Incarceration and drug use patterns among a cohort of injection drug users

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Abstract

Aims—Drug law enforcement remains the dominant response to drug-related harm. However, the impact of incarceration on deterring drug use remains under-evaluated. We sought to explore the relationship between incarceration and patterns of drug use among people who inject drugs (IDU).

Design—Using generalized estimating equations (GEE), we examined the prevalence and correlates of injection cessation among participants in the Vancouver Injection Drug User Study followed over 9 years. In subanalyses, we used McNemar's tests and linear growth curve analyses to assess changes in drug use patterns before and after a period of incarceration among participants reporting incarceration and those not incarcerated.

Findings—Among 1603 IDU, 842 (53%) reported injection cessation for at least 6 months at some point during follow-up. In multivariate GEE analyses, recent incarceration was associated negatively with injection cessation [adjusted odds ratio (AOR) = 0.43, 95% confidence interval (CI) 0.37–0.50], whereas the use of methadone was associated positively with cessation (AOR = 1.38, 95% CI 1.22–1.56). In subanalyses assessing longitudinal patterns of drug use among incarcerated individuals and those not incarcerated over the study period, linear growth curve analyses indicated that there were no statistically significant differences in patterns of drug use between the two groups (all P > 0.05).

Conclusions—These observational data suggest that incarceration does not reduce drug use among IDU. Incarceration may inhibit access to mechanisms that promote injection cessation among IDU. In contrast, results indicate that methadone use is associated positively with injection cessation, independent of previous frequency of drug use.

Keywords

Addiction treatment; deterrence; drug law enforcement; drug policy; drug use patterns; incarceration; injection cessation; injection drug use

INTRODUCTION

Public policy makers continue to face complex challenges in attempting to reduce the health, social and economic costs associated with problematic substance use. While addiction is understood increasingly to be a health issue [1,2] the overarching global policy response to problematic substance use continues to be dominated by drug law enforcement, which has been shown to receive the overwhelming majority of drug policy funding [3,4].

A central strategy of illicit drug law enforcement is to incarcerate drug users for drug possession and other drug-related offences with the aim of deterring drug use and lowering the supply and demand for drugs [2,3,5–7]. From 1999 to 2004 in Spain, France, Austria, Sweden and the United Kingdom more than 80% of drug law offences were for drug use or possession for the purpose of use [8]. During this same period in the 29 countries contributing data to the European Monitoring Centre for Drugs and Drug Addiction, all but two reported an increase in the number of drug offences [8]. In Canada, 30% of female prisoners and 14% of male prisoners in federal institutions are serving sentences for drug-related offences [9]. In the United States, 20% of inmates in state prisons and 55% of inmates in federal prisons are incarcerated for drug offences [10,11].

The fiscal costs associated with incarcerating individuals for drug-related offences are substantial; estimates suggest that more than $8 billion dollars in the United States and $573 million dollars in Canada are spent annually to imprison those found guilty of drug-related offences [6,12]. In Canada, the use of incarceration as a tool to manage substance use is likely to increase, as the federal government recently launched a new 'National Anti-Drug Strategy' which proposes to introduce new legislation for mandatory minimum prison sentences for drug offences [13]. Despite the vast funding investments associated with this approach, the effectiveness of law enforcement and incarceration on deterring and reducing drug use have not been well evaluated [14].

In light of the continued emphasis on criminal justice approaches to address illicit drug use, we sought to test the policy assumption that incarceration deters drug use using longitudinal data derived from a cohort study of people who inject drugs (IDU) in Vancouver, Canada. While IDU are a relatively small proportion of the overall drug-using population, the majority of problematic and harmful drug consumption takes place among this group [3]. Therefore, we sought to explore the possible relationship between incarceration and changes in drug use patterns in this group to indicate whether current law enforcement approaches are producing their intended effects.

