Title: Association between neighbourhood socioeconomic characteristics and high-risk injection behaviour amongst injection drug users living in inner vs. other city areas in Montréal, Canada.

Short title: Neighbourhoods and high-risk injection behaviour

Keywords: urban health; injection drug use; syringe sharing; neighbourhoods; small-area analysis

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COMPETING INTERESTS

All authors declare no competing interests, including no financial, personal or other relationships with people or organisations within three years of beginning the work that could inappropriately influence, or be perceived to inappropriately influence, the work.

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Abstract

Background: Area-level socioeconomic conditions are associated with epidemic rates of viral hepatitis and HIV amongst urban injection drug users (IDUs), but whether specific socioeconomic markers are uniformly related to IDU outcomes across different urban environments is unclear. We evaluated whether injection behaviour is differentially related to neighbourhood socioeconomic characteristics for IDUs in inner city versus surrounding urban areas.

Methods: The study population was 468 active IDUs on the Island of Montréal. Neighbourhoods were represented as 500 meter radius buffers around individual IDU dwelling places. High-risk injection behaviour (HRIB) was defined dichotomously. Relations between neighbourhood socioeconomic disadvantage (percentage households below low income cutoff), neighbourhood educational attainment (percentage adults with university degree), and HRIB were assessed using multivariate logistic regression. Stratified analyses were conducted for inner city IDUs (*n*=219), and those in surrounding areas (*n*=249).

Results: Similar proportions of IDUs in inner city and surrounding areas reported HRIB. Neighbourhood socioeconomic characteristics were not associated with HRIB for IDUs in surrounding areas. For inner city IDUs, those in socioeconomically disadvantaged neighbourhoods were more likely to practice HRIB (OR 4.34; 95% CI 1.15-16.35). Conversely, inner city IDUs residing in lower educational attainment neighbourhoods had a lower odds of HRIB (OR 0.41; 95% CI 0.21-0.80).

Conclusion: HRIB did not vary according to urban environment but for inner-city IDUs was differentially related to socioeconomic markers. Converse associations between HRIB and neighbourhood socioeconomic disadvantage and lower educational attainment, negative and positive, respectively, indicate that adverse socioeconomic circumstances are not related to a uniformly greater likelihood of HRIB.

Introduction

Two decades of risk factor research has yielded a comprehensive understanding of the individual-level determinants of HIV and viral hepatitis C (HCV) transmission amongst injection drug users (IDU) (Backmund et al., 2005; Patrick et al., 1997; Santibanez et al., 2006). A high burden of viral outcomes and high rates of HIV and HCV transmission persist in many urban settings despite ongoing virus reduction efforts (ASSSM, 2006; Vancouver Coastal Health News Release, 2003). The limited utility of actions to curtail these viral epidemics by promoting individual behaviour change suggests a need to consider contextual factors that might positively or negatively condition high-risk injection behaviour and blood-borne transmission of HIV and HCV. A first step in assessing any such conditioning of health-related behaviour is to evaluate heterogeneity in place-based risk conditions in relation to group- and area-based differentials in risk factors and their health consequences (Daniel et al., 2008).

Several studies have shown that blood-borne virus infections and high-risk injection behaviour among IDUs are not distributed homogeneously within city boundaries (Brugal et al., 2003; Diaz et al., 2001; Hutchinson et al., 2000; Maas et al., 2007; Miller et al., 2004; Rockwell et al., 2002; Wood et al., 2002). In comparison with their counterparts residing in less central surrounding areas, IDUs in the inner city of Barcelona, Spain, were more likely to be infected with HIV (Roca et al., 2005). In contrast, IDUs within inner city areas of Sydney, Australia had a lower likelihood of practicing syringe sharing relative to those in the surrounding areas (Darke et al., 1994). These incongruent observations may relate to differences in local contextual conditions, specifically, the potential influence of small-scale

local neighbourhood factors embedded within larger-scale areas (e.g., inner city versus surrounding city areas) on high-risk injection behaviour.

