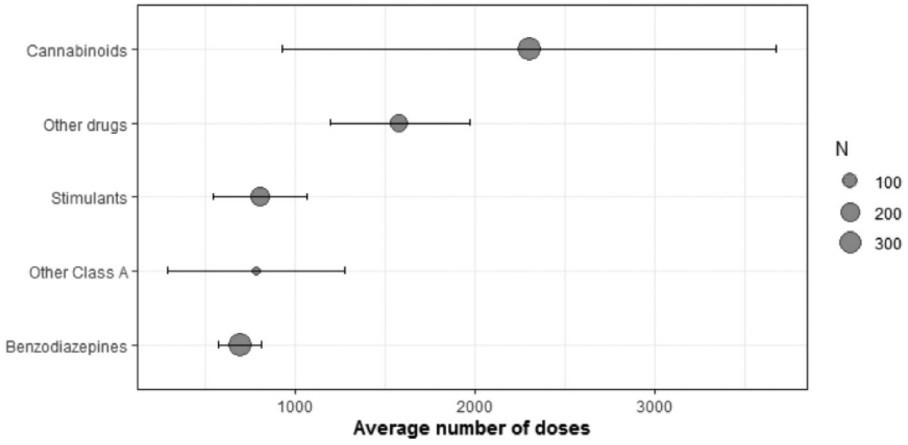

Fig. 1. Distribution of parcels by estimated number of doses and drug type.

drugs and Stimulants is much lower than for Cannabinoids and 'Other drugs', which suggests that the former parcels were most likely purchased with the intention of personal consumption. However, the very large confidence intervals observed for some drug types suggests large variation in the number of doses between parcels. This makes it difficult to draw any conclusion about buyer motivation based simply on dosage and drug type. Therefore, we examined the dosage distribution for each drug category in terms of quintiles (i.e. five equally distributed parts, each representing 20% percent of all packages). This method has been used previously to distinguish between different motivations of online purchases (based on Cryptomarket price) and has proved to be an effective way of identifying both cheap transactions associated with personal use and more expensive ones likely linked to re-sale (Aldridge & Décary-Hétu, 2014; Kruithof et al., 2016).

Table 2 shows the distribution of intercepted parcels based on the number of doses by quintile. For each drug type, we present the average (mean) and the maximum number of doses purchased within each quintile. Crosses at the top of each segment of the table, by drug type, indicate our hypothesised buyer motivation based on our classification scheme. In developing our classification, we had to make some assumptions; however, as far as possible these were based on pre-existing research and intelligence from police drugs experts about typical purchasing and consumption patterns in Scotland.[9]

We classified all parcels in Q1 as most likely for personal consumption. While the average (and maximum) number of doses varied, we were reassured by police intelligence that the purchase of each drug type in these quantities was in line with what might be expected for individual use over a period of approximately 1–2 months. Clearly this varies, from an average of 29 doses for Other Class A drugs (such as cocaine and heroin) to 117 doses for other drugs (such as amphetamines, GBL or mephedrone); however, this is in line with a lower expected frequency of usage for the former Class A drugs compared to the latter Class B and C drugs (which are often taken at higher dosages, or may be taken together).

We also classified all parcels in Q5 as most likely for wholesale dealing. All of the parcels in this quintile contained, on average, well over 1,000 doses, which is in line with the criterion for wholesale used by Aldridge and Décary-Hétu (2016) and Demant et al. (2018) and met Police Scotland expectations about the likely use of these parcels.

To classify the parcels in Q3 to Q5, we adopted an intelligence-led approach based on the distribution of the quintiles, previous research, and expert police knowledge about dosage and consumption patterns in Scotland. In doing so, we made the assumption that the parcels were purchased with intention of consumption within an eight week period in order to provide a plausible 'upper limit' for personal consumption, so that we could attempt to distinguish this from heavy use or social supply. While social supply is understood to be 'something "less" than drug dealing but "a little more" than possession for use' (Coomber et al., 2016, p. 256), we did not consider it feasible to attempt to differentiate between heavy personal consumption and social supply as the lines are somewhat blurred and our data not sufficiently fine grained. Therefore, we combined these into a single category that encompasses the potential motivation behind medium size purchases that do not fit into the categories of self-consumption or wholesale. Each drug type is discussed individually below.

