



Employment Cessation, Long Term Labour Market Engagement and HIV Infection Risk Among People Who Inject Drugs in an Urban Canadian Setting

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Abstract

The potential for changes in socio-economic status, such as employment exits, to increase HIV infection risk are not well examined among people who inject illicit drugs (PWID). We used longstanding cohort data from Vancouver, Canada, to longitudinally assess associations between employment cessation and outcomes with documented linkages to HIV infection risk among PWID. From 2005 to 2015, 1222 participants reported 1154 employment exits. Employment exits were significantly associated with transitions into unstable housing; moving to the inner-city; initiating informal, prohibited or illegal income generation; high risk drug use practices; and exiting methadone maintenance therapy. HIV infection rates were higher among participants with lower long-term labour market engagement. These findings suggest that employment cessation coincides with initiating exposure to aspects of socioeconomic marginalization and drug use associated with HIV infection risk. Support for employment retention that prevents poverty entrenchment and harmful drug use could contribute to HIV prevention measures for PWID.

Keywords Injection drug use · Employment transitions · HIV infection · Socioeconomic marginalization

Introduction

Employment and unemployment have long been linked to individual well-being, morbidity and mortality in the general population [1–3]. Labour market activity provides income, which, as a flexible resource, is linked to material security and the ability to mitigate the health, social and economic impacts of poverty [1, 4]. The loss of material resources commonly associated with leaving employment may produce pressures toward informal, prohibited or illegal income generation [5]. Such activities have been further

and independently associated with negative health and social outcomes [6–8], including poor HIV clinical outcomes [9]. In addition to the health impacts of material hardship brought on by job loss, previous research identifies social-psychological penalties of unemployment such as loss of time structure, status, social contact and meaningful activity [10, 11]. These penalties may be reflected in studies of labour market dynamics and mental health focusing on job loss and unemployment, which have generally found associations with financial stress, depression, anxiety, decreased self-esteem, substance use and suicidal ideation [12–18].

In the context of the HIV epidemic, understandings of people who inject drugs (PWID) as a key affected population have been linked to social, economic and legal vulnerabilities that increase the risk of infection and barriers to accessing HIV care [19, 20]. For example, socio-economic disadvantage, criminal justice system involvement, and drug-related violence have all been implicated in elevated HIV infection risk for PWID [20–22]. Previous research has documented low levels of employment among PWID at-risk or living with HIV [9, 23, 24], particularly among people who use drugs on a long-term, high-intensity or poly-substance basis [25, 26]. Conversely, employment has been

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significantly associated with considerable benefits, including lower likelihood of injection drug use and relapse, higher likelihood of entering substance use disorder treatment programs, and lower likelihood of mortality [26–29]. Indeed, employment and unemployment are emerging as key determinants of health among PWID [21, 23].

Despite a growing literature documenting the health impacts of employment and unemployment among PWID, little of this research has focused on labour market dynamics, labour market engagement, or labour market attachment. Compared to assessments of employment status at a single moment in time, labour market transitions are highly relevant to health as they may be accompanied by the redistribution of resources; changes in behaviour, or decreased stability [30, 31]. Similarly, differential levels of long-term labour market attachment may be closely linked to health outcomes through predispositions toward health-protective behavior and exposures [1, 32]. Employment exits may be of particular importance to HIV infection risk and HIV infection as they may precipitate socio-economic marginalization commonly involving elevated exposure to risk-related contexts [21, 22, 33] and previous qualitative research has linked negative labour market and substance use trajectories [34]. As such, employment exits may be critical to understanding labour market dynamics and the health of PWID at elevated risk of HIV infection, particularly compared to individuals not exposed to employment status changes. Further, labour market attachment may be indicative of higher long-term socio-economic well-being and thus protective against risk of HIV infection. To our knowledge no study has examined potential links between employment cessation, long-term labour market engagement and social and structural vulnerabilities linked to HIV infection among PWID.

