Risky and rushed public crack cocaine smoking: the potential for supervised inhalation facilities

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Abstract

**Background:** Despite the multitude of public health and community harms associated with crack cocaine use, little is known about factors associated with smoking crack in public and related risks such as rushed public crack smoking.

**Methods:** Data were derived from two prospective cohort studies of people who use illicit drugs in Vancouver, Canada between 2010 and 2014. Multivariable generalized estimating equations were used to identify the prevalence and correlates of public crack smoking and rushed public crack smoking.

**Results:** In total, 1085 participants who had smoked crack in the prior six months were eligible for the analysis, of which 379 (34.9%) reported always or usually smoking crack in public in the previous six months at some point during the study period. Factors positively and independently associated with public crack smoking included public injection drug use (adjusted odds ratio [AOR]: 5.42, 95% confidence interval [CI]: 3.76-7.82), homelessness (AOR: 3.48, 95% CI: 2.77-4.36), at least daily crack use (AOR: 2.69, 95% CI: 2.19-3.31), crack pipe sharing (AOR: 1.98, 95% CI: 1.60-2.46), drug dealing (AOR: 1.59, 95% CI: 1.30-1.94), recent incarceration (AOR: 1.47, 95% CI: 1.09-1.98), noticing police presence when buying or using drugs (AOR: 1.30, 95% CI: 1.06-1.60), and younger age (AOR: 1.03, 95% CI: 1.01-1.04). Rushed public crack smoking, which was reported by 216 (28.8%) of 751 participants who had smoked crack in public at least once during the study period, was positively and independently associated with homelessness (AOR: 2.61, 95% CI: 1.96-3.49), at least daily crack use (AOR: 1.48, 95% CI: 1.11-1.98), crack pipe sharing (AOR: 1.44, 95% CI: 1.10-1.89), drug dealing (AOR: 1.39, 95% CI: 1.04-1.86), and younger age (AOR: 1.02, 95% CI: 1.01-1.04).

**Conclusions:** A high prevalence of public crack smoking and rushed public crack smoking was observed in this setting. These findings point to the need for implementing and evaluating evidence-based public health interventions, such as supervised inhalation facilities, to reduce the risks and harms associated with smoking crack in public.

**Keywords:** Crack, Cocaine, Public drug use, Rushed drug use, Supervised inhalation, Supervised consumption, Crack pipe distribution, Intravenous, Injection, Harm reduction

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Background
In recent years, increases in crack cocaine use in many North American settings have contributed to a “neglected epidemic” in which crack cocaine has remained among the most prevalent and easily obtainable illicit drugs [1–3]. National population-level surveys estimate that past-year crack cocaine use is prevalent in approximately 1.1 % and 0.3 % of the general adult populations in Canada and the United States, respectively [4, 5]. A recent multi-criteria decision analysis performed by the Independent Scientific Committee on Drugs found that crack cocaine (herein referred to as “crack”) is among the top three illicit drugs that are most harmful to individual users and to others, due to its potential for causing substantial physical, psychological, and social harms [6]. Specifically, individuals who use crack have been found to have elevated risk of HIV, hepatitis C virus (HCV), tuberculosis, herpes zoster, and other infectious pathogens secondary to sores, burns, or cuts, either from shared crack pipes or from increased prevalence of sexual risk behaviors [7–14]. Additionally, crack use has been found to be associated with polysubstance use, comorbid mental illness, incarceration, and other health and social-structural problems, yet research indicates that individuals who use crack may be less likely to access health and social services [3, 15–17].

Crack is often smoked in public settings, which may contribute to public health risks such as hazardous debris from crack smoking paraphernalia potentially contaminated with infectious pathogens (e.g., from glass crack pipes), as well as crack-related street disorder such as public intoxication, dealing drugs in public, or related violence [18–20]. To date, much of the literature on public drug use has focused on the use of injection drugs in public and associated risks. Specifically, public injecting has been found to be associated with greater odds of injection-related risk behaviours (e.g., sharing used injection equipment, not cooking or filtering drugs prior to injecting), HIV and HCV transmission, and poor health and social status (e.g., more severe drug dependency, social isolation, and unstable lifestyles) [21–23]. However, little is known about risks associated with the use of non-injection drugs in public settings—particularly crack.

