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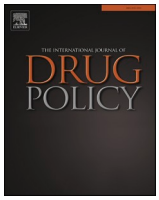

Research Paper

Recent increases in crack injection and associated risk factors among people who inject psychoactive drugs in England and Wales

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ABSTRACT

Background: Crack use is higher in the United Kingdom (UK) than other European countries. Crack is a stimulant with a short half-life, requiring frequent injection to maintain its euphoric effects, thus increasing the risk of blood borne viruses (BBVs) and skin and soft tissue infections (SSTIs). We assessed trends in the prevalence of current crack injection among people who inject drugs (PWID) and investigated harms and other factors associated with its use.

Methods: We used data from the annual Unlinked Anonymous Monitoring Survey of PWID, which recruits people who have ever injected psychoactive drugs through specialist services. Participants provide a biological sample and self-complete a questionnaire. We included participants from England and Wales who had injected in the past month. We examined trends in crack injection over time (2011–2021) and factors associated with crack injection using multivariable logistic regression (2019–2021).

Results: The proportion of people self-reporting crack injection in the past month almost doubled between 2011–2020/21, from 34 % (416/1237) to 57 % (483/850). Crack injection was more frequently reported by males than females (adjusted odds ratio 1.46, 95 % confidence interval: 1.15–1.87) and injected alongside heroin (6.67, 4.06–10.97) more frequently than alone. Crack injection was independently associated with injecting equipment sharing (1.64, 1.30–2.07), groin injection (2.03, 1.60–2.56) in the past month, overdosing in the past year (1.90, 1.42–2.53), homelessness in the past year (1.42, 1.14–1.77) and ever having hepatitis C infection (1.64, 1.31–2.06).

Conclusion: Crack injection has increased significantly over the past decade in England and Wales. People injecting crack are more likely to engage in behaviours that increase the risk of BBV and SSTI acquisition, such as needle/syringe sharing, groin injection and polydrug use. Harm reduction and drug treatment services should adapt to support the needs of this growing population of people injecting stimulants.

Background

The United Kingdom (UK) has one of highest reported levels of drug use in Western Europe (EMCDDA, 2021). Although heroin is the preferred drug for the majority of people who inject drugs (PWID) in the UK (EMCDDA, 2019), crack cocaine is the most commonly used stimulant (Public Health England, 2021a). Patterns of drug use change over time and are often impacted by drug availability, purity, price and associated stigma, with different secondary drugs phasing in and out of popularity (UK Health Security Agency, 2022).

In recent years, there has been a notable increase in the availability of crack cocaine to the UK drug market (EMCDDA, 2019; Public Health England et al., 2021; United Nations Office on Drugs and Crime, 2021), thought to be driven by a large increase in Colombian cocaine production since 2013 due to political changes in the country (Home Office, 2020). Crack cocaine is an alkaloid form of cocaine obtained by heating a solution of cocaine hydrochloride and sodium bicarbonate until small crystalline rocks form (Hope et al., 2005). Crack cocaine can either be smoked or dissolved in an acid and injected (Hope et al., 2005); although globally smoking is the most common route of adminstration (National

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Drug Intelligence Center, 2003). The majority of crack cocaine in the UK is manufactured locally from imported powder cocaine; the availability and purity of powder and crack cocaine are therefore similar (Public Health England et al., 2021). Currently crack use in the UK is higher than in any other European nation (Home Office, 2020).

Crack cocaine has been associated with a number of health-related harms and behaviours, each impacting the individual and society as a whole (Hope et al., 2005). Stimulants such as crack provide a short-lived intense euphoria. As a result, injecting frequency is often higher than that seen in people who inject opiates (Hatsukami & Fischman, 1996) with "binging" behaviour often exhibited. Frequent injecting increases an individual's potential for exposure to blood borne viruses (BBVs) through contaminated injecting equipment and could increase the risk of developing bacterial injection site infections through poor injection hygiene (Paquette et al., 2013; Trayner et al., 2020).

Concurrent use alongside available brown heroin, through the practice of "snowballing", is common in the UK, as both are soluble in acid and can be dissolved and injected together (Drug Science, 2023; Public Health England, 2019). Concurrent use places the individual at increased risk of overdose (Public Health England, 2019). Deaths associated with cocaine have increased to levels over five times that seen in 2012 (Home Office, 2020). During a crack cocaine "binge", an individual's sole focus can be on sourcing drugs, often impacting health needs and criminal behaviours (Hope et al., 2005). Opiate and cocaine use is thought to be responsible for 95 % of drug-related crime in the UK (Home Office, 2020), with acquisitive crimes such as shoplifting and burglary most commonly associated with crack use (Gossop et al., 2006; Public Health England, 2019).