The impacts of such vulnerabilities will undoubtedly vary by context. The current study context of Vancouver, Canada, has been characterized by one of the highest historical rates of HIV infection among PWID in developed countries [35], rates whose considerable decline has been attributed largely to a widespread seek, test, treat and retain campaign and universal province-wide no-cost HIV care and treatment [36, 37]. In addition, there exists both a federal employment insurance [EI] system providing recently fired or laid off individuals a portion of their previous salary [38], and a provincial income assistance system supporting individuals ineligible for EI [39]. These systems have time-delimited eligibility criteria, job search requirements, and benefit amounts that commonly place participants well below different measures of low income or poverty [40]. Income supports may be expected to mitigate some of the health, poverty and other consequences of employment cessation or low overall employment engagement relevant to HIV infection among PWID. Nevertheless, an improved understanding of the relationship between employment instability,

labour market detachment, changes HIV infection risk and HIV infection may identify points of potential intervention to reduce the risk of HIV acquisition among PWID as a key affected population. We therefore undertook the current study to examine associations between employment cessation and transitions of potential relevance to HIV infection risk and HIV infection among PWID in Vancouver, Canada.

Methods

This study draws on data from the Vancouver Injection Drug Users Study (VIDUS). Described in detail elsewhere [41], VIDUS is a longstanding prospective cohort study of people who inject drugs recruited through self-referral and street outreach. Individuals were eligible for the study if, at the time of recruitment, they reported illicit injection drug use within the past month, lived in the greater Vancouver area, were HIV-seronegative and provided written informed consent. At baseline and semi-annually thereafter, participants completed detailed questionnaires that gathered information on socio-demographic characteristics, drug use, income generation, drug- and HIV-related risk and social-structural exposures. Participants also provided blood samples at each follow up for HIV and Hepatitis C (HCV) serologic testing. Initiated in 1996, the cohort was refreshed in 2005. Participants receive a stipend of \$30 at each study visit for their time and interview-related expenses. The study was approved by the University of British Columbia/Providence Health Care Research Ethics Board.

Measures

The current analyses use all baseline and available follow up observations provided by participants enrolled in VIDUS between May 2005 and December 2015. Our primary variable of interest was employment cessation. This variable was derived from the question, “In the past 6 months, what have been your sources of income?” Participants were considered to have undergone a transition out of employment if they did not report regular, temporary or self-employment as a source of income in the 6 months prior to interview but had listed one of these as a source of income at the previous follow up. Employment was distinguished from other income sources by separate response options for government income assistance, illegal income sources (e.g. theft, drug-dealing) and informal street-based income generation (e.g. panhandling, informal recycling and car window washing).

Our analytical focus was on the relationship between employment cessation and other transitions relevant to the risk of HIV infection. Variables measuring such transitions were constructed similarly to our indicator of employment

cessation, by identifying a transition if the presence or absence of a relevant variable differed between sequential follow-up observations. The transitions we examined included: becoming unstably housed (moving from stable housing to living in a hotel, hostel, jail or prison, or being homeless); moving to the Downtown Eastside (DTES), a Vancouver neighbourhood characterized by a public drug scene, high prevalence of HIV and HCV infection and socio-economic disadvantage [42]; initiating illegal, prohibited or informal income generation other than sex work (drug dealing, acquisitive criminal activity or street-based activity); initiating sex work; increasing the frequency of injection heroin, injection or non-injection cocaine or smoked crack-cocaine use (from none to less than daily frequency or less than daily frequency to daily or greater frequency); initiating binge drug use; initiating acquisitive syringe sharing (i.e., syringe borrowing); initiating assisted injecting; discontinuing methadone maintenance therapy; and newly encountering barriers to addiction treatment enrolment. In previous research, the end states of all transitions examined have been associated with elevated levels of HIV infection or increased likelihood of behaviour or exposures associated with HIV infection [43–53].