Furthermore, there is a dearth of research on factors associated with the use of non-injection drugs while rushed. Here again, much of the literature has concentrated on rushed injection drug use, which is often prompted by fear of police arrest or street violence, and which frequently involves risky injection behaviors (e.g., jabbing at veins, not testing the strength of drugs before injecting, re-using injecting equipment) that may lead to vein trauma, abscesses, overdose, bacterial infections, or infectious disease transmission [24–26]. The risks associated with rushed crack smoking are not well described, apart from one study which found a high prevalence of burns and inhaled metallic crack pipe filter screens among individuals who reported rushed crack smoking [27]. Therefore, this study sought to investigate the prevalence and correlates of public crack smoking and rushed public crack smoking among participants of two prospective cohorts of people who use illicit drugs in Vancouver, Canada.

Methods
Data for these analyses were derived from two prospective observational cohorts in Vancouver, Canada: the AIDS Care Cohort to evaluate Exposure to Survival Services (ACCESS) of HIV-seropositive illicit drug users and the Vancouver Injection Drug Users Study (VIDUS) of HIV-seronegative injection drug users. These cohorts have previously been described in detail [28, 29]. In short, since 1996, more than 2000 individuals have been recruited into these cohorts through snowball sampling and street outreach methods in Vancouver’s Downtown Eastside, a post-industrial neighbourhood with an established drug market and widespread illicit drug use, poverty, poor housing conditions, and infectious diseases such as HIV and HCV [30].

Participants are eligible for VIDUS if they are HIV-seronegative, over 18 years of age, and have injected an illicit drug in the month prior to the baseline interview. Participants are eligible for ACCESS if they are HIV-seropositive, over the age of 18, and have used an illicit drug other than or in addition to cannabis within the month prior to the baseline interview. As these two cohorts were originally one single cohort until they were split into the two present cohorts in 2005, the two cohorts employ harmonized data collection and follow-up procedures to allow for combined analyses of the HIV-seronegative and HIV-seropositive study participants. Specifically, at baseline and semi-annually, participants answer an interviewer-administered questionnaire, which elicits data on demographic characteristics, drug-using behaviours and related exposures; provide blood samples for HIV (for VIDUS participants only) and HCV serologic analyses; and are referred as necessary to medical care and drug and alcohol treatment. All participants provide written informed consent and receive a $30 stipend at the end of each study visit. These studies have received annual ethics approval from the University of British Columbia and Providence Health Care Research Ethics Board.

The present analyses were restricted to interviews that were conducted between December 1, 2010 to May 31, 2014. Participants were eligible for this analysis if they reported smoking crack at least once in the six-month period prior to their interview, and if they had a history of ever injecting any drug at the time of interview. The main outcome measure of interest was smoking crack in
public (always or usually vs. sometimes, occasionally or never) [31]. The self-reported demographic, behavioural, social and structural explanatory characteristics considered in the analyses were: age (per one-year decrease); gender (female vs. male); HIV serostatus (positive vs. negative); homelessness (yes vs. no); drug dealing (yes vs. no); sex work (yes vs. no); crack smoking (≥ daily vs. < daily); sharing a crack pipe (yes vs. no); binge non-injection drug use (yes vs. no); heroin injection (≥ daily vs. < daily); cocaine injection (≥ daily vs. < daily); crystal methamphetamine injection (≥ daily vs. < daily); public injection drug use (always or usually vs. sometimes, occasionally or never); noticing police presence when buying or using drugs (yes vs. no); being stopped, searched or detained without arrest by police (yes vs. no); recent incarceration (yes vs. no); enrolment in drug addiction treatment, excluding methadone (yes vs. no); and being a victim of violence (yes vs. no). All variables referred to activities or events in the six months prior to the participant’s interview, unless otherwise indicated. As in previous studies, binge non-injection drug use was defined as any period of time within the previous six months from the time of interview during which any drugs were used more frequently than usual [32].

First, we compared those who did and did not smoke crack in public at baseline using Pearson’s Chi-squared test for dichotomous variables and the Wilcoxon rank sum test for continuous variables. Next, since analyses of factors potentially associated with public crack smoking included serial measures for each subject, we used generalized estimating equations (GEE) with logit link function and exchangeable working correlation structure to account for correlations between repeated measurements. Bivariable GEE analyses were conducted to obtain unadjusted odds ratios and p-values for factors associated with public crack smoking. Using an a priori-defined statistical protocol based on examination of the quasi-likelihood under the independence model criterion (QIC) value, a preliminary multivariable model was built using all variables that were significantly associated with the outcome at the p < 0.10 in the bivariable analyses. Next, each variable with the highest p-value was removed sequentially. The final model included the set of variables associated with the lowest QIC, and was assessed with variance inflation factors to ensure the absence of multicollinearity.

As a secondary analysis, among participants who reported any public crack smoking (i.e., always, usually, sometimes, or occasionally), bivariable and multivariable GEE analyses were conducted to determine factors associated with rushed public crack smoking, using the same procedures detailed above. All p-values were two sided. A significant association was defined as p < 0.05. All statistical analyses were performed using the SAS software version 9.4 (SAS, Cary, NC).