Although national estimates for crack cocaine use and drug treatment data indicate that crack use in the UK has increased in recent years (Public Health England et al., 2021), little data are available to describe the prevalence of crack injection among PWID outside of drug treatment settings. Use of drugs by injecting increases the risk of human immunodeficiency virus (HIV), hepatitis B (HBV) and C (HCV), as well as the risk of other injecting related harms; the increased frequency of injecting associated with crack use amplifies these risks. Here, we describe trends in crack cocaine injection among people currently injecting drugs in England and Wales over the last decade and investigate factors associated with current injection of crack in recent years.

Methods

Data source

We used data from a long-standing cross-sectional survey of PWID conducted annually across England, Wales and Northern Ireland, the Unlinked Anonymous Monitoring (UAM) Survey. Survey methods are described elsewhere (Hope et al., 2014; Noone et al., 1993). Briefly, individuals who have ever injected drugs are recruited through a variety of services provided by specialist drug and alcohol agencies (e.g., harm reduction, drug treatment, outreach, etc.). Participants are asked to provide a dry blood spot (DBS) sample and self-complete a short questionnaire containing questions on demographics, injecting and sexual behaviours and uptake of harm reduction interventions, as well as BBV testing and treatment. The participant's questionnaire and DBS sample are linked; however, as no personal identifiers are collected in the questionnaire, data remain anonymous. Participants are eligible to take part once every calendar year if they have ever injected a psychoactive drug.

DBS samples are tested for markers of ever infection with BBVs: antibodies to HIV (anti-HIV), HBV core antigen (anti-HBc) and HCV (anti-HCV) to determine ever infection. Testing of HCV RNA is conducted to determine current HCV infection status. All laboratory testing is conducted at the Virus Reference Department, UK Health Security Agency (UKHSA), London, using previously reported methods (Cullen et al., 2015). The UAM Survey has multi-site ethical approval (London Research Ethics Committee: 98/2/051 and UKHSA).

Information on UAM Survey recruitment for the years used in these analyses (2011–2021) can be found in Supplementary Table 1.

Statistical analyses

Participants were eligible for inclusion if they took part in the UAM Survey in England or Wales; data for Northern Ireland were excluded due to a continued low prevalence of crack cocaine injection there. Individuals were excluded from all analyses if they had incomplete data for age ($n = 220$) and/or gender ($n == 37$). Current crack injection was defined as self-reported injection of crack in the past month (28 days). All analyses were carried out using Stata 15 (College Station, TX: StataCorp LP). Further information on variables used in these analyses can be found in Supplementary Table 2.

Trends in current crack injection

Ten-year trends in current crack injection were explored between 2012 and 2021. As participants can take part in the UAM Survey every year, repeat participations during the ten-year period were excluded ($n == 1264$). The proportion of people currently injecting crack each year between 2012 and 2021 were compared to 2011 as baseline using logistic regression and adjusting for gender, age at participation and region of survey recruitment. Trends are presented for all people currently injecting and a subset of this population who reported first injecting drugs in the past three years (recent initiates). Data for 2020 and 2021 were combined due to limited recruitment during these years as a result of the coronavirus-19 (COVID-19) pandemic (UK Health Security Agency, 2022).

Injection of crack compared to the injection of other drugs in recent years

Descriptive analysis was carried out to characterise people currently injecting crack cocaine in recent years (2019–2021) and compare them to those currently injecting other drugs (statistical significance $p < 0.05$); data from 2019–2021 were combined to allow for a sufficient sample size for analyses. People missing data on current drug injection were excluded ($n == 419$), as well as those who indicated they had already taken part in the UAM Survey in the three-year period ($n == 98$).

Factors associated with current crack injection in recent years

Factors associated with current crack injection in recent years (2019–2021) were explored using multivariable logistic regression (complete-case analysis). Only data for first participations were included; participants who indicated they had already taken part in the UAM Survey within the three-year period were excluded ($n == 98$). Demographic, biological, and behavioural variables were considered for inclusion in these analyses if they were associated with crack injection in prior literature or hypothesised to be of interest. All variables found to be significant in univariate analyses (statistical significance $p < 0.05$) were included in the multivariable model. Polydrug use was not included due to collinearity with heroin and amphetamine injection. A backward stepwise approach was used to construct the final model (likelihood ratio test: $p < 0.05$).