METHODS

The Vancouver Injection Drug User Study (VIDUS) is a longitudinal cohort study that began recruiting injection drug users (IDU) through self-referral and street outreach in May 1996. The study has been described in detail previously [15]. Briefly, individuals were eligible if they had injected drugs at least once in the previous month, resided in the greater Vancouver region and provided written informed consent. At baseline and every 6 months, subjects provide blood samples and complete an interviewer-administered questionnaire. The questionnaire elicits demographic data as well as information about recent drug use patterns, human immunodeficiency virus (HIV) risk behaviour and experience with the criminal justice system and addiction treatment programmes. All participants are given a stipend ($20 CDN) at each study visit. The study has received ethical approval from the Providence Health Care/University of British Columbia's Research Ethics Board.

As a first analysis, we conducted a longitudinal study of factors associated with cessation of injection drug use to examine if periods of incarceration were associated with drug

cessation. In this analysis, we included all participants seen for baseline and follow-up interviews from May 1996 to December 2005. Drug use cessation was defined as not reporting any injection drug use in the 6-month period prior to a follow-up interview. Incarceration was defined as 'being in detention, prison, or jail overnight or longer' in the previous 6 months. Explanatory variables of interest included socio-demographic information such as: gender (female versus male), age (per year older) and Aboriginal ethnicity (yes versus no). Drug use variables considered were measured at baseline and refer to behaviours in the previous 6 months. They included: frequent heroin injection (= daily versus < daily), frequent cocaine injection (= daily versus < daily) and frequent crack cocaine smoking (= daily versus < daily). Other characteristics considered included: current participation in methadone treatment, residing in the Downtown Eastside in the last 6 months (i.e. Vancouver's illegal drug use and HIV epicentre) and having regular paid employment in the last 6 months. All variable definitions were identical to earlier reports [15].

Because analyses of factors associated potentially with injection cessation included serial measures for each subject, we used generalized estimating equations (GEE) for binary outcomes with logit link for the analysis of correlated data to determine factors associated with injection cessation throughout the 9-year follow-up period. This approach has been used successfully in previous analyses [16,17]. These methods provided standard errors adjusted by multiple observations per person using an exchangeable correlation structure. Therefore, data from every participant follow-up visit was considered in this analysis. For individuals who missed follow-up appointments during the study period, missing data were addressed through the GEE estimating mechanism, which uses the all-available-pairs method to encompass the missing data [18]. As a first step, we conducted univariate GEE analyses to determine factors associated with injection cessation. In order to adjust for potential confounding, all variables of interest were entered into a fixed multivariate logistic GEE model.

We were aware that any association between injection cessation and incarceration could be observed because those who were incarcerated were inherently more or less likely to cease drug use, or because those who had continued or stopped injecting drugs may be inherently more or less likely to be incarcerated. To assess more closely the relationship between incarceration and drug use patterns, we conducted secondary analyses on drug use patterns before and after a period of incarceration and compared these with drug use patterns among a group of non-incarcerated participants interviewed during the same time-periods. The approach of comparing before and after patterns of drug use among incarcerated versus non-incarcerated groups was used to account for the cohort effect, in which drug use behaviours change over time [19]. Specifically, with cohorts of adult injection drug users, declining trends in many drug use behaviours are observed commonly as cohort participants age and progress through their drug use careers [20,21]. Hence, we expected most patterns of drug use to decline from the 'before' to 'after' periods in both groups as a function of time. To control for these expected changes, and isolate more clearly the independent relationship between incarceration and drug use patterns, our primary interest was not to consider changes in drug use patterns over time, but rather to assess whether longitudinal trends were different between the two groups.

As a first step in subanalyses, we identified all VIDUS participants with no previous history of incarceration who reported being incarcerated at some point during follow-up. Among these individuals, only participants who had at least one study visit before incarceration and at least one study visit after incarceration were eligible for inclusion. Eligibility for being a control included having no previous history of incarceration, no report of incarceration at any point during the entire 9-year study period and at least three study visits. Because cases

were identified throughout the 9-year study period, observations for controls were selected at a frequency that matched the proportion of cases identified at each study follow-up. For example, if 8% of cases were identified at the fifth study follow-up, 8% of all controls were selected to use that same study follow-up. We elected to match our controls to cases based on time rather than on subject characteristics, as we have observed that drug use patterns have changed over study follow-up [22,23]. This matching approach has been employed successfully in other longitudinal analyses using IDU cohort data spanning an extended period of time [24]. To examine if there were significant differences between the cases and control groups with regard to demographic characteristics, simple descriptive comparisons using χ^2 tests and Wilcoxon rank sum tests were undertaken.