Cannabinoids

The average number of doses contained in parcels within Q2 was more than five times greater than that for Q1. For a supply of eight weeks, this equated to a daily equivalent of around five doses, which was considered by policing experts to be towards the upper end of per-

[9] It is important to note that there is very little available publicly information on typical patterns of drug consumption, including number of 'doses' consumed daily, which is why police intelligence was used for classification purposes.

Table 2
Quintile distribution of parcels by estimated number of doses and drug type.

	Quintile per drug type based on average number of doses				
	Q1	Q2	Q3	Q4	Q5
Cannabinoids	+	++	++	++	+++
Average number of doses	52	273	566	996	10,596
Maximum number of doses	120	400	720	1200	240,000
Benzodiazepines	+	+	+	++	+++
Average number of doses	37	106	336	809	2,258
Maximum number of doses	67	167	500	1,000	14,333
Stimulants	+	++	++	+++	+++
Average number of doses	68	130	200	462	3,560
Maximum number of doses	100	160	212	600	11,700
Class A	+	++	++	+++	+++
Average number of doses	29	56	101	662	3,079
Maximum number of doses	40	60	135	1250	5000
Other drugs	+	++	++	+++	+++
Average number of doses	117	407	970	1,840	5,110
Maximum number of doses	200	700	1,000	2,000	25,000

+Likely self-consumption; ++ Likely Heavy Use/Social Dealing; +++ Likely wholesale.

sonal usage. The average size of parcels in Q3 was around twice as large (around 10 doses per day) and the parcels in Q3 were almost twice as large again (around 18 doses per day). While far larger than would be expected for even heavy users, police intelligence indicated that quantities of this level were more likely to be purchased for social supply rather than wholesale dealing in Scotland. Therefore, parcels in Q2, Q3 and Q4 were classified as most likely for heavy use/social dealing.

Benzodiazepines

The average number of doses contained in the parcels within Q2 equated to an estimated 2 doses per day; while an average parcel within Q3 equated to around 6 doses per day. Research shows that many Benzodiazepine users take them more than once per day, and often take quantities that exceed one dose within a single drug taking episode (Benetto, 2012; Johnson et al., 2016; SDF, 2014). Within the Scottish context, 'benzos' have been identified as a particular problem amongst drug users, and one of primary challenges in the fight against drug-related deaths (Matheson, 2021; National Records of Scotland, 2021; SDF, 2018). Therefore, drawing on police intelligence, we classified parcels in Q2 and Q3 as within the plausible boundaries of personal consumption. However, parcels contained in Q4 (at around 14 doses per day) were considered to be too large for personal consumption, even at the heavier end, but most likely for social, rather than wholesale, dealing (as they were 14 times smaller than the average parcel in Q5).

Class A stimulants

Popular party drugs, such as hallucinogens and MDMA (or Ecstasy), are more likely to be used recreationally at weekends rather than taken daily. The average number of doses of Stimulants for parcels within Q2 and Q3 equated to 2–4 per day, which was not considered to be plausible for personal consumption. However, based on typical consumption patterns within Scotland, it was considered plausible that such amounts may be purchased for heavy consumption and/or social dealing purposes. The average number of doses within Q4 (at around 60 per week) was considered implausibly large for social dealing and was, therefore, classified as most likely for wholesale.

Other Class A drugs

Drugs such as cocaine or heroin are used frequently by those with a serious addiction; however, are also used recreationally by others (Black, 2020), which makes packages difficult to classify based on potential motivation of purchase. Research has shown that these types of Class A drugs are typically purchased in smaller quantities via online markets (Aldridge et al., 2018; Kruithof et al., 2016). The average number of doses within parcels in Q2 and Q3 equated to 1–2 doses per day. On balance, based on police intelligence for Scotland, we classified these as most likely for either heavy personal consumption or small-scale social dealing. The parcels in Q4 contained an average of 12 doses per day so, given patterns of consumption observed in other studies (Aldridge et al., 2018; Kruithof et al., 2016), we classified these as most likely for wholesale dealing.