Results

Trends in current crack injection

Among all people currently injecting drugs recruited in 2011, 21 % ($n == 272$) were female; this rose to 25 % ($n == 232$) in 2020/2021 ($p = 0.03$). The median age at participation was 34 years (interquartile range (IQR): 29–40 years) in 2011 and rose to 40 (IQR: 35–46 years) in 2020/2021 ($p < 0.001$). Among recent initiates currently injecting drugs, 30 % ($n == 42$) were female in 2011, compared with 40 % ($n == 27$) in 2020/2021 ($p == 0.174$). Median age of participation was 27 (IQR:

22–35 years) in 2011, rising to 35 (IQR: 29–40 years) in 2020/2021 ($p < 0.001$).

The proportion of people self-reporting currently injecting crack almost doubled over the last decade, from 34 % in 2011 to 57 % in 2020/2021, with people currently injecting in 2020/2021 being over two times more likely to report crack injection than in 2011 (adjusted odds ratio (aOR) 2.46, 95 % confidence interval (CI) 2.05–2.96) (Table 1). An increase was also seen in the proportion of recent initiates currently injecting crack, from 30 % in 2011 to 65 % in 2020/2021, with recent initiates reporting in 2020/2021 having over four times the odds of reporting crack injection compared to in 2011 (aOR 4.45, 95 % CI 2.33–8.48).

Characteristics of people currently injecting in recent years

Between 2019 and 2021, 4821 eligible participants with age and gender reported, took part in the UAM Survey and answered the question about current injecting (92 % of total sample). Of these, 49 % (2365/4821) reported that they had injected any psychoactive drug in the past 28 days, thus "currently" injecting.

Among those reporting currently injecting, the median age of participation was 40 years (IQR 34–46 years), the majority were male (73 %, 1737/2365), had ever experienced homelessness (80 %, 1826/2296) and reported ever being imprisoned (68 %, 1541/2257). In the past month, 93 % (2142/2302) reported heroin injection, 10 % (236/2302) amphetamine injection and 58 % (1334/2302) crack injection. The proportion of people currently injecting reporting crack injection remained high in recent years and was not significantly different across surveys (2019 vs. 2020/2021 aOR 0.91, 95 % CI 0.77–1.08).

Under two thirds (62 %, 1274/2055) of those reporting current injection of any drug between 2019 and 2021 had ever had HCV infection (anti-HCV positive), while 24 % (510/2117) had chronic HCV infection (HCV RNA positive). A small proportion of people currently injecting drugs were living with HIV (0.58 %, 12/2056) and 8.0 % (165/2057) had ever had HBV infection (HBV core antigen positive).

Injection of crack compared to the injection of other drugs in recent years

The characteristics of participants during 2019–2021 who reported currently injecting crack are compared to those of participants who reported currently injecting other drugs in Table 2. A higher proportion of people who reported current crack injection were male (76 % vs. 71 %; $p == 0.010$) and had ever been imprisoned (73 % vs. 63 %; $p < 0.001$), than people who reported current injection of other drugs. Age ($p == 0.022$), region of recruitment ($p < 0.001$) and homelessness ($p < 0.001$) were also significantly different among those people who reported currently injecting crack compared to people who injected other drugs.

With regard to injecting risk behaviours in the past month, a higher proportion of people who reported current crack injection also reported injecting heroin (97 % vs. 87 %; $p < 0.001$) and/or any polydrug injection (99 % vs. 18 %; $p < 0.001$), groin injection (43 % vs. 27 %; $p < 0.001$) and sharing of any injecting equipment (43 % vs. 31 %; $p < 0.001$) than people who reported currently injecting other drugs; a lower proportion reported injecting amphetamines in the last month (9.0 % vs. 12 %; $p == 0.020$). Those reporting current crack injection were more likely to report injecting drugs more than once a day on the last day they injected (77 % vs. 65 %; $p < 0.001$) and a non-fatal overdose in the past year (26 % vs. 16 %; $p < 0.001$) than people currently injecting other drugs.

Infections among those injecting crack in the past month and those who injected drugs other than crack in the past month were similar. However, a higher proportion of people reporting crack injection ever had HCV (anti-HCV positive) (68 % vs. 54 %; $p < 0.001$).

Factors associated with current crack injection in recent years

Factors associated with current crack injection in multivariable analyses are presented in Table 3. Self-reported current crack injection varied regionally across England. Individuals recruited in the South of England had over three times the odds of reporting current crack injection than the baseline group, of those recruited in the North (aOR

Table 1
Trends in crack injection among i) people current injecting drugs and ii) recent initiates to injecting who reported current drug injection participating in the UAM Survey: England and Wales, 2011 to 2021.