As a second step, we examined the proportion of cases reporting selected drug use behaviours in the study visits before and after the reported incarceration period for both the incarcerated and non-incarcerated groups. Characteristics measured at the study follow-up that included the report of incarceration were not included in analyses. Differences in the before and after drug use behaviours were assessed for each group using McNemar's test. As noted for the first analysis, drug use patterns of interest all refer to behaviours in the past 6 months and include: any heroin use (yes versus no), any cocaine use (yes versus no), any crack use (yes versus no), frequent heroin injection (= daily versus < daily), frequent cocaine injection (= daily versus < daily), frequent crack cocaine smoking (= daily versus < daily) and injection cessation (yes versus no). Because declines in most drug use behaviour were expected for both groups, we were interested primarily in identifying instances where different trends emerged over time between the two groups.

To test formally for differences over time and between groups, linear growth curve models were constructed. These models combine logistic regression and growth curve analyses. This statistical approach has been employed in illicit drug use research, as the method enables the identification of changes over time and the incorporation of interaction terms to determine if the changes over time between two groups are statistically significant [25,26]. We performed logistic growth curve analyses using Proc GENMOD in SAS version 9.1 for selected drug use behaviours as outcome variables in each model with group (incarcerated versus non-incarcerated) and period (before versus after) as the explanatory variables. To adjust for differences in participants' baseline risk profiles, models were modified by including the propensity scores calculated through logistic regression from the following factors measured at baseline: age, gender, ethnicity, Downtown Eastside residence, frequent heroin injection, frequent crack use, frequent cocaine injection, methadone treatment and regular paid employment [27]. Propensity scores for injection cessation could not be calculated because, by definition, all study participants were injection drug users at baseline. As such, the linear growth curves for injection cessation were adjusted for age, gender and ethnicity. For all analyses all P-values were two-sided, with statistical significance set at P < 0.05. All statistical analyses were performed using SAS software version 9.1 (SAS Institute, Cary, NC, USA).

RESULTS

A total of 1603 participants were recruited during the study period, including 584 (36%) women and 435 (27%) people reporting Aboriginal ancestry. The median age of participants at baseline was 33 years [interquartile range (IQR) = 26–40]. This sample contributed to 15 748 observations over the study period. A total of 1218 (76%) participants completed at least three study follow-up visits and the median number of follow-up visits was 10 (IQR = 4–16) over a median of 60 (IQR 24–96) months' follow-up per participant. Among this sample, a total of 842 (53%) reported injection cessation at some point during follow-up. Of

the 15 748 observations included in the primary analysis, 3731 (24%) involved a report of injection cessation over the previous 6 months.

The univariate GEE analyses of behavioural and socio-demographic variables are presented in Table 1. Factors found to be associated significantly with injection cessation in univariate analyses included: older age (per year older) [odds ratio (OR) = 1.10, 95% confidence interval (CI) 1.09–1.12]; Downtown Eastside residence (OR = 0.40, 95% CI 0.34–0.46); frequent heroin injection (OR = 0.74, 95% CI 0.63–0.87); recent incarceration (OR = 0.34, 95% CI 0.30–0.40); participation in methadone treatment (OR = 1.50, 95% CI 1.33–1.69); and regular paid employment (OR = 2.36, 95% CI 2.02–2.76).

In the multivariate GEE analysis, also shown in Table 1, factors that remained associated independently with injection cessation in our logistic model included: older age [adjusted odds ratio (AOR) = 1.01, 95% CI 1.00–1.02]; Aboriginal ethnicity (AOR 1.22, 95% CI 1.00–1.47); Downtown Eastside residence (AOR = 0.43, 95% CI 0.37–0.50); recent incarceration (AOR = 0.43, 95% CI 0.37–0.50); participation in methadone treatment (AOR = 1.38, 95% CI 1.22–1.56); and regular paid employment (AOR = 2.00, 95% CI 1.71–2.35).

