

## Research paper

## Income level and drug related harm among people who use injection drugs in a Canadian setting

Cathy Long<sup>a,b</sup>, Kora DeBeck<sup>a,c</sup>, Cindy Feng<sup>d</sup>, Julio Montaner<sup>a,e</sup>, Evan Wood<sup>a,e</sup>, Thomas Kerr<sup>a,e,\*</sup><sup>a</sup> British Columbia Centre for Excellence in HIV/AIDS, Canada<sup>b</sup> Dalla Lana School of Public Health, University of Toronto, Canada<sup>c</sup> School of Public Policy, Simon Fraser University, Canada<sup>d</sup> School of Public Health, University of Saskatchewan, Canada<sup>e</sup> Department of Medicine, University of British Columbia, Canada

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## ABSTRACT

**Background:** Higher income is generally associated with better health outcomes; however, among people who inject drugs (IDU) income generation frequently involves activities, such as sex work and drug dealing, which pose significant health risks. Therefore, we sought to examine the relationship between level of income and specific drug use patterns and related health risks.

**Methods:** This study involved IDU participating in a prospective cohort study in Vancouver, Canada. Monthly income was categorized based on non-fixed quartiles at each follow-up with the lowest level serving as the reference category in generalized linear mixed-effects regression.

**Results:** Among our sample of 1032 IDU, the median average monthly income over the study follow-up was \$1050 [interquartile range = 785–2000]. In multivariate analysis, the highest income category was significantly associated with sex work (adjusted odds ratio [AOR] = 7.65), drug dealing (AOR = 5.06), daily heroin injection (AOR = 2.97), daily cocaine injection (AOR = 1.65), daily crack smoking (AOR = 2.48), binge drug use (AOR = 1.57) and unstable housing (AOR = 1.67). The high income category was negatively associated with being female (AOR = 0.61) and accessing addiction treatment (AOR = 0.64), (all  $p < 0.05$ ). In addition, higher income was strongly associated with higher monthly expenditure on drugs (>\$400) (OR = 97.8).

**Conclusion:** Among IDU in Vancouver, average monthly income levels were low and higher total monthly income was linked to high-risk income generation strategies as well as a range of drug use patterns characteristic of higher intensity addiction and HIV risk. These findings underscore the need for interventions that provide economic empowerment and address high intensity addiction, especially for female IDU.

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## Introduction

Income is an important determinant of health. It can influence health directly, by its absolute value in shaping material living conditions, and indirectly, by its relative effects on social participation and control over life situations (Marmot, 2002). Individuals who make more income generally experience better health and are better economically positioned to take up health promoting behaviours (Cross, Johnson, Davis, & Liberty, 2001; Lynch, Smith, Kaplan, & Hous, 2000; Subramanian & Kawachi, 2004;

Subramanian, Belli, & Kawachi, 2002). For example, having a higher income enables better nutrition, exercise, housing, health care, and recreation (Marmot, 2002). Conversely, poverty has a strong deleterious effect on health and is associated with a cornucopia of unhealthy behaviours (Laaksonen, Prättälä, Helasoja, Uutela, & Lahelma, 2003; Pfoertner, Andress, & Janssen, 2011). In particular, low income has been observed to be significantly associated with the consumption of unhealthy goods, such as tobacco, alcohol and illicit drugs (Cerdá, Johnson-Lawrence, & Galea, 2011; Jefferis, Manor, & Power, 2007; Redonnet, Chollet, Fombonne, Bowes, & Melchior, 2012). Individuals who use illicit drugs are particularly vulnerable to poverty as well as poor health and health behaviours (Ompad et al., 2012). Many frequently experience food insufficiency (Anema et al., 2010), unstable housing and homelessness (Rhoades et al., 2011), physical (Marshall, Fairbairn, Li, Wood, & Kerr, 2008) and sexual (Braitstein et al., 2003) violence, poor mental health (Batki et al., 2010; Topp, Hudson, & Maher, 2010),

\* Corresponding author at: Urban Health Research Initiative, B.C. Centre for Excellence in HIV/AIDS, University of British Columbia, St. Paul's Hospital, 608-1081 Burrard Street, Vancouver, B.C. V6Z 1Y6, Canada. Tel.: +1 604 806 9116; fax: +1 604 806 9044.