Statistical Analyses

We first examined participation rates in the study and whether there were any systematic differences in loss to follow up, defined as not providing a follow up observation in the final 24 months of the observation period. Second, we examined the characteristics of the study sample, assessing the employment patterns of the sample with particular focus on employment entries and exits. We identified long-term labour market engagement patterns by categorizing participants according to the proportion of observations in which they report regular, temporary or self-employment. Categories included never employed (no observations), rarely employed (0–1/3), sometimes employed (1/3–2/3), and often employed (> 2/3). We then examined the baseline characteristics of the study sample stratified by whether they were in the never/rarely employed categories (low labour market engagement) or the sometimes/often employed categories (high labour market engagement). Baseline differences between those in the low and high labour market engagement categories were assessed using Chi square tests for categorical variables and Mann–Whitney tests for continuous variables.

Third, we engaged in a step-wise model development process whereby we constructed three models for each transition of relevance identified above in which the transition was considered the key outcome of interest and employment cessation the primary independent variable

of interest. Models used generalized estimating equations (GEEs) for binary outcomes using a logit link function, an unstructured correlation structure and robust standard errors. GEE models provide estimates of longitudinal population averaged estimates at the observation level, accounting for within-subject correlation across repeated measures without requiring joint distributional assumptions of the observed data and the individual-level random effects [54]. As the focus of these analyses was on transitions associated with employment loss rather than time to employment loss, we include all individuals in analyses rather than only those in employment. Results should be interpreted as correlates of change compared to stability in either employment or non-employment as a result, and participant observations are not right hand censored following an employment transition as they would be in a time-to-event analysis.

For each outcome, the first model assessed the simple bivariate relationship between employment cessation and the transition of interest. The second partially adjusted model included controls for age (per additional year), gender and ethnicity (white vs. non-white). The fully adjusted model additionally included covariates chosen given their previously documented associations with employment transitions [24, 33]. These included binary indicators for substance use disorder treatment enrolment, recent incarceration, exposure to violence and public drug use. A final indicator of whether an employment exit was the second or greater exit during the observation period was included in final models, given the strong rationale that higher levels of employment instability may have a different relationship with the transitions of interest.

Finally, we assessed whether labour market involvement was associated with HIV infection. We initially determined the number of HIV infections among the study population over the course of the observation period. We then assessed whether there were significant differences in the number of HIV infections across levels of labour market engagement, and finally used the same nested model building approach described above to determine whether labour market cessation was associated with HIV infection. This modelling strategy specifically assessed whether employment cessation is associated with changes involving a new exposure or behaviour linked to HIV infection risk and with HIV infection itself. In so doing, we assessed the HIV infection risk implications of a specific labour market participation dynamic and the elimination of a legal source of income that is consistently associated with better physical and mental health outcomes as well as decreased socio-economic insecurity [1, 2]. All analyses were conducted using Stata Version 15 (College station, TX: Stata Corporation).

Results

Between June, 2005, to November, 2015, 1222 VIDUS participants provided a total of 12230 observations with a median number of observations per participant of 10 (interquartile range [IQR]: 4–16). Bivariate analyses of whether there are systematic differences at between participants retained in the study and those lost to follow up found no significant differences at baseline across any of the variables included in analyses. Six hundred and eighteen unique individuals (50.6%) transitioned out of employment at least once, with a total of 1181 transitions into employment (9.7% of observations) and 1154 transitions out of employment (9.4% of observations) during the 10-year study period. Fully 315 (25.7%) participants had at least two employment entries and 321 (26.2%) at least two employment exits, indicating that approximately half of those labour market engaged participants were moving in and out of employment. The distribution of participants across the different levels of labour market engagement categories indicated 414 (33.9%) of the sample were never

employed; 460 (37.6%) rarely employed, reporting regular, temporary or self-employment in fewer than one-third of their follow up visits; 211 (17.3%) were sometimes employed, reporting employment between 1/3 and 2/3 of their visits; and 137 (11.21%) in the often-employed group, reporting employment at greater than 2/3 of their visits.