Attempts to frame the influence of neighbourhood characteristics on risk of viral acquisition among IDUs can be guided by the conceptual framework for cities and population health developed by Galea et al. (2005a). This framework theoretically situates population health outcomes in an ecological system involving multiple levels of influence that condition health and specific determinants of health. It seeks to broadly account for the influence of higher levels of context (e.g., policies and regulations, services provision, etc.) on local living conditions relevant to various health outcomes. For IDUs and IDU outcomes, an inner-versus-outer city distinction may arguably differentiate a higher order of context within which local neighbourhood conditions could vary in their associations with high-risk injection behaviour. Collective features of inner city areas as these typify many urban environments may either harm or promote health, and these impacts could well be different from those that prevail in surrounding areas outside of the central urban core. On the one hand, inner cities provide easier access to illicit drug markets and high-risk injection networks, and are characterised by undesirable environmental conditions including poverty, violence, deteriorated built environments, and considerable income and education disparities (Séguin & Divay, 2002; Wasylenki, 2001). On the other hand, inner cities can sometimes provide easier access to social and health services, particularly for marginal sub-populations such as IDUs.

Income and educational attainment aggregated at level of small administrative units have been emphasised as two key features of local environments that may influence population health and health-related behaviour in urban areas (Ompad et al., 2007). In American cities, individual injection drug use patterns were found to be associated with living

in an economically disadvantaged neighbourhood and/or a low educational attainment neighbourhood (Bluthenthal et al., 2007; Buchanan et al., 2003; Fuller et al., 2005; Galea et al., 2003). Other research indicates that neighbourhood income is more strongly related to the health of low income residents than that of the more advantaged (Boardman et al., 2001; Stafford & Marmot, 2003). It is unclear however whether neighbourhood income and education have a unique influence or if the influence of one dimension is spurious due to association with the other (Galea & Ahern, 2005b; Wen et al., 2003).

The measurement of local neighbourhood attributes relevant to health outcomes is a challenging task. In a recent special issue of the journal, Cooper et al. applied geographic information system (GIS) techniques, specifically buffer zones, to create geographic measures of syringe exchange program access and law enforcement activities at small geographic area levels (Cooper 2008). Likewise, the use of GIS to create circular buffers centred on residents' homes has been used elsewhere to study the associations between local contextual conditions and health outcome (Chaix et al., 2005a; Chaix et al., 2005b; Chaix et al., 2006). Buffers can be used to obtain summary measures of local factors which can then be examined in relation to the health outcome of interest, with the size of these circular surfaces (e.g., a given radius around each residential address) being based on the study's purpose (Berke et al., 2007; Crawford et al., 2008; Pate et al., 2008). For IDUs as well as the average resident, a 10-minute walking distance, corresponding to a 500-meter buffer, is generally recognised as a reasonable radius by which to represent access to local services. (Cooper et al., 2008; Rockwell et al., 1999; Rockwell et al., 2002).

Small circular buffers centred on an individual's residential address may be a more meaningful way to represent immediate residential environments, rather than large groupings

of people within the artificial boundaries of administrative units. Administrative units such as census tracts, often used as proxies for neighbourhoods, are assumed to be homogeneous with respect to population characteristics, socioeconomic status and living conditions (US Census Bureau, 2007). Such representations however may not coincide with health-related processes (Diez-Roux, 2001; Diez-Roux, 2007).

In this study, we hypothesised that for IDUs on the Island of Montréal high-risk injection behaviour would be (1) more prevalent in inner city areas, (2) associated with neighbourhood socioeconomic living conditions including educational attainment and low income, and (3) differentially associated with neighbourhood conditions according to inner-city versus surrounding area residence.