Results

Of the 1085 participants eligible for the present analysis, 400 (36.9 %) were female. The median age at the first study visit was 46 (interquartile range: 40—52) years. Participants in this sample contributed to a total of 5126 observations during the study period. Table 1 shows the baseline sample characteristics. At the first study visit, 244 (22.5 %) participants reported “always” or “usually” smoking crack in public in the previous six months. During the 42-month study period, 379 (34.9 %) participants reported “always” or “usually” smoking crack in public at least once.

Table 2 presents the results of the bivariable and multivariable GEE analyses. In multivariable GEE analyses, factors that remained positively and independently associated with public crack smoking included: public injection drug use (adjusted odds ratio [AOR]: 5.42, 95 % confidence interval [CI]: 3.76-7.82), homelessness (AOR: 3.48, 95 % CI: 2.77-4.36), at least daily crack use (AOR: 2.69, 95 % CI: 2.19-3.31), crack pipe sharing (AOR: 1.98, 95 % CI: 1.60-2.46), drug dealing (AOR: 1.59, 95 % CI: 1.30-1.94), recent incarceration (AOR: 1.47, 95 % CI: 1.09-1.98), noticing police presence (AOR: 1.30, 95 % CI: 1.06-1.60), and younger age (AOR: 1.03, 95 % CI: 1.01-1.04).

Of the 751 participants who smoked crack in public at least once, rushed public crack smoking was reported by 216 (28.8 %) participants at least once during the study period. Table 3 shows the factors positively and independently associated with rushed public crack smoking in multivariable GEE analyses, which included: homelessness (AOR: 2.61, 95 % CI: 1.96-3.49), at least daily crack use (AOR: 1.48, 95 % CI: 1.11-1.98), crack pipe sharing (AOR: 1.44, 95 % CI: 1.10-1.89), drug dealing (AOR: 1.39, 95 % CI: 1.04-1.86), and younger age (AOR: 1.02, 95 % CI: 1.01-1.04).

Discussion

In this study, more than one-third of participants who had smoked crack reported “always or usually” smoking crack in public at some point during the study period. Of the participants who had smoked crack in public at least once, 28.8 % reported rushed public crack smoking.

This study found that individuals who were homeless had elevated odds of public crack use and rushed public crack use compared to individuals who were not homeless, which is consistent with other literature that has found that homelessness is one of the strongest predictors of using injection drugs in public [22, 33–35]. Among individuals who use crack in particular, rates of homelessness have been found to be disproportionately higher than individuals who use other illicit drugs [2]. Therefore, one way to reduce risky public crack use may involve addressing barriers to securing stable housing among this population, such as increasing accessibility...
| Characteristic                          | Smoked crack in public<sup>a</sup> | Did not smoke crack in public<sup>b</sup> | Odds ratio (95 % CI) | p - value |
|----------------------------------------|------------------------------------|------------------------------------------|----------------------|-----------|
| Age                                    | Median years                       |                                          |                      |           |
|                                        | 42.1 (36.1 – 47.0)                 | 47.2 (40.7 – 52.5)                       | 1.05 (1.04, 1.08)    | <0.001    |
| Gender                                 |                                    |                                          |                      |           |
| Female                                 | 93 (38.1)                          | 307 (36.5)                               | 1.07 (0.80, 1.44)    | 0.646     |
| Male                                   | 151 (61.9)                         | 534 (63.5)                               |                      |           |
| HIV serostatus                         | Positive                           | 90 (36.9)                                | 0.63 (0.47, 0.84)    | 0.002     |
|                                        | Negative                           | 154 (63.1)                               |                      |           |
| Homelessness<sup>c,d</sup>             | Yes                                | 115 (47.1)                               | 6.02 (4.36, 8.31)    | <0.001    |
|                                        | No                                 | 128 (52.5)                               |                      |           |
| Drug Dealing<sup>c</sup>               | Yes                                | 106 (43.4)                               | 3.37 (2.48, 4.59)    | <0.001    |
|                                        | No                                 | 138 (56.6)                               |                      |           |
| Sex work<sup>c, a</sup>                | Yes                                | 40 (16.4)                                | 1.56 (1.05, 2.33)    | 0.029     |
|                                        | No                                 | 201 (82.4)                               |                      |           |
| Crack smoking<sup>c,d</sup>            | ≥ Daily                            | 136 (55.7)                               | 2.90 (2.16, 3.89)    | <0.001    |
|                                        | < Daily                            | 108 (44.3)                               |                      |           |
| Shared crack pipe<sup>e</sup>          | Yes                                | 143 (58.6)                               | 1.68 (1.26, 2.25)    | <0.001    |
|                                        | No                                 | 101 (41.4)                               |                      |           |
| Binge non-injection drug use<sup>c</sup>| Yes                                | 99 (40.6)                                | 1.01 (0.75, 1.34)    | 0.994     |
|                                        | No                                 | 145 (59.4)                               |                      |           |
| Heroin injection<sup>c</sup>           | ≥ Daily                            | 78 (32.0)                                | 3.03 (2.17, 4.23)    | <0.001    |
|                                        | < Daily                            | 166 (68.0)                               |                      |           |
| Cocaine injection<sup>c,d</sup>        | ≥ Daily                            | 28 (11.5)                                | 2.40 (1.46, 3.95)    | <0.001    |
|                                        | < Daily                            | 216 (88.5)                               |                      |           |
| Crystal meth injection<sup>c</sup>     | ≥ Daily                            | 10 (4.1)                                 | 1.29 (0.61, 2.70)    | 0.501     |
|                                        | < Daily                            | 234 (95.9)                               |                      |           |
| Public injection drug use<sup>c,d</sup> | Always or usually                 | 59 (24.2)                                | 13.80 (8.04, 23.72)  | <0.001    |
|                                        | Sometimes, occasionally or never   | 184 (75.4)                               |                      |           |
to supportive housing and housing support staff who may assist with issues such as social assistance and tenancy rights [22].