E-mail address: [urhi-tk@cfenet.ubc.ca](mailto:urhi-tk@cfenet.ubc.ca) (T. Kerr).

blood-borne infections (Aceijas & Rhodes, 2007; Hagan & Des Jarlais, 2000; Miller et al., 2002), and sexually transmitted infections (Celentano, Latimore, & Mehta, 2008; Strathdee & Sherman, 2003), all of which independently and collectively contribute to worse health.

People who use injection drugs (IDU) often have difficulty achieving financial security and experience significant barriers to legal and meaningful employment. Barriers include employer discrimination (Grover & Paylor, 2010), having a criminal history (Pager, 2003), mandated drug testing (Tunnell, 2004), unstable housing, and limited education attainment and employable skills (Pinkham et al., 2012; Sherman, German, Chen, Marks, & Bailey-Kloche, 2006). In a recent study of employment patterns among a cohort of IDU living in Vancouver, Canada, less than a third reported ever having a regular job and at any point in time only around a tenth report having had a regular job in the previous six months (Richardson, Wood, Li, & Kerr, 2010). An alternative source of income for many IDU is social assistance (DeBeck et al., 2007); however, provisions from social assistance are often insufficient. A lack of legal employment opportunities leads many IDU to turn to high risk income generating activities, the most common being drug dealing and sex work, both of which carry substantial health risks (Chettiar, Shannon, Wood, Zhang, & Kerr, 2010; Cross et al., 2001; Shannon et al., 2008; Werb, Kerr, Li, Montaner, & Wood, 2008). A strong driver of participation in such activities is the cost of illegal drugs (DeBeck et al., 2007; McCoy, Comerford, & Metsch, 2007; Richardson et al., 2008, 2010). It has been shown that, IDU with high intensity addiction are both more likely to engage in high-risk income generating activities (DeBeck et al., 2007; Deering, Shoveller, Tyndall, Montaner, & Shannon, 2011) and less likely to have legal employment (Richardson et al., 2010). While involvement in drug dealing or sex work exposes IDU to additional risks of violence, incarceration, and HCV and HIV infection (Epele, 2002; Kerr et al., 2008; Werb et al., 2008), when faced with a competition of needs and few alternative income generation opportunities, drug dependence frequently takes precedence and thus lead IDU to resort to risky income generation practices.

Given that people who inject drugs experience a wide range of health risks associated with absolute poverty, it could be expected that greater income would substantially improve their health outcomes and their uptake of health promoting behaviours. However, among IDU the usual benefits conferred by having a higher income may be absent as many IDU rely on risky activities, which carry substantial health risks, for income. To further clarify the role of income in shaping health and health related behaviour among IDU, we sought to examine the relationship between level of income and specific drug use patterns and related health risks. We also sought to examine the relationship between level of income and expenditure on drugs.

## Methods

The Vancouver Injection Drug User Study (VIDUS) is an open prospective cohort study of individuals who inject illicit drugs, which began enrolment through self-referral and street outreach in May 1996. This cohort has been described in detail previously (DeBeck et al., 2007; Wood et al., 2001). In brief, an individual was eligible if he or she lived in the Greater Vancouver Region District at the time of enrolment, injected illicit drugs in the previous month, and provided written informed consent. At baseline and bi-annually thereafter, participants completed an interviewer-administered questionnaire and provided a blood sample for serologic testing of HIV and HCV. For their time, participants received a stipend of \$20 CDN at each study visit. VIDUS

has ethical approval from St. Paul's Hospital and the University of British Columbia's Research Ethics Board.

The current analysis was restricted to active IDU, defined as participants who reported injection drug use in the six months prior to their study visit, who were seen for a study visit during the period of December 1 1999 and May 31 2005. Measures of key characteristics under investigation are available only over this sample period. All study follow-up visits during the study period that included a report of active injecting drug use in the previous six months were included in the analyses; similarly, all follow-up visits that did not include a report of injecting drugs in the previous six months were excluded from the analyses. Our main outcome of interest, total monthly income, was derived from a single question asking, "what is your current monthly income", which included the following sources of income: social assistance; family and friends; paid work; sex work; drug dealing; criminal activity (e.g., theft, break and entry); and binning and panhandling. Responses for monthly income were categorized into non-fixed quartiles for each follow-up. In addition, participants were asked whether they engaged in drug dealing (yes vs. no); sex work, defined as having exchanged sex for money, gifts, food, shelter, clothes, or drugs (yes vs. no); and regular employment, defined as a job or business with regular salary (yes vs. no) in the previous six months. Participants were also asked, "How much do you think you have spent on drugs in the past month?" Responses for monthly expenditure on drugs were divided into two categories at the median (>\$400 vs. ≤\$400).