Methods

Setting

This study was conducted on the Island of Montréal, with a population 1.8 million residents and a land base of 500 km^2 divided into 27 boroughs. Each borough is locally responsible for governance and municipal services. Ville-Marie borough is widely regarded as the inner city of Montréal. This central and oldest portion of the city is characterised by the highest levels of socioeconomic disadvantage and crime of all boroughs in Montréal (Savoie et al., 2006; Service de la mise en valeur du territoire et du patrimoine, 2004). Ville-Marie is also the sole borough which has as part of its strategic plan specific, prioritised partnerships and interventions to enhance cohabitation with marginal resident sub-populations including IDUs (Ville de Montréal, 2008).

Study population

The sample was drawn from the St-Luc Cohort, an ongoing open cohort of IDUs established in Montréal in 1988. The St-Luc Cohort has been regularly recruiting IDUs for two decades with the aim of studying determinants of HIV/HCV seroconversion (Boileau et al., 2005; Bruneau et al., 2001). Behavioural questionnaires are administered at 6-month intervals by trained interviewers with venous blood samples drawn and tested for HIV and HCV antibodies. From November 2004, participants were specifically asked for their residential postal code or, for those with no stable housing, the cross-street intersection corresponding to the place they most often slept within the last month (from which the postal code was then determined). Canadian 6-digit postal codes are highly precise (see Measures).

The analysis was restricted to active IDUs, defined as participants who reported injecting drugs within the six months prior to their study visit, and to those IDU living on the Island of Montréal at the time of interview, seen between November 2004 and January 2006. For participants who entered the cohort prior to the study period, information collected at the first visit during the study period was used for this analysis. A total of 540 IDUs reporting injection in the past 6 months were considered for this study. Of these, 15 IDUs had missing or invalid postal codes corresponding to place of residence, and 57 did not currently reside on the Island of Montréal. Hence, 468 IDUs were included in the present analyses. Self-referral accounted for 42% of study participants, with 35% recruited through community-based agencies, the remaining participants being recruited through health care services and addiction treatment agencies.

Measures

The main outcome variable was "high-risk injection behaviour" (HRIB) occurring within the past 6 months, defined dichotomously as either "no" or "yes" based on agreement with any or all of the following conditions: (1) having borrowed a syringe or injection material at least five times; or (2) having injected with groups of strangers at least five times; or (3) having borrowed a syringe or injection material with a known HIV-positive person.

Montréal inner city area was represented by Ville-Marie borough with the remaining 26 Montréal boroughs considered to represent less central surrounding areas.

Two neighbourhood-level socioeconomic variables, derived using data from the 2001 Canada Census, were investigated: (1) socioeconomic disadvantage, the percentage of households below the low-income cutoff (LICO); and (2) neighbourhood educational attainment, the percentage of adults with a university degree. The LICO is a measure established by Statistics Canada, based on household size, where a household spends 20% more than the average household of the same size on shelter, food and clothing (Statistics Canada, 2007). Neighbourhood data were assigned to each participant using the postal code corresponding to their usual dwelling place. Postal codes were geocoded using GeoPinPoint Suite software (DMTI Spatial Inc. Markham, Ontario). Local residential neighbourhood was represented as a circular buffer zone of 500 metres radius, corresponding to 10 minutes of walking, centred on the residential postal code of each participant. Although the street address has the highest precision, Canadian six-digit postal codes are far more precise than four-digit U.S. Zip codes, corresponding to one side of one street section and thus accurately approximating residential location (Bow et al., 2004). Values for neighbourhood measures were computed for each participant using the population-weighted average for the values in each enumeration area encompassed by buffer zones (enumeration areas on the Island of

Montréal contain an average of 600 households, a far smaller grouping than census tracts which contain an average of 4,000 households). We did not use administrative units as neighbourhood proxies due to (1) considerable variation in the spatial distribution of IDUs with a consequently large range of IDUs within administrative boundaries, resulting in sparse counts across many administrative units, and (2) our theoretically-guided intention to centre IDUs within a local sphere of environmental influences.