Other drugs

Given that this group contained multiple different drug types, with different consumption patterns, it was particularly difficult to classify these quintiles. Since the average dosage size for parcels in Q4 was over 1,000, these were automatically classified as for wholesale (as noted above). Parcels in Q2 and Q3 contained an average of 7 and 17 doses per day, respectively, which were considered to be implausible for personal consumption. However, police intelligence indicates that some of these drug types (such as GBL) are often consumed in larger than recommended doses by heavy users, and are often shared in a social setting (where users consume together). Therefore, it was considered plausible that parcels in Q2 and Q3 were most likely purchased for heavy personal use and/or social dealing.

Overall, 29.1% of parcels were classified as being most likely for personal consumption, 45.5% were classified as being for heavy personal use and/or social dealing, and 25.4% were classified as being for wholesale dealing. The fact that almost half of all parcels were classified in the heavy use/social dealing category is significant as debates about purchase for social supply are largely missing from the cryptomarkets literature, even though it has been examined in studies of drugs offered over social media (Demant et al., 2019; Moyle et al., 2019). It potentially suggests that online drug markets are a major contributor to the proliferation of dealing via friendship networks, which can be harder for law enforcement to monitor and take action against than large-scale dealers.

Stage 2: Potential levels of risk and harm posed to Scottish communities

Fig. 2 shows the population profile of the average Scottish datazone compared with the population profile of the average parcel datazone (i.e. those to which intercepted drug parcels were destined) at the aggregate level. The results show that, compared to the Scottish average, the parcel datazones had a higher level of overall deprivation, higher crime rates, and poorer health outcomes. They were less deprived on the access domain, which suggests that drug parcels were more likely than average to be destined for urban areas. The drug parcel datazones

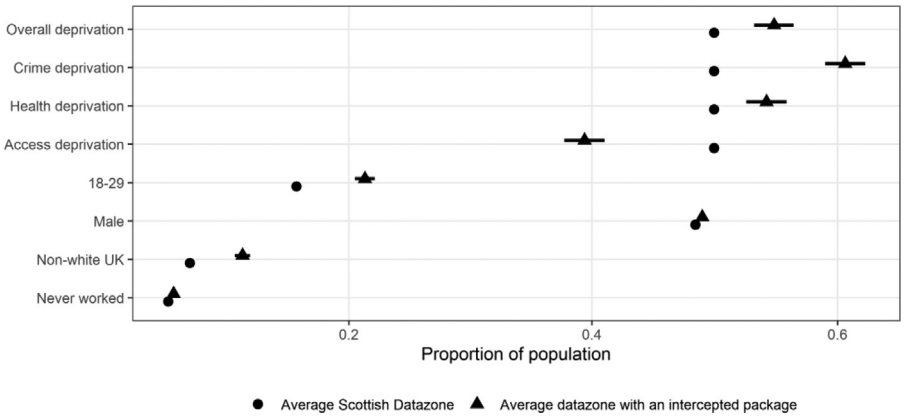

Fig. 2. Comparison of average datazones for all Scotland and those with intercepted drug packages.

Table 3
Multinomial logistic regression for motivation of drug purchasers (reference group = personal consumption) n = 1,129.

	Heavy use or social dealing					*Likely wholesale*				
	Coef.	S. E.	*P*-value	95% CI		Coef.	S. E.	*P*-value	95% C.I.	
				Lower Bound	Upper Bound				Lower Bound	Upper Bound
By total deprivation										
SIMD Index	2.063	0.429	0.000	1.221	2.905	1.786	0.476	0.000	0.853	2.719
% pop. 18 to 29	−2.480	0.868	0.004	−4.181	−0.779	*−1.067*	*0.929*	*0.251*	*−2.888*	*0.755*
% pop. male	*−5.364*	*2.925*	*0.067*	*−11.096*	*0.368*	*−0.924*	*3.029*	*0.760*	*−6.860*	*5.012*
% pop. non-white UK	3.234	1.272	0.011	0.742	5.726	2.597	1.317	0.049	0.016	5.178
% pop. never worked or long term unemp.	−11.467	3.406	0.001	−18.143	−4.791	*−1.938*	*3.408*	*0.569*	*−8.617*	*4.740*
By deprivation domain										
SIMD Health	1.323	0.454	0.004	0.433	2.212	*1.005*	*0.515*	*0.051*	*−0.004*	*2.015*
SIMD Crime	0.774	0.392	0.049	0.005	1.542	1.152	0.456	0.011	0.259	2.045
SIMD Access	0.727	0.321	0.023	0.099	1.355	*0.669*	*0.368*	*0.069*	*−0.052*	*1.391*
% pop. 18 to 29	−2.296	0.888	0.010	−4.037	−0.555	*−1.172*	*0.963*	*0.224*	*−3.059*	*0.716*
% pop. male	−5.862	2.958	0.048	−11.660	−0.063	*−1.638*	*3.081*	*0.595*	*−7.677*	*4.400*
% pop. non-white UK	3.267	1.306	0.012	0.706	5.827	*2.563*	*1.362*	*0.060*	*−0.106*	*5.232*
% pop. never worked or long term unemp.	−8.988	3.233	0.005	−15.325	−2.650	*−0.877*	*3.296*	*0.790*	*−7.337*	*5.582*