In this study, individuals who smoked crack in public had a five-fold increased odds of also having injected drugs in public, which is concerning given the added risk of infection and disease transmission associated with public injection drug use [21–23]. Daily crack use and crack pipe sharing were also significantly associated with public crack use and rushed public crack use. These findings suggest that individuals who smoke crack in public may at increased risk of transmitting HIV, HCV and other infectious pathogens [7–15]. The finding that rushed public crack use was significantly associated with crack pipe sharing is especially concerning, given that rushed drug use is often characterized by inattention to hygiene and harm reduction practices, which may further exacerbate the risk of infectious disease transmission [24–26]. Therefore, greater efforts are needed to reduce barriers to distributing sterile crack pipes to reduce risky pipe sharing, especially given literature suggesting that crack pipe sharing is significantly associated with difficulty obtaining new pipes [31, 36].

Individuals who used crack in public in the present study demonstrated higher odds of recent incarceration and noticing police presence. These findings echo other research that has found that individuals who use drugs in public are often involved in the criminal justice system [23, 33, 34, 37] and are often fearful of, hassled, or shamed by police, which may perpetuate drug use in riskier environments perceived to be less exposed to police (e.g., alleys, dumpsters, hidden doorways) [26, 35]. However, such hidden environments often pose high risk for fatal overdose due to individuals being out of sight from passersby, injury or infection due to hazardous litter that is frequently found in such areas (e.g., used needles or crack pipes), or lack of access to sterile supplies in such settings [21, 26].

Individuals who reported public crack use and rushed public crack use were also more likely to have recently engaged in drug dealing. A limited body of literature has found that public crack use is associated with drug dealing [37], and that crack users are more likely than non-crack users to report illegal activities such as drug dealing as a method of income generation [15]. One potential explanation is that drug dealing and public crack use both occur at street level, where individuals may spend a large portion of their time [18]. Therefore, street-level harm reduction interventions such as utilizing street outreach programs to distribute sterile drug use equipment and provide safer drug use education may be beneficial for this population [38, 39]. Additionally, improving access to low-threshold employment opportunities for this population may reduce the need for individuals to rely on street-level income-generating activities, and in turn potentially reduce drug use and related harms [40].

Collectively, these findings suggest the potential for evidence-based public health interventions to reduce the harms associated with public crack use and rushed

| Table 1 Baseline characteristics of VIDUS and ACCESS participants who smoked crack in Vancouver, Canada, stratified by public crack smoking (n = 1085) (Continued) |
|---------------------------------|---------|---------|---------|---------|---------|
| Noticed police presence\(^c\)\(^d\) | Yes | 175 (71.7) | 536 (63.7) | 1.47 (1.07, 2.02) | 0.016 |
| No | 67 (27.5) | 302 (35.9) | | |
| Stopped, searched or detained without arrest by police\(^c\)\(^d\) | Yes | 57 (23.4) | 90 (10.7) | 2.62 (1.81, 3.80) | <0.001 |
| No | 181 (74.2) | 750 (89.2) | | |
| Incarceration\(^c\) | Yes | 43 (17.6) | 55 (6.5) | 3.13 (2.04, 4.81) | <0.001 |
| No | 196 (80.3) | 785 (93.3) | | |
| Drug addiction treatment (excluding methadone)\(^c\)\(^d\) | Yes | 148 (60.7) | 525 (62.4) | 0.96 (0.71, 1.28) | 0.766 |
| No | 92 (37.7) | 312 (37.1) | | |
| Victim of violence\(^c\) | Yes | 39 (16.0) | 128 (15.2) | 1.08 (0.73, 1.59) | 0.710 |
| No | 200 (82.0) | 707 (84.1) | | |