Population	Year	N	Crack injection		Univariable analyses			Multivariable analyses		
			n	%	OR	95 % CI	*p* value[a]	aOR	95 % CI	*p* value[b]
PWID reporting current drug injection[c]	2011	1237	416	34	1.00	.	.	1.00	.	.
	2012	1590	581	37	1.14	0.97–1.33	0.108	1.18	1.00–1.38	0.047
	2013	1458	557	38	1.22	1.04–1.43	0.014	1.33	1.13–1.56	0.001
	2014	1306	544	42	1.41	1.20–1.66	<0.001	1.51	1.28–1.78	<0.001
	2015	1208	570	47	1.76	1.50–2.08	<0.001	1.87	1.58–2.21	<0.001
	2016	1275	694	54	2.36	2.01–2.77	<0.001	2.51	2.13–2.97	<0.001
	2017	1152	595	52	2.11	1.79–2.49	<0.001	2.35	1.98–2.79	<0.001
	2018	1273	780	61	3.12	2.65–3.68	<0.001	3.00	2.54–3.55	<0.001
	2019	1259	734	58	2.76	2.34–3.25	<0.001	2.84	2.41–3.36	<0.001
	2020/2021	850	483	57	2.60	2.17–3.11	<0.001	2.46	2.05–2.96	<0.001
Recent initiates to injecting reporting currently injecting drugs[d]	2011	132	40	30	1.00	.	.	1.00	.	.
	2012	235	71	30	1.00	0.63–1.58	0.986	1.15	0.71–1.86	0.546
	2013	163	52	32	1.08	0.66–1.77	0.768	1.26	0.75–2.10	0.388
	2014	137	42	31	1.02	0.60–1.71	0.950	1.06	0.62–1.80	0.994
	2015	118	52	44	1.81	1.08–3.05	0.025	2.00	1.17–3.42	0.014
	2016	108	55	51	2.39	1.41–4.05	0.001	2.91	1.68–5.04	<0.001
	2017	106	48	45	1.90	1.12–3.24	0.018	2.22	1.27–3.87	0.005
	2018	129	80	62	3.76	2.25–6.28	<0.001	3.58	2.11–6.09	<0.001
	2019	140	70	50	2.30	1.40–3.78	0.001	2.44	1.45–4.10	0.001
	2020/2021	66	43	65	4.30	2.30–8.06	<0.001	4.45	2.33–8.48	<0.001

OR, Odds ratio; aOR, Adjusted odds ratio; CI, Confidence interval.
[a] *p* value generated using Pearson's chi-squared test.
[b] *p* value generated using logistic regression analyses, adjusting for age gender and region of recruitment.
[c] Current drug injection is defined as reporting drug injecting in the past month.
[d] A recent initiate to injecting is someone who began injecting drugs within the 3 years prior to their survey participation.

Table 2
Characteristics of people participating in the UAM Survey who reported current crack injection compared with those who reported current injection of any other drug*: England and Wales, 2019-2021 ($N = 2365$).

Characteristics		PWID currently injecting other drugs		PWID currently injecting crack		*p* value[a]
		n	%	*n*	%	
Demographics						
Gender	Female	282	29 %	325	24 %	
	Male	686	71 %	1009	76 %	0.010
Age	<25 years	32	3.3 %	24	1.8 %	
	25-34 years	240	25 %	300	22 %	
	≥35 years	696	72 %	1010	76 %	0.022
Region	North of England	317	33 %	255	19 %	
	London	102	11 %	151	11 %	
	Midlands & East of England	265	27 %	405	30 %	
	South of England	180	19 %	440	33 %	
	Wales	104	11 %	83	6.2 %	<0.001
Risk behaviours						
Recent initiate to injecting[b]	No	345	94 %	454	91 %	
	Yes	23	6.3 %	43	8.7 %	0.188
Drugs injected[c]	Heroin	843	87 %	1299	97 %	<0.001
	Powder cocaine	153	16 %	253	19 %	0.050
	Amphetamine	116	12 %	120	9.0 %	0.020
	Other	30	3.1 %	47	3.5 %	0.576
Polydrug use[c]	No	307	82 %	7	1.4 %	
	Yes	69	18 %	502	99 %	<0.001
Sharing of needles or syringes[c]	No	789	83 %	982	75 %	
	Yes	158	17 %	323	25 %	<0.001
Sharing of any injecting equipment[c]	No	651	69 %	743	57 %	
	Yes	298	31 %	568	43 %	<0.001
Injecting frequency on last day injected	Once a day	301	35 %	278	23 %	
	Two times or more	567	65 %	942	77 %	<0.001
Groin injection[c]	No	700	73 %	753	57 %	
	Yes	264	27 %	572	43 %	<0.001
Overdose in past year	No	774	84 %	931	74 %	
	Yes	150	16 %	329	26 %	<0.001
Ever engaged in transactional sex	Never	305	84 %	418	85 %	
	At some point	57	16 %	76	15 %	0.886
Structural factors						
Homelessness	No	246	26 %	209	16 %	
	Yes, but not the past year	281	30 %	338	26 %	
	Yes, in the past year	414	44 %	754	58 %	<0.001
Ever imprisonment	No	345	37 %	351	27 %	
	Yes	581	63 %	928	73 %	<0.001
Infection status						
Ever having HCV infection (anti-HCV)	Negative	394	46 %	371	32 %	
	Positive	454	54 %	780	68 %	<0.001
Having chronic HCV infection (HCV RNA)	Negative	269	59 %	471	60 %	
	Positive	185	41 %	309	40 %	0.695
Ever having HIV infection	Negative	846	100 %	1143	99 %	
	Positive	4	0.5 %	7	0.6 %	0.680
Ever having HBV infection (anti-HBc)	Negative	780	92 %	1062	92 %	
	Positive	70	8.2 %	89	7.7 %	0.681
Skin or soft tissue infection in past year	No	229	67 %	313	65 %	
	Yes	115	33 %	167	35 %	0.685