We also considered socio-demographic and drug use characteristics that have been previously linked to income generation and health. The socio-demographic variables considered were: age (per year older); sex (female vs. male); Aboriginal ancestry (Aboriginal vs. other); and unstable housing, defined as living in a single occupancy hotel, a shelter, a hostel, a treatment or recovery house, or on the street with no fixed address (yes vs. no). The behavioural and drug use variables considered pertained to the previous six months and included: daily heroin injection (yes vs. no), daily cocaine injection (yes vs. no), daily crack smoking (yes vs. no), binge injection drug use defined as a period of time of using injection drugs more than usual (yes vs. no), non-fatal overdose (yes vs. no), receptive syringe sharing defined as borrowing syringes already used by someone else to inject drugs (yes vs. no), and recent engagement in an addiction treatment defined as reporting being enrolled in methadone treatment, a detoxification program, a recovery house, a residential addiction treatment center, or engaging with an addictions counsellor or participating in peer support programs such as Narcotics Anonymous (yes vs. no). We also considered HIV status (yes vs. no), which was determined by a serologic test on the blood sample provided.

In our primary analysis, which sought to determine factors associated with level of monthly income, we used generalized linear mixed-effects models (GLMM), which accounted for within individual similarities across repeated measures over the study period. The lowest level of monthly income served as the reference category. First, we performed bivariate GLMM analyses to calculate the unadjusted odds ratios and 95% confidence intervals of the associations between variables of interest and level of monthly income. Monthly expenditure on drugs was excluded from the primary analysis because it was expected to be heavily confounded with our measures of high intensity drug use. We then fit a multivariate GLMM to identify factors that were independently associated with level of monthly income. Variables that had an unadjusted odds ratio less than 0.05 were inputted into a multivariate GLMM. Thereafter, we used a backwards model selection based on Type III *p*-value so that at each step the variable with the highest Type III *p*-value was dropped until there were no variables with a *p*-value greater than 0.05. In sub analysis, we modeled the association between level of monthly income and monthly expenditure on

drugs. Unadjusted odds ratios and 95% confidence intervals were obtained from a bivariate GLMM. All statistical analyses were performed using SAS software version 9.2 (SAS, Cary, NC). All *p*-values are two sided.

## Results

Between December 1 1999 and May 31 2005, a total of 1032 active IDU participated in this study, of which 412 (40%) were female and 351 (34%) identified as being of Aboriginal ancestry. The median age of participants at the start of the sample period was 34 (IQR = 28–41). The median number of follow-up visits was 5 (IQR = 2–9). This sample contributed 5158 observations. At December 1999, income quartiles were separated as follows: the 'Lowest' income category ranged from \$0 to \$697, the 'Low' category ranged from \$697 to \$980, the 'Moderate' category ranged from \$980 to \$2000, and the 'High' category ranged from \$2000 to \$30,586. The median monthly income was \$980 (IQR = 697–2000) at the beginning of the sample period and increased to \$1100 (IQR = 832–2000) by May 2005. Characteristics of the study sample at the beginning of the sample period stratified by level of monthly income are presented in Table 1 (as income quartiles were non-fixed over the sample period only data obtained in December 1999 are show in this table). Bivariate GLMM analyses of associations between variables of interest and level of monthly income across the entire sample period are presented in Table 2.

In multivariate GLMM analysis (Table 3), level of monthly income was strongly correlated with high risk drug use behaviours and markers of higher intensity drug use in a dose-dependent pattern. Relative to the lowest quartile of monthly income, adjusted odds of daily heroin injection, daily cocaine injection, daily crack smoking, and binge drug use increased with increasing level of monthly income. The highest income category was significantly and positively associated with daily heroin injection (adjusted odds ratio [AOR] = 2.97; 95% confidence interval [CI], 0.2.33–3.78), daily cocaine injection (AOR = 1.65; 95% CI, 1.28–2.12), daily crack smoking (AOR = 2.48; 95% CI, 1.93–3.17), and binge drug use (AOR = 1.57; 95% CI, 1.24–1.99). Enrolment in addiction treatment was significantly and negatively associated with the highest level of income (AOR = 0.64; 95% CI, 0.05–0.81). In addition, being HIV seropositive was positively associated with all three levels of monthly income, although the adjusted odds of being HIV seropositive decreased from low (AOR = 3.63; 95% CI, 2.82–4.69) to moderate (AOR = 3.28; 95% CI, 2.53–4.27) to high (AOR = 1.45; 95% CI, 1.05–2.02) income. Trends of associations of key variables across income categories in multivariate GLMM analysis are shown in Fig. 1.