At baseline, the median age of respondents was 40.7 years (IQR: 33.4–47.1), 414 (33.8%) of the sample was female, 754 (61.7%) of white ancestry, and 369 (30.2%) of Indigenous ancestry. Baseline characteristics stratified by whether a participant was in the low or high labour market engagement category over the course of the study period are displayed in Table 1. Participants who were older (Odds ratio [OR] = 1.00, 95% confidence interval [CI]: 1.00–1.00, $p < 0.001$), of white ethnicity (OR = 1.30, 95% CI: 1.00–1.69, $p = 0.046$), and employed (OR = 13.1, 95% CI: 9.72–17.68, $p < 0.001$) at baseline were significantly more likely to have higher levels of labour market engagement. Conversely, women (OR = 0.33, 95% CI: 0.24–0.44, $p < 0.001$), residents of the Downtown Eastside (OR = 0.45, 95% CI: 0.35–0.59, $p < 0.001$), those reporting income from income

Table 1 Baseline characteristics of people who inject drugs in Vancouver, Canada stratified by levels of labour market engagement during the study period (2005–2015)

Characteristic	Total (%) (n = 1222)	Labour Market Engagement ^a		Odds Ratio (95% CI)	p value
		Low (%) (n = 874)	High (%) (n = 348)		
Sociodemographic					
Age (median, IQR)	40 (33–47)	40 (33–47)	40 (34–47)	1.00 (1.00–1.00)	<0.001
Female gender	414 (33.9)	351 (40.2)	63 (18.1)	0.33 (0.24–0.44)	<0.001
White ethnicity	754 (61.7)	524 (60.0)	230 (66.0)	1.30 (1.00–1.69)	0.046
Unstably housed ^b	471 (38.5)	341 (39.1)	130 (37.4)	0.92 (0.72–1.20)	0.561
DTES residency ^b	857 (70.1)	656 (75.1)	201 (57.8)	0.45 (0.35–0.59)	<0.001
Income Generation					
Employed ^b	332 (27.1)	107 (12.2)	255 (64.7)	13.1 (9.72–17.68)	<0.001
Income assistance ^b	1015 (83.0)	775 (88.9)	240 (69.4)	0.28 (0.21–0.39)	<0.001
Sex work ^b	185 (15.1)	159 (18.6)	26 (0.07)	0.36 (0.23–0.55)	<0.001
Informal, prohibited or illegal income generation ^b	787 (64.4)	622 (71.2)	165 (47.4)	0.37 (0.28–0.47)	<0.001
Drug Use					
≥ Daily heroin injection ^b	397 (32.5)	301 (34.6)	96 (27.6)	0.72 (0.55–0.95)	0.019
≥ Daily cocaine injection ^b	115 (9.4)	88 (10.1)	27 (7.8)	0.75 (0.48–1.17)	0.204
≥ Daily crack use ^b	486 (39.8)	394 (45.2)	92 (26.4)	0.44 (0.33–0.57)	<0.001
Requires help injecting ^b	283 (23.2)	213 (25.3)	70 (20.9)	0.78 (0.57–1.06)	0.111
Borrowed syringe ^b	109 (8.9)	81 (9.5)	28 (8.3)	0.86 (0.55–1.35)	0.510
Addiction treatment enrollment ^b	626 (51.2)	442 (50.6)	184 (52.8)	1.10 (0.86–1.41)	0.468

CI confidence interval, IQR interquartile range, DTES downtown eastside

^aLabour market engagement was determined by taking the number of observations with self-reported regular, temporary or self-employment and dividing this by the total number of observations. Participants with 1/3 or fewer observations in employment were considered to have low labour market engagement; participants with greater than 1/3 of their observations were considered to have high labour market engagement

^bDenotes exposure or activities in the 6 months prior to interview

assistance (OR = 0.28, 95% CI: 0.21–0.39, $p < 0.001$), sex work (OR = 0.36, 95% CI: 0.23–0.55, $p < 0.001$) or informal, illegal or prohibited sources (OR = 0.37, 95% CI: 0.28–0.47, $p < 0.001$), as well as those engaged in daily or more frequent heroin injection (OR = 0.72, 95% CI: 0.55–0.95, $p = 0.019$) or crack cocaine use (OR = 0.44, 95% CI: 0.33–0.57, $p < 0.001$) were significantly less likely to be in the high labour market engagement group.