also had a higher than average proportion of young adults and non-white people within the population. However, there was little or no difference between parcel datazones and the average Scottish datazone in the proportion of the population that were male or that were unemployed or never worked.

The results from our two multinomial regression models are presented in Table 3. These show which drug-related characteristics were most strongly associated with the communities to which parcels purchased for heavy use/social dealing and for wholesale dealing were destined, compared to communities to which parcels for personal consumption were intercepted. Model 1, controls for overall deprivation, while Model 2 controls for the three individual deprivation domains (health, crime and access) separately.[10] The Census variables are the same in both models.

Model 1 shows that, compared to intercepted parcels that were classified as being most likely for personal consumption, parcels purchased for 'heavy use/social dealing' and 'likely wholesale' were significantly more likely to be destined to communities with higher levels of overall deprivation. Model 1 also shows some community differences in terms of Census characteristics, particularly for parcels in the heavy use/social dealing category. Drug purchases thought to be most likely for 'heavy use/social dealing' were significantly more likely than those purchased for personal consumption to be destined for areas with a lower than average unemployment rate, a higher than average non-white population, and a lower than average population of young adults. The large coefficient size for unemployment rates is particularly notable. Parcels classified as being for wholesale dealing showed far less difference in terms of community-level socio-demographic differences to those for personal consumption, although they were slightly more likely to be destined for areas with a higher than average non-white population.

Using the overall deprivation index conceals underlying differences, however, as Model 2 shows that (compared to the reference category of personal consumption) parcels classified as being for 'heavy use/social dealing' were significantly more likely to be destined for communities with greater levels of health morbidity, higher crime areas, and those within more rural locations; whereas, parcels classified for 'wholesale dealing' were significantly more likely to be destined for higher crime communities (although the coefficients for health and access deprivation were only just non-significant). The coefficient sizes for the SIMD variables suggest that community-level health morbidity was the factor most strongly associated with heavy use/social dealing. Table 3 also shows that the Census variables that were significant in Model 1 for the heavy use/social dealing category were also significant in Model 2; but, when controlling for SIMD indices separately, there is also a significant association with lower than average concentration of males in the population. There was no evidence of any significant difference between parcels most likely for wholesale dealing and those most likely for personal consumption in terms of association with any of the Census characteristics.

To look in more detail at the underlying relationship between community level measures of deprivation and buyer motivation, Fig. 3 shows the predictive margins from the multinomial regression models for the three buyer motivation categories for each deprivation domain (where 0

[10] This was done to avoid multicollinearity as measures for the crime, health and access domains are sub-sets of the overall SIMD.