In addition, level of monthly income was strongly associated with several important socio-demographic characteristics. Older age was significantly and positively associated with low and moderate income. Conversely, being female was strongly and negatively associated with moderate (AOR = 0.74; 95% CI, 0.57–0.97) and high (AOR = 0.61; 95% CI, 0.43–0.87) income. Unstable housing was significantly and positively associated with the highest category of monthly income (AOR = 1.67; 95% CI, 1.32–2.12). Compared to those who reported the lowest level of income, individuals who reported moderate or high income were significantly and independently more likely to have participated in drug dealing, sex work, and regular employment.

In sub analysis, level of monthly income was strongly associated with monthly expenditure on drugs. At study period baseline, 151 (92%) participants in the high income category reported a monthly expenditure on drugs above the median (i.e. \$400) while only 98 (64%), 37 (23%) and 25 (16%) reported spending more than the median in the moderate, low and lowest categories respectively. In

bivariate GLMM analysis, the association between level of monthly income and monthly expenditure on drugs increased substantially from low (OR = 2.24; 95% CI, 1.79–2.80) to moderate (OR = 10.26; 95% CI, 8.19–12.85) to high (OR = 97.77; 95% CI, 71.49–133.73).

## Discussion

In this study, we examined the relationship between level of income and specific drug use patterns and related health risks. We found that among active IDU living in Vancouver, average monthly income levels were low, much lower than the national before-tax Low Income Cut-Off, which was \$18,051 in 1999 and \$20,344 in 2004 (for a single person family in a city with a population greater than 500,000) (Statistics Canada, 2010). The reported median annual income was \$11,760 at the start of the study follow-up and only increased to \$13,200 by 2004. In adjusted analysis, being female was negatively associated with higher monthly income and individuals who reported higher income were significantly more likely to be unstably housed. Higher monthly income was linked to high-risk income generation strategies and markers of high intensity drug use in a dose-dependent pattern. Additionally, level of income was negatively associated with enrolment in addiction treatment. This study further found that level of income was strongly associated with expenditure on drugs, with odds of reporting an above median expenditure increasing exponentially with increasing income.

That active IDU experience disproportionately high levels of economic disadvantage and poverty has been well documented. Basic needs such as food, shelter and sanitation are frequently unmet (Pfoertner et al., 2011), all of which increase IDU' susceptibility to poor health. In the present study, levels of unstable housing were high with more than 50% of the participants in the high income category reporting unstable housing. This finding is consistent with existing research, which documents high levels of unstable housing and homelessness among IDU (Corneil et al., 2006; DeBeck et al., 2011a; Palepu, Marshall, Lai, Wood, & Kerr, 2010). However, instead of seeing an improvement in housing status with higher income, as is typically the trend in the general population (Marmot, 2002; Robert, Booske, Rigby, & Rohan, 2008), odds of unstable housing increased with increasing income. This may reflect the need for IDU with higher intensity addiction to generate more income and to allocate more of their earnings to drug spending. Many studies have noted a positive relationship between unstable housing and high intensity drug use (Cheng et al., 2013; Milburn, Rotheram-Borus, Rice, Mallet, & Rosenthal, 2006; Roy et al., 2003). Furthermore, many existing long-term housing options require abstinence from drug use and have rather restrictive regulations, which in addition to Vancouver's exceptionally low rental vacancy rate, pose significant challenges for active IDU to find stable housing (Briggs et al., 2009; Kertesz, Crouch, Milby, Cusimano, & Schumacher, 2009; Krüsi et al., 2010; Palepu et al., 2010). This anomaly hints at the primacy of drug dependence in shaping the economic decisions of IDU and underscores the importance of providing supportive housing options for this population.