Table 2 displays results from unadjusted, partially adjusted and fully adjusted analyses of the relationship between employment cessation and transitions of key relevance for changes in exposure to HIV infection risk. In final fully adjusted multivariate models, transitioning out of employment was significantly associated with several HIV-infection risk-related outcomes. These include becoming unstably housed (Adjusted Odds Ratio [AOR] = 2.02; 95% CI: 1.60–2.34, $p < 0.001$); relocating to the Downtown Eastside (AOR = 1.65; 95% CI: 1.24–2.20, $p = 0.001$); initiating informal, prohibited or illegal income generation (AOR = 1.95, 95% CI: 1.62–2.35, $p < 0.001$); initiating sex work (AOR = 2.06, 95% CI: 1.33–3.16, $p = 0.001$); increasing crack cocaine use (AOR = 1.61, 95% CI:

1.32–1.97, $p < 0.001$); initiating acquisitive syringe sharing (AOR = 1.59, 95% CI, $p = 0.018$), initiating assisted injecting (AOR = 1.44; 95% CI: 1.05–1.98, $p = 0.024$) and ending enrolment in methadone maintenance therapy (OR = 1.61; 95% CI: 1.18–2.21, $p = 0.002$). Notably, while not displayed, the binary indicator of repeated employment exits was significant in final multivariate models for increasing cocaine use (AOR = 0.70, 95% CI: 0.52–0.95, $p = 0.022$); acquisitive syringe sharing (AOR = 0.34, 95% CI: 0.13–0.88, $p = 0.027$); and encountering a barrier to accessing treatment (AOR = 0.55, 95% CI: 0.32–0.92, $p = 0.024$).

Finally, we identified 35 seroconversions over the course of the study period. Twenty-five of these (71.4%) were observed among those who never reported employment over the study period ($\chi^2 = 6.72$, df 1, $p = 0.010$), and 34 (97.1%) were observed among individuals who did not have repeated employment spells ($\chi^2 = 9.89$, df 1, $p = 0.002$). In terms of the four categories of labour market engagement, seroconversions were observed among 21 (5.07%) of those in the never employed group, 8 (1.74%) among the rarely employed group, 4 (1.90%) of the sometimes employed group and 2 (1.46%) of the often employed group

Table 2 GEE analyses assessing associations between employment cessation and key outcomes representing transitions associated with elevated hiv risk among people who inject drugs in Vancouver, Canada, 2005–2015 (N = 1222)^a