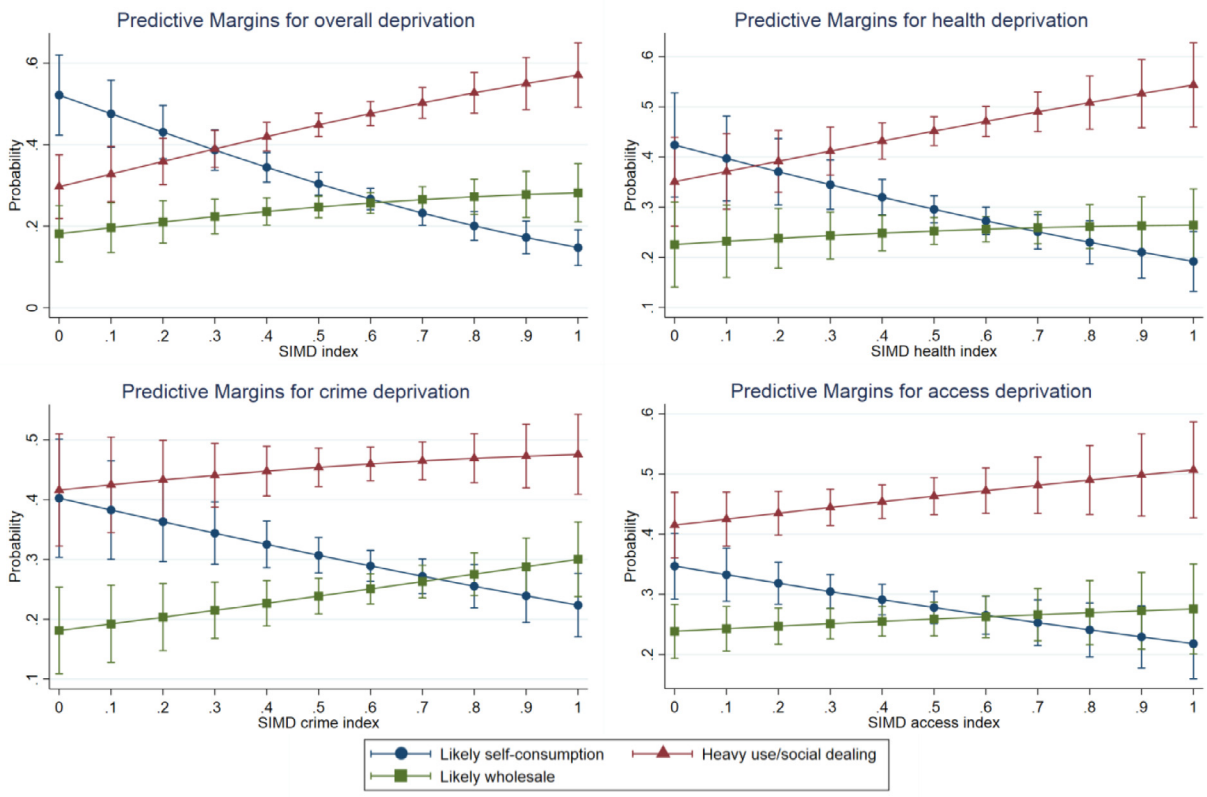

Fig. 3. Adjusted predictions for buyer motivation by deprivation domains.

represents low deprivation and 1 represents high deprivation).[11] Packages classified as being motivated by 'personal consumption' had a diminishing probability of being destined for areas with low deprivation (i.e. they were more commonly delivered to affluent areas), whereas packages classified as being most likely for 'heavy use/social dealing' had an increasing probability of being destined for deprived areas.

Surprisingly, packages that were classified as being for 'wholesale dealing' showed no notable difference in the probability of being destined for communities with high or low deprivation. Although similar patterns are observed for all three deprivation domains (crime, health and access), there are some important differences. For instance, parcels for heavy use/social dealing had an increasing probability of being destined for areas with higher health deprivation; however, this was less pronounced for the crime and access domains. Whereas, there wholesale parcels had an increasing probability of being destined for communities with higher crime rates; but this was not evident for the health and access domains. Drugs purchased for heavy use/social dealing purposes also had an increasing probability of being destined for rural areas, while the opposite was true for drugs purchased for personal consumption.

We also examined the predictive margins for the four Census variables (although, for reasons of space, the results are not shown here). Most notably, we found that drugs that were most likely purchased for heavy use/social dealing had a diminishing probability of being destined for communities with a higher proportion of young adults, whereas those that were classified as being for personal consumption had an increasing probability of being destined for such communities. Parcels for heavy use/social dealing also had a decreasing probability of delivery to areas with high unemployment rates and an increasing probability of being destined for communities containing a higher proportion of non-white people. Drugs that were most likely purchased for wholesale dealing showed a slightly inclining likelihood of being delivered to areas with higher levels of unemployment, but no other notable trend.

[11] Predictive margins are probability-based predictions of a fitted model at fixed values of some covariates and averaging or otherwise integrating over the remaining covariates (StataCorp, 2021).