* Current injection is reporting injecting a drug in the 4 weeks prior to survey participation.
[a] *p* value generated using Pearson's chi-squared test.
[b] A recent initiate to injecting is someone who began injecting drugs within the 3 years prior to their survey participation.
[c] in the past month.

Variable completeness: recent initiate to injecting 98 %, injecting heroin 97 %, injecting powder cocaine 97 %, injecting amphetamine 97 %, injecting any other drug 97 %, polydrug use 100 %, sharing needles and syringes 97 %, sharing needles, syringes and other injecting equipment 97 %, injecting frequency on last day injected 90 %, groin injection 99 %, overdose in the past year 94 %, ever transactional sex 95 %, homelessness 97 %, ever imprisonment 95 %, ever HCV infection 87 %, chronic HCV infection 90 %, ever HIV infection 87 %, ever HBV infection 87 %, skin or soft tissue infection 94 %.

3.48, 95 % CI: 2.53–4.78). The odds of reporting current crack injection were also significantly higher in participants recruited in London and the Midlands and East of England when compared with baseline (aOR 2.46, 95 % CI 1.66–3.63 and aOR 2.21, 95 % CI 1.65–2.97 respectively). Current crack injection was more frequently reported by males than females (aOR 1.46, 95 % CI: 1.15–1.87), among those who had ever been imprisoned (aOR 1.36, 95 % CI: 1.07–1.73) and among individuals homeless in the past year (aOR 1.42, 95 % CI: 1.14–1.77).

Individuals reporting crack injection in the past month had over six times the odds of reporting that they also injected heroin (aOR 6.67, 95 % CI: 4.06–10.97). Current crack injection was also independently associated with sharing any injecting equipment in the past month (aOR 1.64, 95 % CI: 1.30–2.07) and groin injection in the past month (aOR 2.03, 95 % CI: 1.60–2.56), injecting more than once on the last day of injection (aOR 1.76, 95 % CI: 1.39–2.23) and reporting a non-fatal overdose in the past year (aOR 1.90, 95 % CI: 1.42–2.53).

PWID reporting current crack injection had almost double the odds of having ever been infected with HCV (anti-HCV positive) (aOR 1.64, 95 % CI: 1.31–2.06) compared to those injecting other drugs.

Although significant in univariable analyses, after adjustment, no

Table 3
Factors associated with self-reported crack injection in the preceding month among PWID in England and Wales: 2019 to 2021 (N == 1669).