In this study, higher income was associated with regular employment, but higher income was more strongly associated with participation in drug dealing and sex work, both of which carry substantial health risks. This finding is in congruence with prior studies, which have noted that many IDU rely on high risk activities to generate income and to support their drug use (Deering et al., 2011; DeBeck et al., 2007). Additionally, being female was positively associated with higher income in bivariate analysis, however, upon adjusting for regular employment, sex work, drug dealing and drug use related practices, being female became negatively associated with higher income. This change in the directionality

**Table 1**Characteristics at the start of the sample period (December 1999) stratified by level of monthly income among Vancouver based injection drug users ( $n = 647$ ).

Characteristic	Total monthly income <sup>a</sup>							
	Lowest		Low		Moderate		High	
	$n = 161, n (\%)$		$n = 162, n (\%)$		$n = 156, n (\%)$		$n = 168, n (\%)$	
Median age (IQR)	38	(30–44)	40	(35–46)	39	(33–45)	34	(28–41)
Female sex	60	(37)	57	(35)	58	(37)	72	(43)
Aboriginal ancestry	58	(36)	43	(27)	51	(33)	59	(35)
Unstable housing <sup>†</sup>	54	(34)	71	(44)	67	(43)	97	(58)
Sex work <sup>†</sup>	9	(6)	11	(7)	29	(19)	56	(33)
Drug dealing <sup>†</sup>	10	(6)	13	(8)	13	(8)	25	(15)
Regular employment <sup>†</sup>	16	(10)	10	(6)	22	(14)	12	(7)
Daily heroin injection <sup>†</sup>	56	(35)	33	(20)	63	(40)	112	(67)
Daily cocaine injection <sup>†</sup>	34	(21)	26	(16)	37	(24)	71	(42)
Daily crack smoking <sup>†</sup>	41	(25)	31	(19)	43	(28)	77	(46)
Syringe sharing <sup>†</sup>	105	(65)	119	(73)	116	(74)	111	(66)
Binge drug use <sup>†</sup>	40	(25)	45	(28)	57	(37)	60	(36)
Non-fatal overdose <sup>†</sup>	22	(14)	15	(9)	16	(10)	20	(12)
Addiction treatment <sup>†</sup>	87	(54)	80	(49)	76	(49)	57	(34)
HIV positive	31	(19)	76	(47)	47	(30)	44	(26)

<sup>a</sup> The four categories of monthly income were defined by non-fixed quartiles for each follow-up. At December 1999, the lowest income category ranged from \$0 to \$697, low ranged from \$697 to \$980, moderate ranged from \$980 to \$2000, and high ranged from \$2000 to \$30,586.

<sup>†</sup> Activities or situations referring to the previous 6 months.

**Table 2**

Bivariate generalized linear mixed-effects model analyses of factors associated with level of monthly income among Vancouver based injection drug users.

Characteristic	Low vs. lowest		Moderate vs. lowest		High vs. lowest	
	Odds ratio (95% CI)	<i>p</i> -Value	Odds ratio (95% CI)	<i>p</i> -Value	Odds ratio (95% CI)	<i>p</i> -Value
Older age (Per year older)	1.06 (1.04–1.07)	<0.001	1.02 (1.01–1.03)	0.004	0.95 (0.94–0.97)	<0.001
Female sex (Yes vs. no)	1.05 (0.81–1.35)	0.730	0.93 (0.72–1.19)	0.551	1.55 (1.12–2.16)	0.009
Aboriginal ancestry (Yes vs. no)	0.90 (0.70–1.17)	0.426	0.78 (0.60–1.00)	0.054	0.97 (0.69–1.36)	0.837
Unstable housing <sup>†</sup> (Yes vs. no)	0.99 (0.81–1.21)	0.932	1.10 (0.90–1.34)	0.362	2.17 (1.74–2.72)	<0.001
Sex work <sup>†</sup> (Yes vs. no)	1.08 (0.77–1.50)	0.669	2.49 (1.83–3.40)	<0.001	7.55 (5.38–10.6)	<0.001
Drug dealing <sup>†</sup> (Yes vs. no)	1.03 (0.78–1.35)	0.853	2.25 (1.75–2.89)	<0.001	5.08 (3.91–6.60)	<0.001
Regular employment <sup>†</sup> (Yes vs. no)	0.66 (0.43–1.01)	0.055	2.21 (1.55–3.15)	<0.001	2.08 (1.39–3.12)	<0.001
Daily heroin injection <sup>†</sup> (Yes vs. no)	0.63 (0.51–0.79)	<0.001	1.33 (1.07–1.64)	0.009	4.39 (3.51–5.50)	<0.001
Daily cocaine injection <sup>†</sup> (Yes vs. no)	1.05 (0.83–1.31)	0.696	1.43 (1.14–1.78)	0.002	2.52 (1.99–3.20)	<0.001
Daily crack smoking <sup>†</sup> (Yes vs. no)	1.01 (0.81–1.25)	0.960	1.34 (1.09–1.66)	0.007	4.22 (3.34–5.32)	<0.001
Syringe sharing (Yes vs. no) <sup>†</sup>	0.98 (0.80–1.20)	0.870	1.23 (1.01–1.50)	0.038	1.05 (0.85–1.31)	0.657
Binge drug use <sup>†</sup> (Yes vs. no)	0.94 (0.76–1.17)	0.575	1.61 (1.31–1.98)	<0.001	1.87 (1.50–2.34)	<0.001
Non-fatal overdose <sup>†</sup> (Yes vs. no)	0.89 (0.68–1.17)	0.407	1.15 (0.89–1.50)	0.286	1.25 (0.94–1.65)	0.119
Addiction treatment <sup>†</sup> (Yes vs. no)	1.19 (0.97–1.46)	0.101	0.92 (0.75–1.13)	0.435	0.46 (0.37–0.58)	<0.001
HIV positive (Yes vs. no)	3.73 (2.87–4.85)	<0.001	2.89 (2.22–3.76)	<0.001	1.19 (0.84–1.67)	0.334