Outcome of Interest	Unadjusted Models		Partially Adjusted Models ^b		Fully Adjusted Models ^b	
	Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value
Residential status						
Became unstably housed ^c	1.89 (1.57–2.29)	<0.001	1.93 (1.60–2.34)	<0.001	2.02 (1.60–2.56)	<0.001
Relocated to the Downtown Eastside ^c	1.70 (1.37–2.09)	<0.001	1.68 (1.36–2.08)	<0.001	1.65 (1.24–2.20)	0.001
Income generation						
Initiated informal, prohibited or illegal income generation ^c	1.74 (1.52–1.99)	<0.001	1.77 (1.54–2.03)	<0.001	1.96 (1.63–2.35)	<0.001
Initiated sex work ^c	1.31 (0.93–1.86)	0.125	1.48 (0.92–2.40)	0.106	2.06 (1.33–3.17)	0.001
Drug use						
Increase in heroin use ^c	1.12 (0.94–1.35)	0.211	1.12 (0.93–1.34)	0.242	1.24 (0.98–1.57)	0.072
Increase in cocaine use ^c	1.18 (0.99–1.41)	0.059	1.19 (1.00–1.41)	0.055	1.18 (0.93–1.50)	0.175
Increase in crack-cocaine use ^c	1.38 (1.17–1.62)	<0.001	1.36 (1.16–1.60)	<0.001	1.62 (1.33–1.97)	<0.001
Drug use-related risk						
Initiated binge drug use ^c	0.97 (0.83–1.14)	0.698	0.98 (0.83–1.14)	0.762	1.03 (0.84–1.28)	0.754
Initiated acquisitive syringe sharing ^c	1.17 (0.87–1.57)	0.307	1.15 (0.84–1.56)	0.387	1.59 (1.08–2.35)	0.018
Initiated assisted injection ^c	1.14 (0.89–1.47)	0.290	1.19 (0.92–1.53)	0.185	1.44 (1.05–1.98)	0.024
Addiction treatment						
MMT cessation ^c	1.33 (1.03–1.71)	0.026	1.34 (1.04–1.73)	0.022	1.62 (1.18–2.21)	0.002
New barrier to substance use treatment ^c	1.00 (0.78–1.29)	0.989	1.05 (0.81–1.35)	0.728	1.31 (0.96–1.77)	0.086

MMT methadone maintenance therapy; CI confidence interval

^aSeparate models were conducted for each listed outcome of interest for each level of model adjustment. Odds Ratios and p-values correspond to employment cessation as the primary covariate of interest in all models

^bPartially adjusted models controlled for age, gender, and ethnicity; Fully adjusted models additionally controlled for substance use disorder treatment enrolment, recent incarceration, exposure to violence, public injection, and whether an employment exit was the second or greater employment exit during the observation period

^cDenotes exposures or activities reported in the 6 months prior to interview

($\chi^2 = 11.03$, $df [1]$, $p = 0.012$). While multivariate models estimating the relationship of employment cessation to HIV infection did not converge, likely due to a lack of statistical power or variability in the relationship between employment exits and seroconversion, there were significant systematic differences across levels of labour market involvement with participants with higher levels of labour market involvement having lower rates of HIV infection.

Discussion

This study identified the employment patterns of a cohort of people who use injection drugs characterized by low levels of employment and high levels of employment transitions both in and out of regular, temporary or self-employment as well as relatively low levels of overall labour market engagement over time. It further identified linkages between employment exits and transitions to new exposures or initiating behaviour that have previously demonstrated links with HIV infection risk. In final multivariate models, employment cessation maintained significant associations with transitions to unstable housing, relocation to an inner-city neighbourhood, initiation of informal, illegal or prohibited income generation as well as sex work, increasing the intensity of crack-cocaine use, initiating acquisitive syringe sharing and requiring help injecting, and ending enrolment in MMT. We additionally noted systematic differences in rates of HIV infection across different levels of labour market engagement over the course of the study, with those in the never employed category having significantly higher rate of infection than those in labour market engagement categories involving any employment.

While employment cessation may have coincided with the initiation or intensification of behaviors and exposure with previously documented linkages to elevated HIV infection, most HIV infections observed over the study period did not occur among people engaged in the labour market who would undergo an employment exit. The study therefore provides important exploratory information on employment dynamics, employment status and HIV risk, specifically in terms of labour market engagement. These findings are of particular interest to efforts to address upstream determinants of health among PWID: whether associations reflect coinciding transitions, employment preceded transitions or the transitions we examined precipitated employment exits [23], social and structural vulnerabilities that increase employment precarity, are exacerbated by employment exits, or produce barriers to labour market engagement [55] may play a key role in HIV infection risk and infection itself [56].