\(^a\) Defined as “always” or “usually” smoking crack in public in the previous six months

\(^b\) Defined as “sometimes,” “occasionally” or “never” smoking crack in public in the previous six months

\(^c\) Denotes activities/events in the previous six months

\(^d\) Counts may not add up to column totals due to missing responses
While the evidence in support of supervised injection facilities is now well-established [41–45], the implementation of supervised inhalation rooms has been slow to follow suit, despite the overwhelming benefit that such facilities may offer in terms of providing a safe, non-rushed environment; sterile equipment to prevent disease transmission; direct access to health and social services for this hard-to-engage population prone to fatal overdose, infection, and other complex health concerns; immediate support for addiction treatment and counselling; reducing public drug use and related disorder; and affording considerable cost savings.

| Characteristic                                      | Unadjusted |  | Adjusted |  |
|----------------------------------------------------|------------|---|----------|---|
|                                                    | Odds ratio (95 % CI) | p-value | Odds ratio (95 % CI) | p-value |
| Age (per one-year decrease)                        | 1.06 (1.05 – 1.08) | <0.001 | 1.03 (1.01 – 1.04) | <0.001 |
| Gender                                             | 1.09 (0.86 – 1.39) | 0.465 |
| HIV serostatus (positive vs. negative)             | 0.71 (0.56 – 0.91) | 0.006 |
| Homelessnessa (yes vs. no)                         | 4.55 (3.71 – 5.59) | <0.001 | 3.48 (2.77 – 4.36) | <0.001 |
| Drug dealinga (yes vs. no)                         | 2.76 (2.30 – 3.32) | <0.001 | 1.59 (1.30 – 1.94) | <0.001 |
| Sex worka (yes vs. no)                             | 1.94 (1.48 – 2.54) | <0.001 |
| Crack smokinga (≥ daily vs. < daily)               | 3.11 (2.59 – 3.74) | <0.001 | 2.69 (2.19 – 3.31) | <0.001 |
| Shared crack pipea (yes vs. no)                    | 2.78 (2.31 – 3.34) | <0.001 | 1.98 (1.60 – 2.46) | <0.001 |
| Binge non-injection drug usea (yes vs. no)         | 1.44 (1.24 – 1.67) | <0.001 |
| Heroin injectiona (≥ daily vs. < daily)           | 2.21 (1.72 – 2.84) | <0.001 |
| Cocaine injectiona (≥ daily vs. < daily)           | 1.48 (1.09 – 1.99) | 0.011 |
| Crystal meth injectiona (≥ daily vs. < daily)      | 0.89 (0.57 – 1.40) | 0.626 |
| Public injection drug usea (Always or usually vs. sometimes, occasionally or never) | 7.46 (5.42 – 10.28) | <0.001 | 5.42 (3.76 – 7.82) | <0.001 |
| Noticed police presencea (yes vs. no)              | 1.67 (1.42 – 1.97) | <0.001 | 1.30 (1.06 – 1.60) | 0.013 |
| Stopped, searched or detained without arrest by policea (yes vs. no) | 1.98 (1.61 – 2.44) | <0.001 |
| Incarcerationa (yes vs. no)                         | 2.36 (1.79 – 3.11) | <0.001 | 1.47 (1.09 – 1.98) | 0.011 |
| Drug addiction treatment (excluding methadone)a (yes vs. no) | 0.95 (0.78 – 1.16) | 0.622 |
| Victim of violencea (yes vs. no)                    | 1.52 (1.22 – 1.88) | <0.001 |

*aDenotes activities/events in the previous six months
savings for health care systems [15, 46–49]. Notably, the implementation of supervised inhalation rooms need not be separate from supervised injection facilities; in fact, the delivery of both supervised injection and inhalation (or other non-injection drug use) in a single ‘safe drug use facility’ may be a more feasible and accessible approach for this population. Although individuals who use crack have previously reported high rates of willingness to use supervised inhalation rooms [27, 37, 50], policy barriers continue to impede the implementation of these potentially life-saving facilities [51].