The four categories of monthly income were defined by non-fixed quartiles for each follow-up. The generalized linear mixed-effects models included data from December 1999 to May 31 2005.

<sup>†</sup> Activities or situations referring to the previous 6 months.

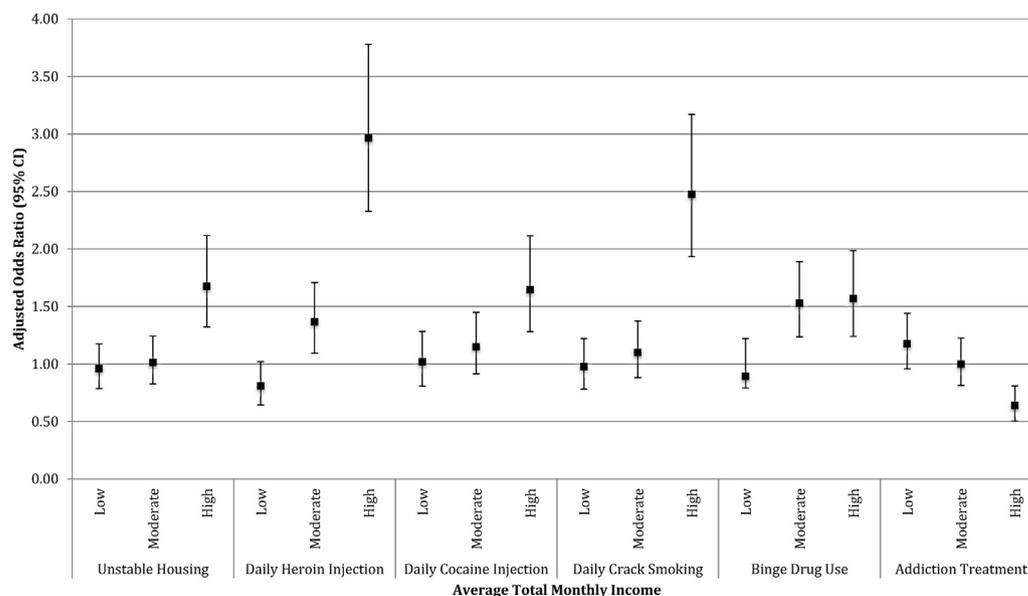
**Table 3**

Multivariate generalized linear mixed-effects model analysis of factors associated with level of monthly income among Vancouver based injection drug users.