Factors		Univariable analyses			Multivariable analyses		
		OR	95 % CI	p value[a]	aOR	95 % CI	p value[b]
Demographics							
Gender	Female	1.00	.		1.00	.	
	Male	**1.28**	1.06–1.54	0.010	**1.46**	1.15–1.87	0.002
Age	<25 years	1.00	.		[c]		
	25-34 years	**1.80**	0.96–2.91				
	≥35 years	**2.40**	1.09–3.19	0.022			
Region	North	1.00	.		1.00	.	
	London	**1.84**	1.36–2.49		**2.46**	1.66–3.63	
	Midlands & East of England	**1.90**	1.52–2.38		**2.21**	1.65–2.97	
	South	**3.04**	2.39–3.86		**3.48**	2.53–4.78	
	Wales	0.99	0.71–1.38	<0.001	0.94	0.61–1.44	<0.001
Risk behaviours							
Injected heroin[d]	No	1.00	.		1.00	.	
	Yes	**5.50**	3.75–8.09	<0.001	**6.67**	4.06–10.97	<0.001
Injected amphetamine[d]	No	1.00	.		[c]		
	Yes	**0.73**	0.55–0.95	0.02			
Sharing needles, syringes, spoons, filters or mixing containers[d]	No	1.00	.		1.00	.	
	Yes	**1.67**	1.40–1.99	<0.001	**1.64**	1.30–2.07	<0.001
Injecting frequency on last day injected	Once a day	1.00	.		1.00	.	
	Two times or more	**1.80**	1.48–2.18	<0.001	**1.76**	1.39–2.23	<0.001
Groin injection[d]	No	1.00	.		1.00	.	
	Yes	**2.01**	1.68–2.41	<0.001	**2.03**	1.60–2.56	<0.001
Overdose in past year	No	1.00	.		1.00	.	
	Yes	**1.82**	1.47–2.26	<0.001	**1.90**	1.42–2.53	<0.001
Structural factors							
Homeless in the past year	No	1.00	.		1.00	.	
	Yes	**1.75**	1.48–2.08	<0.001	**1.42**	1.14–1.77	<0.001
Ever imprisoned	No	1.00	.		1.00	.	
	Yes	**1.57**	1.31–1.88	<0.001	**1.36**	1.07–1.73	0.013
Infection status							
Ever having HCV infection (anti-HCV)	Negative	1.00	.		1.00	.	
	Positive	**1.82**	1.52–2.19	<0.001	**1.64**	1.31–2.06	<0.001
Skin or soft tissue infection in past year	No	1.00	.		[c]		
	Yes	**1.22**	1.02–1.45	0.685			

OR, odds ratio; aOR, Adjusted odds ratio; CI, Confidence intervals.
[a] p value generated using Pearson's chi-squared test.
[b] p value generated using the likelihood ratio test.
[c] Entered in to the multivariable analysis, but not significant so not included in the final model.
[d] In the past month.

association was found between current crack injection and age (p == 0.980), reporting injecting amphetamines in the past month (p == 0.051) or having a skin and soft tissue infection in the past year (p == 0.295).

Discussion

The UK has the largest reported opioid-using population and highest levels of problematic crack cocaine use in Europe (Public Health England, 2021a). Our analyses identified a near doubling in prevalence of crack cocaine injection among PWID in contact with services in England and Wales over the past decade. This increase was seen among recent initiates to injecting, as well as people who had been injecting longer term.

Global estimates for cocaine use suggest consumption is highest in North America and Western and Central Europe, and an increasing trend has been noted in some countries (Janssen et al., 2020; Jones et al., 2021; Roy et al., 2012; United Nations Office on Drugs and Crime, 2021; Valdez et al., 2015). Our findings support other UK data sources demonstrating a significant increase in crack use among people using drugs in England and Wales (Hay et al., 2019; Public Health England, 2020a). Data for England indicate a 36 % increase in the number of people accessing treatment for problematic crack cocaine use between 2013/14 and 2019/20 (Public Health England, 2020b). National prevalence estimates for crack cocaine use have also shown a statistically significant rise of 8.5 % between 2011/12 and 2016/17 (Hay et al., 2019), with 180,748 people using crack cocaine in England in 2016/17. The increase in crack injection among recent initiates participating in the UAM Survey is particularly concerning, as people less experienced with injecting are known to be at higher risk of BBV infection, overdose (especially when cocaine is injected alongside other drugs), and are more likely to have poor injecting technique, increasing the potential for missed "hits" and skin and soft tissue infections (Becker Buxton et al., 2004; Folch et al., 2016; Hacker et al., 2005; Hickman et al., 2007; Maher et al., 2006).

A national inquiry found that increased availability, purity and aggressive sales tactics by dealers were key drivers of the rise in cocaine use in the UK (EMCDDA, 2021; Public Health England, 2019). Global estimates for cocaine production indicate a sharp rise since 2013; purity was at a record high in England and Wales in 2018. Both of these factors likely impacted the UK drug market, making cocaine a more attractive drug to consume (Public Health England et al., 2021). Drugs trends vary geographically, depending on supply lines, availability and preference; the same is true for crack use. The rise in the county lines business model, in which a group supplying drugs from an urban hub establishes network(s) within rural or coastal towns, is thought to be a major factor in the growth in the crack cocaine market in England and Wales (Black, 2020). When compared with England and Wales, crack injection in Scotland is comparatively low, with injection of powder cocaine much more prevalent and increasing in recent years (UK Health Security Agency, 2022). Drug use trends can also be driven by structural factors, such as poverty, a lack of opportunity, unemployment, austerity, a lack of available health and social services, trauma and adverse life events (House of Commons Scottish Affairs Committee, 2019).