Neighbourhood percentage households below the LICO was expressed at three levels, less than 25%, 25-50%, and more than 50%, and neighbourhood percentage adults with a university degree was dichotomised as less than 30%, and 30% or more. Neighbourhood measures were expressed categorically, as their relation with the logit of HRIB could not be described by a simple or complex linear function. Cut-point selection for each variable was based on the overall distribution of the neighbourhood variables in the study sample, and on the inflection points at which positive or null relations between a given variable and the logit of the outcome changed to negative, or the reverse.

Individual-level characteristics including age, gender and education attainment, monthly income and HIV status were examined as potential confounders or effect modifiers of the relations between HRIB and neighbourhood variables. Housing status (stable housing vs. unstable housing) was considered for inclusion in statistical models, but not used because its contribution was minimal. Cutoffs were chosen according to clinical relevance and the distribution of each variable.

Analyses

Chi-square tests for categorical variables and *t*-tests for continuous variables were used to compare socio-demographic measures, drug use patterns, and neighbourhood variables between IDUs whose regular dwelling place was within inner city Ville-Marie borough boundaries (*n*=219) and IDUs living in the surrounding 26 Montréal boroughs (*n*=249). Logistic regression was used to calculate crude and adjusted odds ratios (OR) and corresponding 95% confidence intervals (CI) for relationships between neighbourhood variables, entered separately and together in the same models, and HRIB, stratified by inner city versus surrounding areas. All analyses were conducted using SPSS v 10.0 (SPSS Inc. Chicago, Illinois).

Results

Of the 468 IDUs included in this study, a majority (84%) was male, with mean age (standard deviation) 40 years (± 9), women being younger (33 ± 10). Nearly half of study participants resided within inner-city areas. Thirty-five percent of the sample engaged in HRIB.

Table 1 contrasts socio-demographic measures, drug injection patterns and health status between IDUs living within the inner city and IDUs from other boroughs. Rates of HRIB were similar for both groups. IDUs from inner city areas were more likely to be male, single, and to report unstable housing than IDUs from other boroughs. A higher proportion of HIV-positive IDUs was also found in inner city areas.

Table 1

Table 2 presents crude and covariate-adjusted associations between HRIB and neighbourhood variables, stratified by inner city versus surrounding areas. Neighbourhood socioeconomic characteristics were not associated with HRIB for IDUs in boroughs outside the inner city area. Adjusted for individual characteristics and neighbourhood educational attainment, inner city IDUs residing in the most socioeconomically disadvantaged neighbourhoods (>50% of households below LICO) were more likely to report HRIB compared to those living in more advantaged neighbourhoods (<25% of households below LICO). Inner city IDUs residing in neighbourhoods with a low percentage of university-educated residents were less likely to report HRIB, compared to inner-city IDUs residing in neighbourhoods with a higher proportion of highly educated residents.

Table 2

Inner-city IDUs in the most socioeconomically disadvantaged neighbourhoods and having a monthly income under $1000 were 12 times more likely to report HRIB, relative to those in more advantaged neighbourhoods. Individual-level income did not modify the association between neighbourhood educational attainment and HRIB for IDUs residing either within or outside the inner city.

Figure 1

Discussion

The alternate hypothesis that a higher proportion of IDUs in inner city areas would report HRIB compared to IDUs in other city areas could not be accepted: similar proportions

of HRIB were observed for both groups. On the other hand, HRIB was differentially related to neighbourhood socioeconomic characteristics between inner city and surrounding areas: associations were observed for neighbourhood educational attainment and low income for IDUs in the inner city, while relationships were null for those in surrounding areas.