In addition to the social and structural interventions described above, more immediate public health interventions to reduce the harms associated with public crack use may include distributing sterile crack smoking equipment and installing safe disposal containers for used crack equipment in public places [21, 35, 52, 53]. Notably, these interventions hold benefit for users of other non-injection drugs (e.g., methamphetamine, heroin), and may even play a crucial role in supporting the transition from injection drug use to less risky forms of non-injection drug use [46, 52, 54]. Furthermore, more research is needed on effective treatments for stimulant dependence, as currently no single approach has yet shown consistent evidence for effectively reducing or sustaining abstinence for stimulant use [55–59].

This study has several limitations. First, our study relied on self-reported data that is susceptible to socially desirable reporting and recall bias. Second, because the study sample was not randomly selected, these results may not be generalizable to other populations. Related to this, as there is a lack of research on crack cocaine use in general population samples—including estimates of co-occurring crack smoking and injection drug use

| Characteristic                                        | Unadjusted                         | Adjusted                          |   |
|-------------------------------------------------------|------------------------------------|------------------------------------|---|
|                                                       | Odds ratio (95 % CI) | p-value | Odds ratio (95 % CI) | p-value |
| Age (per one-year decrease)                           | 1.04 (1.02 – 1.06)               | <0.001 | 1.02 (1.01 – 1.04)   | 0.019   |
| Gender (female vs. male)                              | 1.35 (1.01 – 1.80)              | 0.045 | 1.23 (0.90 – 1.69)   | 0.185   |
| Homelessness (yes vs. no)                             | 2.86 (2.18 – 3.76)               | <0.001 | 2.61 (1.96 – 3.49)   | <0.001  |
| Drug dealing (yes vs. no)                             | 1.86 (1.41 – 2.44)               | <0.001 | 1.39 (1.04 – 1.86)   | 0.026   |
| Sex work (yes vs. no)                                 | 1.25 (0.86 – 1.81)               | 0.241 |                               |         |
| Crack smoking (≥ daily vs. < daily)                   | 1.71 (1.30 – 2.24)               | <0.001 | 1.48 (1.11 – 1.98)   | 0.007   |
| Shared crack pipe (yes vs. no)                        | 1.65 (1.28 – 2.14)               | <0.001 | 1.44 (1.10 – 1.89)   | 0.008   |
| Binge non-injection drug use (yes vs. no)             | 1.28 (1.00 – 1.64)               | 0.051 |                               |         |
| Noticed police presence (yes vs. no)                  | 1.19 (0.88 – 1.60)               | 0.250 |                               |         |
| Stopped, searched or detained without arrest by police (yes vs. no) | 1.68 (1.22 – 2.31)               | 0.001 |                               |         |
| Incarceration (yes vs. no)                            | 1.90 (1.30 – 2.78)               | <0.001 | 1.43 (0.95 – 2.15)   | 0.084   |
| Drug addiction treatment (excluding methadone) (yes vs. no) | 0.97 (0.73 – 1.28)               | 0.828 |                               |         |
| Victim of violence (yes vs. no)                       | 1.36 (0.96 – 1.92)               | 0.088 |                               |         |

*Denotes activities/events in the previous six months*
and estimates of public crack smoking—it is difficult to compare these findings to other populations. Therefore, more research on crack smoking in general population samples is needed. Finally, as in all observational studies of this kind, the associations between the explanatory variables and the outcomes assessed may have been under the influence of unmeasured confounding, although we sought to address this bias with multivariable adjustment involving key potential correlates of public crack smoking.

Conclusions

In summary, a high prevalence of public crack smoking and rushed public crack smoking was observed in this study. These behaviours were associated with an array of factors highlighting the vulnerability of this population, including homelessness, younger age, public injection drug use, daily crack use, crack pipe sharing, exposure to law enforcement, and involvement in drug dealing. These findings point to the need for implementing and evaluating evidence-based social, structural, and public health interventions, such as supervised inhalation facilities, to reduce the risks and harms associated with smoking crack in public.

Abbreviations

ACCESS, AIDS Care Cohort to Evaluate Access to Survival Services; AIDS, acquired immune deficiency syndrome; AOR, adjusted odds ratio; CI, confidence interval; GEE, generalized estimating equations; HCV, hepatitis C virus; HIV, human immunodeficiency virus; QIC, independence model criterion; VIDUS, Vancouver Injection Drug Users Study

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Availability of data and materials

The data used for this study is not publicly available. For further information on the data and materials used in this study, please contact the corresponding author.