Despite the relative paucity of previous analyses examining labour market exits among PWID, findings are nevertheless consistent with how conditions of socio-economic

marginalization among PWID, characterized by low employment rates and barriers to employment, are linked to physical harm as well as poor health and treatment outcomes [7, 9, 24, 57, 58]. In alignment with associations found in the current analysis, sex work and other forms of informal, prohibited or illegal income generation, residing in the DTES or being unstably housed have been found in previous research to be negatively associated with employment status [59] and transitioning into employment [33]. That initiating these exposures are also associated with employment exits points to how exits may demarcate the beginning of the entrenchment of socio-economic marginalization, whereby exposures introduced and income generation strategies initiated at the time of employment exits inhibit work re-entry or retention. While it is not possible to determine whether employment exits are causal drivers or merely coincident with the changes in socio-economic circumstances observed in our results, these findings nevertheless point to how labour market dynamics are implicated in processes with considerable ramifications identified in previous research for exposure to violence [58, 60], criminal justice system involvement [22, 61], harmful drug use patterns [8, 23], treatment outcomes [9, 62], HIV infection [63, 64], and HIV-related morbidity and mortality [27, 56].

Changes in socio-economic status may likewise be a part of transformations that predispose individuals to structurally embedded pressures toward HIV-related risk through their physical and social location [48, 63, 65, 66], including those associated with unemployment [33]. The DTES built environment, for example, has been linked to rushed public injection to avoid police presence, theft or physical assault from other PWID, as well as sequestering of drug use and associate activities within a small area [67]. Given the complex interrelationships between unstable housing, illegal and prohibited income generation, and spatial concentrations of social and structural vulnerability [6, 22, 65, 67–69], identifying how shifts in institutional relationships, of which employment exits are an example, impact configurations of HIV and other health risks is potentially critical. The higher rate of seroconversion among people who have no engagement with the labour market compared to those that do further points to the potential relevance of the stability and durability of such institutional relationships. Further research on the complex linkages between employment status, employment dynamics, labour market attachment and HIV risk may therefore prove to be a fruitful area for further investigation [56].

Our results additionally identify the initiation of harmful drug use practices and patterns coincident with employment exits, including increasing crack-cocaine use, acquisitive syringe sharing, and initiating assisted injecting. To our knowledge, there is little recent evidence specifically examining employment exits and changes in drug use practices

among PWID to which we are able to compare our results, though some studies have identified drug use correlates of voluntary job exits in the general population [70, 71]. Nevertheless, our findings are consistent with previous evidence that crack-cocaine use has been negatively associated with employment [59], that job loss and employment challenges are associated with higher levels of drug use and drug use relapse [23] and that crack-cocaine use has been implicated in unemployment patterns [72, 73]. Conversely, contrary to our results, previous research in this and other settings has not found significant relationships between formal employment and syringe sharing [59, 74, 75]. The relationship between an employment exit and acquisitive syringe sharing or requiring assistance to inject may be related to how aforementioned shifts in physical and social location create pressures toward high-risk injection practices [63, 76–78]. Crack-cocaine use, acquisitive syringe sharing, and assisted injecting have been all been linked to increases in HIV infection risk and seroconversion [45, 46, 51, 79], and the significant associations identified by the current analysis provide additional information about socio-economic dynamics relevant to this risk.

The significant positive association between transitions out of employment and ending MMT enrolment further reinforces the importance of a focus on the entrenchment of socio-economic marginalization. During the period and in the context of the current study, MMT was accessible free of charge for eligible individuals on income assistance, but not for those in employment without extended health care benefits. While it is possible that MMT cessation may precede employment exits, this association may also be connected to changes in financial circumstances that make MMT less accessible or may involve delays initiating income assistance-related benefits following employment cessation. Given that MMT has been shown to reduce illicit drug use, HIV and HCV infection rates as well as needle sharing [43, 80–83], and that MMT cessation has been associated with increases in injection drug use [84], the relationship between employment exits and MMT cessation documented in the current study warrants further exploration of how to maintain MMT continuity when faced with external changes that impact MMT access.