In the subanalyses which examined behaviours before and after incarceration, 889 participants fitted the criteria for inclusion. Compared to participants excluded from the analysis because of limited follow-up (i.e. less than three visits), included participants were more likely to be older (median age 35.1 years versus 30.0 years, P = < 0.001); to be female (P = 0.009); and to identify as Aboriginal (P = 0.045). Among those included in the analysis, 147 (17%) met the criteria of having a period of incarceration at some point during follow-up and the remaining 742 (83%) were included in the non-incarcerated group. Participants reporting a period of incarceration were significantly younger than the non-incarcerated control group [median age 33.4 (IQR: 26.3–39.0) versus 35.5 (IQR: 28.8–41.3), P = 0.004]. No significant differences between the two groups were observed with respect to gender and ethnicity.

The proportion of each group reporting selected drug use behaviours before and after a period of incarceration, as well as the results of McNemar's test assessing whether these changes were statistically significant at P < 0.05, are reported in Table 2. Overall, the prevalence of drug use was higher in the incarcerated group versus the non-incarcerated group. However, as expected, a reduction in drug use was observed in each group with the exception of crack cocaine use, which increased in both groups when the pre- and post-incarceration time-periods were compared. Patterns of change in the variables 'any cocaine use', 'frequent heroin injection' and 'injection cessation' were statistically similar for both the incarcerated and non-incarcerated control groups. Differences in drug use trends observed for both incarcerated and non-incarcerated groups included: any heroin use (P = 0.071 versus P < 0.001, respectively); any crack use (P = 0.572 versus P = 0.095); frequent cocaine injection (P = 0.170 versus P < 0.001); and frequent crack use (P = 0.706 versus P < 0.001). However, linear growth curve analyses (see Table 3), modified by propensity scores, showed that none of the trends among the incarcerated and non-incarcerated groups were statistically significant.

DISCUSSION

The present longitudinal study demonstrated that recent incarceration was associated negatively with drug use cessation, whereas use of methadone was associated positively with drug use cessation. Conversely, in subanalyses, injection cessation increased after periods of incarceration. However, this trend was not statistically significantly different from the increase in injection cessation observed among the non-incarcerated group, suggesting

that this change was probably a result of a cohort effect rather than being attributable to the experience of incarceration. Furthermore, comparisons of all other examined drug use patterns before and after a period of incarceration among incarcerated and non-incarcerated groups were not significantly different, suggesting that incarceration is not associated independently with significant reductions in drug consumption.

Although we are unaware of a similar long-term longitudinal study, our findings are consistent with earlier cross-sectional studies that have failed to establish a positive association between drug use cessation and cumulative time spent in prison [28,29]. This observation may, in part, be attributable to the previously described destabilizing effect of incarceration on IDU [30]. Our findings are also consistent with previous research suggesting that injection cessation is associated negatively with residing in a neighbourhood with a high prevalence of drug market activity (such as Vancouver's Downtown Eastside) [29]. In addition, although previous cross-sectional investigations have found the intensity of drug use to have an independent negative impact on cessation [28], our analysis supports other investigations which found that drug use profiles do not predict injection drug use cessation reliably [31]. Our results also support previous investigations [32] indicating that addiction treatment is associated positively with injection cessation.

Identifying factors which appear to promote and support injection cessation is important for policy makers aiming to reduce the prevalence of high-risk drug use. Our finding regarding the positive association between methadone treatment and injection cessation is encouraging, and reinforces the importance of investing in methadone programs for heroin-using IDU [33]. It is also encouraging that frequent drug use did not appear to be a significant barrier to subsequent injection cessation, indicating that transitions out of injection are possible even for individuals engaging in high-intensity drug use. Conversely, from a policy perspective, it is a concern that our findings do not support the current policy assumption that imprisoning high-risk drug users deters and reduces their drug use. Rather, our analyses found no statistically significant differences in drug use patterns among incarcerated and non-incarcerated injection drug users over time. Although further study is necessary, our findings may be explained by previous studies suggesting that incarceration may reduce access to mechanisms (i.e. addiction treatment, social support, employment) that promote injection cessation among IDU [30]. This finding is of great concern, given the number of individuals incarcerated for drug use and the fiscal costs associated with this policy approach.