Discussion

Problematic drug use and drug-related deaths pose a significant challenge to communities and policy makers in Scotland (House of Commons, 2019), and yet there is relatively little research about the flow of drugs into Scottish communities and how this might impact on local populations. The growing expansion of online drugs markets (Brand et al., 2020), and the rising tide of drugs entering communities via the international postal network (NCA, 2018), creates concern from both a law enforcement and a public health point of view; but tackling the problem is difficult without information about the likely purpose for which drugs are purchased. Building on the work of other scholars in this field (e.g Aldridge & Décary-Hétu, 2016.; Demant et al., 2018; Morelato et al., 2018), this paper makes two significant contributions.

First, we have proposed a new estimation method for classifying the intended motivation of those who purchase drugs from online markets. Administrative data relating to illegal drug parcels that are intercepted by the UK Border Force provide a unique, and largely untapped, resource by which to estimate the number of doses ordered by purchasers. With the support of expert policing intelligence, we found it plausible that almost half of all parcels intercepted en route to Scotland were most likely purchased for the purpose of heavy personal use or social dealing, whereas around a quarter each were most likely for personal consumption or for wholesale dealing. Prior studies have distinguished between people who buy drugs online for personal consumption and those who do so for wholesale purposes; so, the emergence of evidence about this large third category of drug purchaser makes a significant contribution to the literature in this field.

There is a scarcity of research on the extent to which people purchase drugs from cryptomarkets for the express purpose of social sup-

ply; however, research about social dealing on social media sites such as Facebook and Snapchat (Demant et al., 2019; Demant & Bakken, 2019; Moyle et al., 2019) indicates that social dealing, with or without financial gain, is not uncommon, and that buyers are often unaware of the risk of their actions (Demant et al., 2019). Moreover, when unable to buy directly from cryptomarkets themselves, users are most likely to approach friends for drugs before they contact known dealers or strangers (Barratt et al., 2016). The possibility that such a large proportion of online purchasers are buying drugs for more than just personal use raises concerns about the potential impact such behaviours might have on local communities.

The second contribution of this paper was to demonstrate significant variation in the spatial distribution of drug parcels destined for Scottish communities, and the degree of drug-related risk posed by such parcels, when motivation was taken into account. At a national level, Scotland's rate of drug-related deaths is higher than any other country in Europe (National Records of Scotland, 2021); however, at a local level, Scottish communities have been differentially impacted by drug-related problems and deaths, with those living in areas of high deprivation being the most likely to suffer (ISD Scotland, 2019). Our findings provide plausible evidence that drugs purchased via online markets are disproportionately destined for communities with higher levels of drug-related risk factors. Compared to the Scottish average, the communities to which drug parcels were addressed had higher levels of overall deprivation, including higher crime rates and greater health morbidity, and they were more concentrated in urban areas. However, to provide more nuanced information about community-level variation in the nature and extent of drug-related harm posed by online drug purchases, we examined how parcels classified into our three categories were differentially associated with risk factors at a community-level.

We found that the characteristics of areas to which illegal drugs were destined varied considerably depending on the likely reason they were purchased. Packages classified as being intended for wholesale dealing (rather than personal use) were significantly more likely to be destined for communities with higher crime rates. Whether these communities were also the site of distribution, or merely of delivery, is impossible to know; however, these findings suggest that law enforcement strategies aimed at tackling large scale supply of drugs are best focused on areas where drug-related, and other types of, crime are already prevalent. On the other hand, parcels classified as being intended for heavy use/social dealing were more likely than those purchased for personal use to be destined for communities with higher levels of health morbidity, but also higher levels of crime and poor access to services (i.e. more rural areas). Such parcels were also more likely to be destined for communities with a lower level of unemployment and a population with fewer younger people, a lower than average proportion of males, and a higher than average non-white population. In other words, these communities were quite distinctively different and may, therefore, benefit from closer scrutiny in terms of the local level factors that influence drug purchasing.

It is notable that packages classified as being for heavy use/social dealing were significantly more likely (than those for personal use only) to be destined for rural parts of Scotland. Using the same data, Matthews et al. (2021) found a higher than expected rate of drug delivery to remote and rural communities. Although such areas have not, historically, been associated with problematic drug use or increases in drug-related deaths, a recent study raises concern about the impact on rural Scottish communities of County Line recruitment and serious and organised crime groups establishing 'new operational bases' in such environs (Holligan et al., 2020). The fact that we found health morbidity to be the strongest deprivation-related community factor associated with drug parcels intended for heavy use/social dealing is of particular significance. The potential for greater, and more harmful, penetration of illegal drugs into remote and rural locations could increase public health risks within communities where law enforcement and public health agencies are unaware of such an emergent problem or ill-equipped to deal with the consequences. Greater analysis of administrative data on known drug purchases could, therefore, support pro-active efforts to highlight the patterning and motivation of those buying with an intention to supply others.