Authors’ contributions

EW, TK, MJM and KH directed the cohort studies. PV, LT, TK and KH designed the present study. HD conducted the statistical analyses. PV developed the first draft and incorporated suggestions from all co-authors. All authors made significant contributions to the conception of the analyses, interpretation of the data, and drafting of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate

All participants provided written informed consent for study participation. The cohort studies received annual ethics approval from the University of British Columbia and Providence Health Care Research Ethics Board. The Principal Investigators of the cohorts (Drs. Kerr and Milloy) granted permission to use the data for the present study, which was part of the larger cohort study activities that receive annual ethics approval by the aforementioned Research Ethics Boards.

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References

1. UHRI. Drug situation in Vancouver (Second Edition). In: Urban Health Research Initiative, British Columbia Centre for Excellence in HIV/AIDS. 2nd ed. 2013.
2. Fischer B, Coghn M. Crack use in North American cities: the neglected ‘epidemic’. Addiction. 2007;102(9):1340–1.
3. Werb D, Debeck K, Kerr T, Li K, Montaner J, Wood E. Modelling crack cocaine use trends over 10 years in a Canadian setting. Drug Alcohol Rev. 2010;29(3):271–7.
4. Health Canada. Canadian Alcohol and Drug Use Monitoring Survey. 2012. http://www.hc-sc.gc.ca/hc-ps/drugs-drogues/stat_2012/summary-sommaire-eng.php. Accessed 13 Apr 2016.
5. National Institute on Drug Abuse. National Survey of Drug Use and Health. 2014. https://www.drugabuse.gov/national-survey-drug-use-health. Accessed 13 Apr 2016.
6. Nutt DJ, King LA, Phillips LD, Independent Scientific Committee on D. Drug harms in the UK: a multicriteria decision analysis. Lancet. 2010;376(9752):1558–65.
7. Delbeck K, Kerr T, Li K, Fischer B, Buxton J, Montaner J, Wood E. Smoking of crack cocaine as a risk factor for HIV infection among people who use injection drugs. CMAJ. 2009;180(10):E585–9.
8. Edlin BR, Irwin KL, Tashuo S, McCoy CB, Word C, Serrano Y, Inciardi JA, Bowser BP, Schilling RF, Holmberg SD. Intersecting epidemics–crack cocaine use and HIV infection among inner-city young adults. Multicenter Crack Cocaine and HIV Infection Study Team. N Engl J Med. 1994;331(21):1422–7.
9. Nyamathi AM, Dixon EL, Robbins W, Smith C, Wiley D, Leake B, Longshore D, Gelberg L. Risk factors for hepatitis C virus infection among homeless adults. J Gen Intern Med. 2002;17(2):134–43.
10. Ross MW, Hwang LY, Zack C, Bull L, Williams ML. Sexual risk behaviours and STIs in drug abuse treatment populations whose drug of choice is crack cocaine. Int J STD AIDS. 2002;13(1):769–74.
11. McMahon JM, Tortu S. A potential hidden source of hepatitis C infection among noninjection drug users. J Psychoactive Drugs. 2003;35(4):455–60.
12. Story A, Bothamley G, Hayward A. Crack cocaine and infectious tuberculosis. Emerg Infect Dis. 2008;14(9):1466–9.
13. Howard AA, Klein RS, Schoenbaum EE, Gouveitich MN. Crack cocaine use and other risk factors for tuberculin positivity in drug users. Clin Infect Dis. 2002;35(10):1183–90.
14. Nacher M, Basurko C, Adenis A, Gaubert-Marechal E, Mosnier E, Edouard S, Vantilcke V, Swippegassam S, Tressieres S, Cabie A, et al. Predictive factors of herpes zoster HIV-infected patients: another adverse effect of crack cocaine. PLoS One. 2013;8(11):e80187.
15. Fischer B, Rehm J, Patra J, Kalousek K, Haydon E, Tyndall M, El-Guebaly N. Crack across Canada: Comparing crack users and crack non-users in a Canadian multi-city cohort of illicit opioid users. Addiction. 2006;101(12):1760–70.
16. Falcik RS, Wang J, Siegal HA, Carlson RG. The prevalence of psychiatric disorder among a community sample of crack cocaine users: an exploratory study with practical implications. J Nerv Ment Dis. 2004;192(7):503–7.

17. Persaud S, Termini D, Kuo M, Bunag V, Buxton JA. Controlling chaos: the perceptions of long-term crack cocaine users in Vancouver, British Columbia, Canada. J Addict. 2013;2013:B5811840.

18. Kerr T, Small W, Johnston C, Li K, Montaner JS, Wood E. Characteristics of injection drug users who participate in drug dealing: implications for drug policy. J Psychoactive Drugs. 2008;40(2):147–52.

19. Debeck K. Drug-related street disorder: evidence for public policy responses. Vancouver: University of British Columbia; 2010.