When assessing the appropriateness of using incarceration as a tool to manage problematic substance use, it is also important to consider briefly the growing body of evidence demonstrating that IDU face elevated health risks in prison settings [34]. For example, in many areas IDU report injecting drugs in prisons [35–37] and qualitative investigations have documented and described how the nature of the prison environment perpetuates the adoption of risky injection practices among these individuals [38,39]. Epidemiological analyses have further established an independent relationship between HIV infection and recent incarceration [40], and among IDU in Vancouver it has been estimated that at least 20% of HIV infections may have been acquired in prison [41]. This evidence suggests that to offset the health risks posed by incarceration, the benefits of this approach ought to be well established and substantive.

It appears that an assessment of the effectiveness and benefits of incarcerating individuals for drug use is warranted to ensure that resources are not being invested in policy approaches that are either harmful and/or ineffective. This appears especially relevant in the United States, which has the highest incarceration rate in the world [42], as well as in Canada, where the federal government has introduced a new National Anti-Drug Strategy

which relies heavily upon incarceration as a means to address problematic substance use [13].

There are several limitations to be noted in this study. First, as with most other cohort studies of IDU, VIDUS is not a random sample and therefore these findings may not generalize to other IDU populations. In addition, as with all long-term cohort studies of IDU, loss of participants over follow-up is an issue; however, more than 75% of participants completed three or more study visits. Secondly, this study relied upon self-reported information concerning patterns of drug use over the previous 6 months and is susceptible to recall bias as well as socially desirable reporting. In the present study this may have led to an under-reporting of drug consumption resulting in the level of drug use being underestimated. However, it is notable that individuals reporting cessation of drug use in this study also reported injection drug use previously. Thirdly, despite extensive multivariate adjustment, the association between incarceration and injection cessation observed in the primary analysis could be influenced by confounders not measured by the study instrument. Similarly, despite the use of propensity score calculations, it is not possible to control for all possible differences between study groups. Fourthly, reports of incarceration and methadone use relied on self-report and may be subject to recall bias. However, we have no reason to suspect that this bias would be differential between cases and controls. In addition, details regarding the length of each incarceration event were not available. As a result, the measure for incarceration used in these analyses did not incorporate the duration of prison sentences, precluding the detection of potential dose effects of incarceration on drug use patterns. Further study of the possible impact of the duration of periods of incarceration on drug use patterns is needed. Finally, there are limitations involved in relying on statistical criteria to assess whether drug use trends between two groups are meaningfully different [43]. Nevertheless, a priori criteria (e.g. $P < 0.05$) are an established means of assessing whether observed values are significantly different.

In sum, the current investigation did not observe statistically significant differences in drug use patterns measured longitudinally among IDU experiencing a period of incarceration in comparison to IDU who did not experience incarceration. Although further study is necessary, our findings imply that incarceration does not have long-term positive effects on IDU drug use patterns. In addition, the current investigation indicates that methadone has the potential to support injection cessation among IDU, independent of previous drug use frequency. Given the elevated risks to health faced by IDU in prison settings and the monetary costs associated with this component of drug law enforcement, it appears that further investigation to identify and establish the benefits of incarcerating IDU is required. In addition, the cost-effectiveness and impact of community diversion programmes for non-violent drug offenders requires further evaluation.

Acknowledgments

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Table 1

Factors associated with cessation of injection drug use (n = 1603).

Characteristic	Univariate GEE of factors associated with cessation of injection drug use		Multivariate logistic GEE of factors associated with cessation of injection drug use	
	OR(95% CI)	P-value	AOR (95% CI)	P-value
Recent incarceration[a]				
yes versus no	0.34 (0.30–0.40)	<0.001	0.43 (0.37–0.50)	<0.001
Older age				
per year older	1.10 (1.09–1.12)	<0.001	1.01 (1.00–1.02)	0.047
Gender				
female versus male	1.07 (0.91–1.26)	0.402	1.08 (0.90–1.30)	0.405
Aboriginal ethnicity				
yes versus no	1.10 (0.92–1.30)	0.300	1.22 (1.00–1.47)	0.046
Downtown Eastside residency[a]				
yes versus no	0.40 (0.34–0.46)	<0.001	0.43 (0.37–0.50)	<0.001
Frequent heroin injection				
yes versus no	0.74 (0.63–0.87)	0.004	0.91 (0.75–1.10)	0.319
Frequent crack use[a]				
yes versus no	0.98 (0.74–1.31)	0.902	1.21 (0.90–1.64)	0.208
Frequent cocaine injection				
yes versus no	0.89 (0.76–1.05)	0.169	1.17 (0.98–1.40)	0.083
Methadone treatment				
yes versus no	1.50 (1.33–1.69)	<0.001	1.38 (1.22–1.56)	<0.001
Regular paid employment				
yes versus no	2.36 (2.02–2.76)	<0.001	2.00 (1.71–2.35)	<0.001