Limitations of this paper

Inevitably, the dataset used for this study and our proposed approach for classifying the potential motivation of online drug purchasers have some limitations, which creates uncertainty around our findings and means that our conclusions must be treated with some caution. In relation to the NCA dataset, there are three main limitations. First, it represents only illegal drug parcels that were intercepted within the international postal system. Therefore, it excludes information about other drugs intercepted within the UK domestic postal system and those trafficked into Scotland in other ways. Second, it is impossible to say how many drug parcels from abroad were not intercepted, or how representative those that are intercepted are. While NCA intelligence indicates that the vast majority of intercepted parcels were purchased via cryptomarkets, the dataset provides only a partial view of online drug sales and is, therefore, subject to an unknown degree of bias. Nevertheless, even a partial picture is valuable as it means data collected through law enforcement practices are not wasted and may help to draw attention to areas that are at risk from drug-related harms that authorities were not previously aware of.

Third, many drug parcels were recorded using different units of size and some categories included drugs with different consumption patterns. While we tried to overcome this using advice from Scottish policing experts, such differences may have impacted on our dosage estimates. It is also possible that the dataset may have contained a disproportionate number of large parcels (which are more likely to be linked with wholesale) as these were more likely than smaller packages to be seized by law enforcement officers. Nevertheless, our dataset did contain valuable and detailed information about a variety of drug parcels of different sizes and drug types, and we believe we have highlighted the potential value of using administrative data from law enforcement agencies to better explore drug purchasing behaviour. We propose that such data could be of significant value in terms of informing more targeted community-based policies and practices, enabling policing and public health strategies to focus not only on the 'obvious' communities where drug-related crime and deaths are high, but also in less recognised communities where drug purchasing may pose hidden risks. An improved design for further research would involve individual-level data that would allow detailed patterns of purchase to be taken into account. Although some buyers will probably find ways to disguise their identity, taking clustering of parcels into account may help to better detect patterns of purchase for dealing purposes.

In terms of our classification system, we had to make some assumptions about the most likely motivation of purchase based on the size and contents of intercepted parcels; however, we cannot be certain about why people were buying drugs, how long they were expected to last or what their intentions were with regards to supply. As a result, there is an unknown margin of error around our estimations and some parcels will have been incorrectly assigned. We have relied heavily on the judgements of policing experts who work in the field of drug misuse, but dividing the parcels by quintiles may have missed more accurate 'cut points' in terms of decision making. Nevertheless, with the data we had available, we propose this as an experimental method of classifying drug purchase motivation that could be developed and tested by other researchers, provided similar data could be made available, and improved by qualitative research with cryptomarket customers.

Conclusions

This study is highly relevant in the Scottish policy context, which has a significant problem with drug dependence and drug-related deaths

(NRS Scotland, 2021). Understanding more about the patterning and potential usage of drugs entering Scottish neighbourhoods via the postal system offers the potential to extend our understanding of how such purchasing might contribute to harm at a community level. Such information could better inform the work of both law enforcement and public health organisations, particularly in areas affected by problematic drug use. While focused on data for Scotland, this paper is of relevance to other jurisdictions where drugs pose a serious social issue.

We have demonstrated that drugs purchased online for different reasons appear to be associated with different types of drug-related risk factors at a community level and, therefore, could pose different types of harm to different groups within society. While some of our findings align with policy concerns that problematic drug use tends to be more concentrated within deprived Scottish communities (House of Commons, 2019), our research indicates that the relationship between online drug purchasing and deprivation is nuanced and the assumption that drug use is driven by overall levels of deprivation is an oversimplification of reality.

Given limitations of both data and method, these results should be interpreted with caution and further research would be needed to tease out the patterns observed in these data in more detail; however, our analysis has provided a starting point for disentangling the complexity of online drug purchasing motivation and community risk. As one of first empirical insights into the links between online drug purchase motivation and levels of drug-related community risk in the UK, we believe it will be of interest and value to those who may wish to conduct similar studies in other jurisdictions.

Declarations of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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