Consistent with the literature, in this study, crack injection in the past month was found to be associated with behavioural factors known to increase the risk of BBV and SSTI transmission including: groin injection, injecting more frequently and sharing any injecting equipment (Hickman et al., 2007; Leri et al., 2004, Hope et al., 2015). Given increased injecting frequency is expected for stimulant injection due to the short half-life, it is vitally important that needle and syringe programme (NSP) provision remains sufficient to meet injecting need. In 2019, 35 % of PWID in England, Wales and Northern Ireland reported inadequate provision of NSP; after adjusting for missed "hits", the proportion reporting that NSP provision did not meet their need rose to 51 % (Slater et al., 2023). Alongside education of the harms and risks of groin injection, interventions should be available to support injection site management and hygiene to minimise vein damage, reducing vascular access and the need to initiate groin injecting (Hope et al., 2015).

In these analyses, crack injection was also found to be associated with structural inequalities, with higher odds of injecting among those experiencing homeless and/or imprisonment (Hickman et al., 2008; McAuley et al., 2019; Public Health England, 2019; Werb et al., 2010). Although the price of crack and powder cocaine per pure gram is similar, crack is often sold in smaller quantities, meaning a smaller cost to achieve intoxication (Caulkins, 1997; Public Health England, 2019). This likely to be attractive to those with little funds, like those experiencing homelessness (Caulkins, 1997). Crack use may also be a driver for homelessness among PWID, as behaviours linked to stimulant use may result in unemployment. It is thought that for many, maintaining crack use is more expensive than maintaining heroin use due to increased frequency of injecting (Public Health England, 2019). As a result, some may resort to acquisitive crimes to help fund their drug use (Public Health England, 2019).

Crack injection was significantly higher among those reporting concurrent heroin injection, a finding which is in line with what is seen through drug treatment data; in 2019/20, just less than half of the individuals commencing drug treatment for problematic heroin use also cited use of crack cocaine (Public Health England, 2020a). This was also noted through anecdotal evidence gathered through a national inquiry, with reports of dealers selling heroin and crack together (Public Health England, 2019). Polydrug use is known to heighten risk of overdose. In fact, most cocaine-related deaths in Europe in 2019 were also associated with opiate use (EMCDDA, 2021). Our findings support this, with people reporting crack injection in the past month having double the odds of reporting a non-fatal overdose in the past year. In the United States, a "fourth wave" of high mortality among people who use drugs has been found to be associated with the use of cocaine and methamphetamine alongside opioids (Ciccarone, 2021).

Although we found people reporting current crack injection had almost double the odds of being anti-HCV positive, no association was found between current crack injection and chronic HCV infection, being HIV positive or ever having had a HBV infection. Across Europe there have been a number of local HIV outbreaks associated with stimulant injection (Arendt et al., 2019; EMCDDA, 2021; Fotiou et al., 2012; Ragonnet-Cronin et al., 2018) and strong associations have been found between crack injection and HIV and/or hepatitis infection (Butler et al., 2017; Tavitian-Exley et al., 2015). It is likely that routine HIV testing in England, Wales and North Ireland has helped to mitigate transmission, preventing large outbreaks even when changing drug use patterns place individuals at greater risk. Also, as HIV prevalence is low in the UK due to early and effective implementation of harm reduction programmes (Croxford et al., 2022), small changes due to localised outbreaks may not be identifiable through the UAM Survey due to sample size constraints. The higher odds of ever exposure to HCV found through our analyses suggest an increased level of lifetime risk; however, any differences in the prevalence of chronic HCV infection between individuals injecting crack in the past month and those injecting other drugs were non-significant. This could be because those participating in the UAM Survey are in contact with drug and alcohol services, with each contact allowing for engagement in diagnostic BBV testing and HCV treatment.

Engaging in transactional sex was not significantly associated with crack injection in our analyses; however, is worth noting that numerous studies worldwide have found a link between either smoking or injection of crack and increased engagement in transactional sex, especially among women (Duff et al., 2013; Edwards et al., 2006; Guimarães et al., 2016; Public Health England, 2019; Werb et al., 2010).

Our findings highlight the increased risk behaviours associated with crack cocaine injection. Further research is needed on ways to better engage and support individuals who inject crack cocaine. Currently no substitute treatment exists for individuals using crack and most people injecting crack in touch with drug treatment engage with these services to address their concurrent opiate addiction (Public Health England, 2019). Services have greater challenges engaging people who use crack in treatment and retaining them than they do people using opiates, with unmet need for drug treatment among those using crack reported to be 61 % vs. 46 % for opiates (UK Health Security Agency, 2019). This level of unmet need is likely to have increased in recent years, given the disruption to harm reduction and drug treatment services due to the COVID-19 pandemic (Croxford et al., 2021).