GEE: generalized estimating equation; OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval

[a] activities or situations referring to previous 6 months.

Table 2

Drug use patterns among incarcerated group (n = 147) and non-incarcerated control group (n = 742) for before and after a period of incarceration.

Drug use behaviour	Before n (%)	After n (%)	P-value[*]
Any heroin use			
Incarcerated	93 (63.3)	82 (55.8)	0.071
Non-incarcerated	438 (59.3)	388 (52.3)	<0.001
Any cocaine use			
Incarcerated	108 (73.5)	85 (57.8)	<0.001
Non-incarcerated	480 (64.7)	403 (54.3)	<0.001
Any crack use			
Incarcerated	71 (48.3)	75 (51.0)	0.572
Non-incarcerated	317 (42.7)	343 (46.2)	0.095
Frequent heroin injection			
Incarcerated	50(34.0)	41 (27.9)	0.095
Non-incarcerated	235 (31.7)	214 (28.8)	0.092
Frequent cocaine injection			
Incarcerated	46 (31.3)	37 (25.2)	0.170
Non-incarcerated	205 (27.6)	150 (20.2)	<0.001
Frequent crack use			
Incarcerated	28 (19.1)	30 (20.4)	0.706
Non-incarcerated	99 (13.3)	142 (19.1)	<0.001
Injection cessation			
Incarcerated	9 (6.1)	24 (16.3)	0.003
Non-incarcerated	96 (12.9)	169 (22.8)	<0.001

[*] P-value denotes McNemar's test score. All drug use variables refer to behaviours in the past 6 months.

Table 3

Results of the linear growth curve analyses with each drug use behaviour modelled as the outcome—adjusted by propensity scores[a].

Drug use behaviours	Slope (95% confidence interval)	P-value
Any heroin use		
Incarcerated	−0.261 (−0.604 – 0.082)	
Non-incarcerated	−0.282 (−0.426 – −0.138)	0.917
Any cocaine use		
Incarcerated	−0.816 (−1.214 – −0.417)	
Non-incarcerated	−0.439 (−0.600 – −0.279)	0.097
Any crack use		
Incarcerated	0.163 (−0.214 – 0.540)	
Non-incarcerated	0.146 (−0.025 – 0.316)	0.926
Frequent heroin injection		
Incarcerated	−0.270 (−0.631 – 0.092)	
Non-incarcerated	−0.138 (−0.299 – 0.022)	0.525
Frequent cocaine injection		
Incarcerated	−0.337 (−0.774 – 0.100)	
Non-incarcerated	−0.416 (−0.609 – −0.223)	0.751
Frequent crack use		
Incarcerated	0.133 (−0.317 – 0.582)	
Non-incarcerated	0.450 (0.206 – 0.694)	0.239
Injection cessation[b]		
Incarcerated	1.077 (0.331 – 1.823)	
Non-incarcerated	0.684 (0.474 – 0.894)	0.353

Slope represents differences in drug use behaviours among the incarcerated and the non-incarcerated control group over time; P-value represents interaction term.

[a]Propensity scores calculated from the following characteristics measured at baseline: age, gender, ethnicity, Downtown Eastside residence, frequent heroin injection, frequent crack use, frequent cocaine injection, methadone treatment, and regular paid employment.

[b]Propensity scores for injection cessation could not be calculated as all participants were injection drug users at baseline; hence the linear growth curves for injection cessation did not incorporate propensity scores but they were adjusted for age, gender and ethnicity.