The differential distribution of HIV seroconversions across levels of labour market engagement in our analyses is unsurprising alongside observed relationships between employment exits and transitions relevant to HIV infection risk. The near step-wise relationship between labour market engagement over time and HIV infection rates points to how engagement with the labour market may be important to socio-economic well-being or act as an institutional bond that removes people from conditions characterized by social and structural pressure towards high-risk drug use and HIV infection risk [63, 85]. Low levels of HIV infection among

the study population during the observation period are commonly attributed to a robust seek, test, treat and retain strategy and no-cost access to HIV care [36, 37]. However, although there are several linkages between employment exits and HIV infection risk in our results, the empirical evidence of a relationship between employment exits and actual HIV infection in the current study is weak. Our results more readily point to a broader consideration of long term labour market attachment in examining the association between socioeconomic marginalization and HIV infection. The degree to which employment exits are related to HIV infection risk and infection itself in the absence of similar effective public health strategies will be an important focus of further research.

Given the increasing relevance of employment to important social outcomes among PWID [86–88], recent studies have argued for the expansion of low-barrier and supported employment programs for PWID, where employment is adapted to suit the capacities of an individual and accommodate ongoing health and social service utilization, comorbid conditions, disability, and episodic absences from labor market participation [9]. This may be achieved through innovative service delivery models from social enterprise [89], government incentives for the attraction and retention of PWID akin to those that support return to work for people with disabilities [90], and complementary stigma reduction and anti-discrimination measures that normalize the prospect of work among PWID [68, 91]. While not necessarily focused on reducing HIV infection risk, initiatives to create legal income streams among vulnerable populations have demonstrated stabilized drug use and increased social capital, housing security, and employment-related cultural capital [28, 92, 93]. Nevertheless, such initiatives are extremely limited in scope and many PWID continue to face significant social and structural barriers to sustained employment in the traditional workforce [25, 91, 93, 94]. As such, initiatives specifically promoting sustained labour market involvement may offer an approach that has the potential to be protective against exposure to increased risk of HIV infection. Employment opportunities that avoid unnecessary employment exits, limitations on drug testing, and work that supports flexibility represent structural-level interventions that may prevent transitions into higher risk environments or the initiation of risk-associated behavior.

This study comes with a number of limitations. As VIDUS is a non-random sample, the results may not be representative of broader populations of PWID, although previous studies have shown VIDUS to be roughly representative of PWID in Vancouver [95]. This study also relies on self-report, and therefore may contain social desirability or recall biases. Additionally, the VIDUS data provide information on whether a transition occurred in the six-month period prior to interview rather than exact transition dates.

We are therefore unable to draw direct causal conclusions about whether employment cessation precipitates other transitions or vice versa from our data. Nevertheless, this study has drawn independent correlations between transitions out of employment and increased exposure to several factors associated with elevated HIV infection risk for PWID, providing a solid empirical rationale for future research in this area. Further, we were unable to control for a change in income, which may be an important driver of identified risk factors examined as outcomes of interest in these analyses. While employment may be considered a reasonable proxy for income, an inability to control for income precludes any determination of whether increases in HIV infection risk associated with employment cessation could be mitigated by redistributive social policies. This would be an important area of future inquiry.

In the global campaign to end the HIV pandemic, identifying modifiable social and structural circumstances associated with elevated HIV infection risk and infection is of critical importance. It is well documented that physical, social, economic and policy forces critically affect individual likelihoods of HIV infection risk exposure and seroconversion rates [63, 96]. Although there has been limited attention to date on employment exits and labour market engagement vis-à-vis HIV infection risk and infection, this study clearly implicates employment retention in processes related to physical, social and economic stability that may be protective from multiple behaviours, exposures and environments associated with HIV infection risk. Our results further identify a differential distribution of HIV seroconversion across levels of long-term labour market engagement. Given our findings, and considering the desire for increased access to viable income generation opportunities [86, 97] as well as health-related benefits of employment among PWID [9, 27] there is a clear case for promoting employment access and retention for PWID as a part of comprehensive combined HIV prevention efforts.

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