With the announcement of the UK government's new drug strategy (HM Government, 2021), which allocated additional funding to the sector, improvements to access and provision of harm reduction are essential. Local authority commissioners and harm reduction services should be aware of the unmet need of this particularly marginalised and vulnerable group of people injecting stimulants. Adequate provision of injecting equipment is essential given their increased injecting frequency; novel approaches to enhance reach are essential, for example online distribution of injecting equipment via NSPdirect (Exchange Supplies). Interventions to raise awareness for risks associated with polydrug use are needed in order to try to minimise overdose risk, as well as advice for safer injecting and wound packs in order to minimise vascular damage and SSTI risk. This education is vital not only for people who have been injecting long term, but also for recent initiates who may have less experience in how to consume drugs safely. Given the high levels of imprisonment and homelessness among those currently injecting crack, strong local partnerships with hostels and the justice system can offer support, treatment and/or harm reduction engagement through means other than drug services.

Finally, consideration should be given to interventions to promote alternative modes of drug consumption, such as smoking, which is safer than injecting but not without risk. Research is underway to understand the extent to which safe inhalation pipe provision could reduce health risks and enhance service engagement among people who use crack cocaine (Harris, 2023); supply of equipment to reduce risk when smoking crack is currently prohibited by law in the UK (Harris, 2020). Approaches taken to reduce stimulant-related harm outside the UK include safe supply, defined as the prescription of pharmaceutical-grade drugs to individuals at high overdose risk, and drug de-criminalisation (Health Canada, 2022; McNeil, et al., 2022). It is important that all interventions implemented are properly evaluated.

Strengths and limitations

This study utilises data from an annual, cross-sectional, bio-behavioural survey of PWID that has been running for over 30 years. The UAM Survey uses an established approach that has informed the understanding of the burden of disease and related risk behaviours among stigmatized and socially marginalised populations (World Health Organization et al., 2017).

However, this study has several limitations. Recruiting a representative sample of PWID is difficult due to the illicit and marginalised nature of drug injection. The UAM Survey aims to be nationally reflective of PWID by recruiting through targeted services (including a range of drug treatment, harm reduction and outreach services). Although

uptake and use of these services has been found to be high across England, Wales and Northern Ireland (Hickman et al., 2007), the survey sample is only reflective of those in contact with services and not generalisable to the PWID population as a whole. Furthermore, the sample of PWID recruited during the COVID-19 pandemic in 2020 was slightly different to previous years in terms of geographic distribution, demographics and risk (Public Health England, 2021b). This may have been due to increased recruitment through outreach and/or services reserving face-to-face appointments for emergencies or for clients experiencing lifestyles characterised by unstable housing, unemployment or financial difficulties, mental illness, and/or social relationships centred around substance misuse (Davies et al., 2015) and may have affected observed trends in drug use. UAM questionnaire data may be subject recall bias or a reluctance to report accurate information due to fear of stigma or judgement. Despite this, the reliability of self-reported risk behaviours among PWID has been previously shown to be high (Latkin et al., 1993) and bias was minimised through self-completion. In these analyses, we utilised a stepwise approach to logistic regression; repeated model fitting may have resulted in overfitting the data, biased estimates, and inflated type one error (Harrell, 2015). If there were participants who did not disclose previously taking part in the UAM Survey, then it is possible that there were some duplicate observations in our dataset, which would have led to a violation of the logistic regression assumption of independence and incorrect statistical inference. Finally, as the UAM is a cross-sectional survey, we could only explore the factors associated with crack use and could not assess causation.

Conclusions

Over the past decade the prevalence of crack injection among PWID in England and Wales has almost doubled. PWID reporting crack injection were more likely to engage in injecting risk behaviours such as sharing injecting equipment, groin injection, more frequent injecting, and poly-drug use. This is concerning as these behaviours could increase risk of BBV and SSTI acquisition, as well as overdose. Services for PWID should adapt to support the specific needs of this growing population of people injecting stimulants, with provision of adequate harm reduction and education to encourage safer drug consumption and a reduction in risk. As we return to a "new normal" following the COVID-19 pandemic, funding from the UK Drug Strategy should provide opportunities for the redevelopment of local services to be more reactive to the needs of the populations they care for.

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Claire Edmundson: Writing – original draft, Visualization, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Sara Croxford:** Writing – review & editing, Visualization, Validation, Methodology, Conceptualization. **Eva Emanuel:** Writing – review & editing, Investigation, Data curation. **Jacquelyn Njoroge:** Writing – review & editing, Investigation, Data curation. **Samreen Ijaz:** Writing – review & editing, Resources, Investigation. **Vivian Hope:** Writing – review & editing, Supervision, Conceptualization. **Emily Phipps:** Writing – review & editing, Supervision, Conceptualization. **Monica Desai:** Writing – review & editing, Supervision.

Declaration of competing 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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Supplementary materials

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