Our finding that residing within the socially disadvantaged inner-city Ville-Marie borough was not associated with a higher proportion of HRIB was contrary to what we and others (Buchanan et al., 2003; Galea et al., 2003) would predict. Indeed, geographic clustering of persons at risk for HIV in the inner city of Colorado was found to be associated with smaller geodesic distance, presumably enhancing partner availability for syringe sharing within a dense, high-risk network (Rothenberg et al., 2005). Lack of an inner city versus surrounding areas difference in HRIB is important, suggesting that higher-level contextual factors associated with Ville-Marie borough, including service availability and public policies, may either have a positive impact in preventing some HRIB or contribute to the displacement of high-risk IDUs from inner city to surrounding urban areas. Although Montréal inner city is more ghettoised than are the surrounding areas, a higher concentration of targeted services, including HIV preventive services and low-cost housing, is available to IDUs. Alternatively, law enforcement to reduce illicit drug injection in the inner city of Montréal, recently documented (Bellot et al., 2005), may stimulate the spatial diffusion of inner city problems that occurs from large city epicenters into adjacent communities (Wallace & Wallace, 1997).

Associations between HRIB, neighbourhood socioeconomic disadvantage and educational attainment, observed for the more densely populated Ville-Marie borough but not less dense surrounding regions are not unexpected. Other research suggests that local

contextual factors may affect health-damaging and healthcare-seeking behaviour only when a certain concentration of social disadvantage is reached over a given surface (Chaix et al., 2007). Our study reaches farther than the previous literature by demonstrating a differential association between local neighbourhood factors and health outcome according to higher-level urban contexts *within* a single city, rather than *between* cities or between urban versus rural areas.

While it is not unexpected that residing in areas with high concentrations of low income households would be associated with HRIB (Bluthenthal et al., 2007; Buchanan et al., 2003; Galea et al., 2003), we also found that higher neighbourhood educational attainment was associated with *greater* odds of HRIB, accounting for individual characteristics. One plausible explanation for this discordant latter finding is a possible tension between inner-city IDUs and university educated close neighbours which could adversely shape IDUs' behaviours, thus counteracting any potential advantages associated with high education concentration in a neighbourhood.

Associations between HRIB and residence in areas with concentrated low income households were strongest for IDUs with lesser income (Figure 1). These results are consistent with previous observations of effect modification of neighbourhood socioeconomic disadvantage by individual-level personal income (Boardman et al., 2001; Stafford & Marmot, 2003). As for the general population, low-income IDUs may be more susceptible to an influence of local residential neighbourhood conditions as they are more likely than higher-income (and often, employed or mobile) IDUs to spend their daily activities in close vicinity to dwelling places and thus rely more on neighbourhood resources (Diez-Roux, 2002; Stafford & Marmot, 2003).

As is often the case, less educated residents were clustered in lower income areas: neighbourhood socioeconomic disadvantage and educational attainment were moderately negatively correlated (Spearman *r* inner city = -0.53, and *r* surrounding areas = -0.42), comparable with previous reports (Browning & Cagney, 2003; Wen et al., 2003). This observation might suggest that the finding of lower odds of HRIB with lower educational attainment was spurious. However, the simultaneous examination of the relative contribution of socioeconomic disadvantage and educational attainment suggests that these two neighbourhood dimensions are both independently associated with HRIB.

Our use of circular buffers centred on IDU dwelling places was a necessary alternative to the use of administratively defined areas to measure local neighbourhood attributes; the latter approach could not be used due to sparse data. Small areas as used here have been proposed to better capture, however, the pathways through which local factors affect health outcome (Diez-Roux, 2007). Specific populations, such as elderly, children, and non-working adults (generally the case for IDUs), may be particularly vulnerable to local residential environments as they spend large amounts of time in public or private spaces in the vicinity of their dwelling place (Diez-Roux, 2002).