20. Wood E, Kerr T, Spittal P, Tyndall M, O’Shaughnessy M, Schechter M. The health care and fiscal costs of the illicit drug use epidemic: the impact of conventional drug control strategies, and the potential of a comprehensive approach. BC Med J. 2003;45(3):128-134.

21. Rhodes T, Kimber J, Small W, Fitzgerald J, Kerr T, Hickman M, Holloway G. Public injecting and the need for ‘safer environment interventions’ in the reduction of drug-related harm. Addiction. 2006;101(10):1384–93.

22. Debeck K, Small W, Wood E, Li K, Montaner J, Kerr T. Public injecting among a cohort of injecting drug users in Vancouver, Canada. J Epidemiol Community Health. 2009;63(1):81–6.

23. Green T, Hankins C, Palmer D, Boivin JF, Platt R. Ascertaining the need for a supervised injecting facility (SIF): The burden of public injecting in Montreal, Canada. J Drug Issues. 2003;33(3):713–31.

24. Broadhead RS, Kerr TH, Grund JPC, Altice FL. Safer injection facilities in North America: Their place in public policy and health initiatives. J Drug Issues. 2002;32(3):529–55.

25. Dovey K, Fitzgerald J, Choi YJ. Safety becomes danger: dilemmas of drug-use in public space. Health Place. 2001;7(4):319–31.

26. Small W, Kerr T, Charette J, Schechter MT, Spittal PM. Impacts of intensified police activity on injection drug users: evidence from an ethnographic investigation. Int J Drug Policy. 2006;17(2):85–95.

27. Shannon K, Ishida T, Morgan R, Bear A, Oleson M, Kerr T, Tyndall MW. Potential community and public health impacts of medically supervised safer smoking facilities for crack cocaine users. Harm Reduct J. 2006;3:1.

28. Strathdee SA, Patrick DM, Currie SL, Cornelisse PG, Rekart ML, Montaner JS, Schechter MT, O’Shaughnessy MV. Needle exchange is not enough: lessons from the Vancouver injecting drug use study. AIDS. 1997;11(8):F59–65.

29. Strathdee SA, Patelu A, Cornelisse PG, Yip B, O’Shaughnessy MV, Montaner JS, Schechter MT, Hogg RS. Barriers to use of free antiretroviral therapy in injection drug users. JAMA. 1998;280(6):547–9.

30. Milloy MJ, Kerr T, Bangsberg DR, Buxton J, Parashar S, Guillemi S, Montaner J, Wood E. Homelessness as a structural barrier to effective antiretroviral therapy among HIV-seropositive illicit drug users in a Canadian setting. AIDS Patient Care and STDs. 2012;26(7):565–7.

31. Ti L, Buxton J, Wood E, Zhang R, Montaner J, Kerr T. Difficulty accessing crack pipes and crack pipe sharing among people who use drugs in Vancouver, Canada. Subst Abuse Treat Prev Policy. 2011;6:34.

32. Mitra G, Wood E, Nguyen P, Kerr T, DeBeck K. Drug use patterns predict risk of non-fatal overdose among street-involved youth in a Canadian setting. Drug Alcohol Depend. 2015;153:35–9.

33. Navarro C, Leonard L. Prevalence and factors related to public injecting in Ottawa, Canada: Implications for the development of a trial of safer injecting facility. Int J Drug Policy. 2004;15:275–84.

34. Klee H, Morris J. Factors that characterize street injectors. Addiction. 1995;90(9):837–41.

35. Rhodes T, Watts L, Davies S, Martin A, Smith J, Clark D, Craine N, Lyons M. Risk, shame and the public injector: a qualitative study of drug injecting in South Wales. Soc Sci Med. 2007;65(9):572–85.

36. Ti L, Buxton J, Wood E, Shannon K, Zhang R, Montaner J, Kerr T. Factors associated with difficulty accessing crack cocaine pipes in a Canadian setting. Drug Alcohol Rev. 2012;31(7):890–6.

37. Debeck K, Buxton J, Kerr T, Qi J, Montaner J, Wood E. Public crack cocaine smoking and willingness to use a supervised inhalation facility: implications for street disorder. Subst Abuse Treat Prev Policy. 2011;6:44.

38. Hilton BA, Thompson R, Moore-Dempsey L, Hutchinson K. Urban outpost nursing: the nature of the nurses’ work in the AIDS prevention street nurse program. Public Health Nurs. 2001;18(4):273–80.

39. Hilton BA, Thompson R, Moore-Dempsey L. Evaluation of the AIDS Prevention Street Nurse Program: one step at a time. Can J Nurs Res. 2000;32(1):17–38.