Characteristic	Low vs. lowest		Moderate vs. lowest		High vs. lowest	
	AOR (95% CI)	<i>p</i> -Value	AOR (95% CI)	<i>p</i> -Value	AOR (95% CI)	<i>p</i> -Value
Older age (Per year older)	1.06 (1.04–1.07)	<0.001	1.04 (1.02–1.05)	<0.001	0.99 (0.98–1.01)	0.350
Female sex (Yes vs. no)	1.03 (0.80–1.34)	0.810	0.74 (0.57–0.97)	0.028	0.61 (0.43–0.87)	0.005
Unstable housing (Yes vs. no) <sup>†</sup>	0.96 (0.79–1.18)	0.695	1.01 (0.83–1.24)	0.904	1.67 (1.32–2.12)	<0.001
Sex work (Yes vs. no) <sup>†</sup>	1.44 (1.01–2.04)	0.044	3.40 (2.43–4.75)	<0.001	7.65 (5.26–11.1)	<0.001
Drug dealing (Yes vs. no) <sup>†</sup>	1.12 (0.85–1.47)	0.439	2.43 (1.88–3.14)	<0.001	5.06 (3.85–6.63)	<0.001
Regular employment (Yes vs. no) <sup>†</sup>	0.93 (0.61–1.43)	0.738	3.48 (2.42–5.00)	<0.001	4.23 (2.79–6.42)	<0.001
Daily heroin injection (Yes vs. no) <sup>†</sup>	0.81 (0.64–1.02)	0.075	1.37 (1.09–1.71)	0.006	2.97 (2.33–3.78)	<0.001
Daily cocaine injection (Yes vs. no) <sup>†</sup>	1.02 (0.81–1.28)	0.884	1.15 (0.91–1.45)	0.232	1.65 (1.28–2.12)	<0.001
Daily crack smoking (Yes vs. no) <sup>†</sup>	0.98 (0.78–1.22)	0.843	1.10 (0.88–1.37)	0.397	2.48 (1.93–3.17)	<0.001
Binge drug use (Yes vs. no) <sup>†</sup>	0.98 (0.79–1.22)	0.876	1.53 (1.24–1.89)	<0.001	1.57 (1.24–1.99)	<0.001
Addiction treatment (Yes vs. no) <sup>†</sup>	1.18 (0.96–1.44)	0.123	1.00 (0.81–1.23)	0.986	0.64 (0.50–0.81)	<0.001
HIV positive (Yes vs. no)	3.63 (2.82–4.69)	<0.001	3.28 (2.53–4.27)	<0.001	1.45 (1.05–2.02)	0.027

The four categories of monthly income were defined by non-fixed quartiles for each follow-up. The generalized linear mixed-effects model included data from December 1999 to May 31 2005.

<sup>†</sup> Activities or situations referring to the previous 6 months.



**Fig. 1.** Drug use related factors associated with level of monthly income after accounting for socio-demographic characteristics. The four categories of average total monthly income were defined by non-fixed quartiles for each follow-up. The adjusted odds ratios presented above were derived from a multivariate generalized linear mixed-effects model, which used the lowest category of average total monthly income as the reference category. The model also adjusted for age, female sex, unstable housing in the previous 6 months, engaging in sex work in the previous 6 months, drug dealing in the previous 6 months, regular employment in the previous 6 months and HIV status and included observations from December 1 1999 to May 31 2005.

of the correlation between being female and income level is likely driven by the greater reliance of female IDU on sex work for income generation. At baseline, female IDU who reported sex work generated a median monthly income of \$2000, while female IDU who did not report sex work had a median monthly income of \$811. This finding echoes previous studies that have found that compared to their male counterparts, female IDU are more likely to rely on high risk income generation activities (DeBeck et al., 2007) and to experience higher unemployment (McCoy et al., 2007; Pelissier & Jones, 2005; Richardson et al., 2010). This earning disadvantage for female IDU may represent structural barriers that make it more difficult for female IDU to acquire high paying positions in both the legal labour market and shadow economies (Grundetjern & Sandberg, 2012; Pelissier & Jones, 2005; Shannon et al., 2008). Overall, these findings add to the empirical evidence supporting the need for interventions that provide economic empowerment, especially for female IDU (DeBeck et al., 2007; Deering et al., 2011; Richardson et al., 2010). If provided with alternative opportunities for income generation that do not demand drug use abstinence, such as low-threshold employment, many IDU, and in particular sex workers, have expressed a willingness to reduce their involvement in high-risk income generating activities; however, the availability of low-threshold employment is typically scarce (DeBeck et al., 2007, 2011b; Deering et al., 2011). Given the low levels of regular employment reported in this study, further development and expansion of feasible and accessible alternative income generation options for people who use injection drugs, such as low-threshold employment opportunities, should be a public health priority.

As expected, we observed a strong correlation between level of income and markers of high intensity drug use. Prior studies have suggested that increases in income may facilitate increases in drug consumption although patterns of drug use behaviour and intensity will likely vary with source of income. For example, regular employment can provide a potentially stabilizing force for IDU and has been linked to reduced drug use and crime (Magura, Staines, Blankertz, & Madison, 2004; Richardson et al., 2010; Richardson, Sherman, & Kerr, 2012). Conversely, receipt of social assistance has been temporally linked to increases in drug consumption, binge

drug use, overdose and violence, with the odds of high intensity drug use being significantly higher in the days following social assistance payments (Dobkin & Puller, 2007; Li, Sun, March, & Anis, 2007; Riddell & Riddell, 2006). However, there is no indication that receipt of social assistance increases overall drug use above unabated poverty (Rosen, 2011). Participation in drug dealing has been associated with elevated risks of overdose and frequent drug use in addition to violence, HIV infection, and incarceration (Curry & Latkin, 2003; Latkin, 2002; Semple, Strathdee, Volkman, Zians, & Patterson, 2011; Small et al., 2013; Werb et al., 2008). Among female sex workers, the amount of income generated through sex work has been found to be independently correlated with the amount of money spent on drugs and higher income from sex work has been connected to elevated odds of high risk drug use (Deering et al., 2011; Rekart, 2006; Shannon et al., 2008; Spice, 2007). Consequently, the dynamics between high risk income generation and increased and high risk drug consumption may further embed IDU in environments of elevated risk and vulnerability. Given the strong link between high intensity drug use and income generation, the expansion of evidence-based addiction treatment and exploration of innovative addictions treatments is urgently required. Opiate substitution therapies, including methadone maintenance therapy and prescription heroin, have been shown to be highly effective in reducing expenditure on drugs and engagement in risky income generation activities (Oviedo-Joekes et al., 2009; Schwartz, Brady, & Callaman, 2006; van den Brink et al., 2003). Providing IDU with an alternative source of drugs has the potential to not only reduce the financial burden of drug use but also disengage IDU from drug and sex work markets. Despite evidence supporting the effectiveness of opiate substitution therapies, access and availability to these treatments continues to be a challenge in many setting (Bell, Dru, Fischer, Levit, & Sarfraz, 2002; Mattick, Breen, Kimber, & Davoli, 2009; Smye, Browne, Varcoe, & Josewski, 2011). This represents a significant missed opportunity to reduce many of the health and economic harms associated with high intensity drug addiction. Furthermore, to date, substitution and maintenance therapies for stimulant drug users remain illusive. Exploration of innovative addiction treatment therapies in this area is warranted. Supporting

innovation in addiction medicine and ensuring that evidence-based addiction treatments are available on demand may be a critical step toward addressing the economic vulnerability of IDU and reducing their engagement in risky income generation activities.

There are several limitations to this study. First, VIDUS is not a random sample and as a consequence, results from this study may not be readily generalizable to other IDU populations. However, there is evidence that this sample is reflective of the Vancouver IDU community from which this cohort was recruited (Tyndall et al., 2001; Wood et al., 2000). Participants were recruited through extensive street-based outreach and “snowball” sampling. Second, keys measures in this study were based on self-report, which are susceptible to recall bias and response bias. For example, income and participation in high-risk activities may have been under-reported. Also, measures of drug dealing and sex work may not account for all informal and non-monetary transactions. Therefore, the significance of drug dealing and sex work in relation to income and high-risk drug use may be underestimated. Furthermore, the present study does not account for the relationship between drug related harm and income net of expenditure on drugs.

In summary, among our sample of active IDU, average monthly income levels were low. Although higher income is typically beneficial for health, in our study, higher income was associated with high-risk income generation strategies and did not correlate with a number of key markers of economic stability or engagement with health services (e.g. stable housing, enrolment in addiction treatment). These findings underscore the need for more comprehensive social support for this high-risk population. Interventions that provide economic empowerment and address high intensity addiction, especially for female IDU, may help address the paradoxical relationship between income and health risks among IDU and thereby prevent drug related harm.

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### Authors contributions

The specific contributions of each author are as follows: CL, KD, CF and TK designed the study and wrote the protocol, CL managed the literature searches and prepared the first draft of the analysis; CF conducted the statistical analyses with input from CL, KD and TK; all authors contributed to the main content and provided critical comments on the final draft. All authors approved the final manuscript.

### Competing interests

Authors declare no other competing interests.

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