This study is subject to a number of limitations. Subjects were recruited mostly through word of mouth, yielding a non-randomly selected sample in which males and older users may be over represented (Parent et al., 2005). Participants included in our analyses were seen on average for 12 study visits prior to completing the questionnaire included in the present analysis; this suggests the possibility that we underestimated the overall risks of IDUs in the larger population since some participants may have reduced their HRSB over the course

of receiving study-related counselling. The Montréal inner city context may not be generalisable to other contexts, but similarly, the contexts of other cities with high proportions of IDUs, e.g., Vancouver, Toronto, New York, or Los Angeles are not themselves particularly exchangeable, either. Densely populated inner city areas do however display a core set of adverse features, including space compactness, socioeconomic disadvantage, high crime rates, unfavourable physical environment, and social inequalities, these collectively representing inner-city geographic vulnerability (Séguin & Divay, 2002; Vlahov & Galea, 2002; Wasylenki, 2001). Hence, our findings may be reasonably representative of the contextual factors relevant to IDUs' high-risk behaviour in other inner cites in Canada and elsewhere. The cross-sectional nature of our study precludes a capacity for causal inference regarding the associations observed. Despite a large overall sample size, the separate analyses conducted for inner city and surrounding areas resulted in a smaller sample size for each stratum, thus reducing the precision of regression coefficient estimates. Finally, regression models may not be optimal for the study of social determinants of health behaviors. As demonstrated in the previous *special issue* on risk environment of this journal, new analytic tools, like complex system dynamic modelling, may allow us to better recognize the complexity and interdependence of factors across different levels (Galea et al., 2008).

This study sought to contribute to understanding the interplay between geographic location, neighbourhood conditions and HRIB. Our findings suggest the need for further research to investigate higher-level influences on HRIB, in particular, those that are associated with and which may condition living conditions for higher-density inner-city IDU areas, with an emphasis on policy, regulatory, and organisational factors that could be manipulated to influence the relationship between proximal neighbourhood characteristics and HRIB. The lack of observed associations between proximal neighbourhood factors and IDU

risk behaviour outside of inner city areas also suggests that urban living conditions might not be as relevant for IDUs living outside of the inner city drug scene.

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Table 1. Characteristics of IDUs and neighbourhoods inhabited by IDUs, for inner city vs. surrounding areas on Montréal Island, St-Luc Cohort, 2004-2006

	Inner cityn=219	**Surrounding areas** n=249	**Difference**
	Mean (sd)	**Mean (sd)**	***p*-value***
Individual-level			
Risk behaviours			
High-risk injection behaviour (%)	34.7 (0.5)	34.9 (0.5)	0.957
Sociodemographic characteristics			
Age (years)	39.1 (9.2)	38.9 (10.0)	0.834
Gender male (%)	87.6 (0.3)	79.9 (0.4)	0.032
Married /de facto union (%)	3.2 (0.2)	11.7 (0.3)	0.001
Unstable housing (%)	68.5 (0.5)	26.6 (0.4)	<0.001
Total monthly income ($)	1,475 (2,838)	1,389 (1,295)	0.667
Educational attainment			0.607
Less than high school (%)	42.5 (0.9)	38.6 (0.9)	
High school (%)	42.0 (0.9)	41.8 (0.9)	
College (%)	9.1 (0.9)	10.4 (0.9)	
University (%)	6.4 (0.9)	9.2 (0.9)	
Drug injection patterns			
Intravenous cocaine as drug of choice (%)	42.9 (0.5)	39.1 (0.5)	0.430
Number of days injecting in past 4 weeks	11.9 (10.7)	10.3 (10.2)	0.113
Average injections per day in past 4 weeks	6.0 (7.8)	5.1 (6.8)	0.195
Health status			
HIV positive (%)	18.8 (0.4)	12.1 (0.3)	0.046
HCV positive (%)	78.1 (0.4)	74.7 (0.4)	0.391
Neighbourhood- level			
Socioeconomic characteristics			
% households below the LICO**	43.2 (9.3)	36.4 (9.7)	<0.001
% adults with a university degree	31.4 (9.0)	22.5 (12.3)	<0.001

* *P*-values for difference from *t*-test for continuous variables and chi-square test for categorical variables.
** Low-income cut-off established by Statistics Canada where a household spends 20% more than the average same size household on shelter, food, and clothes.

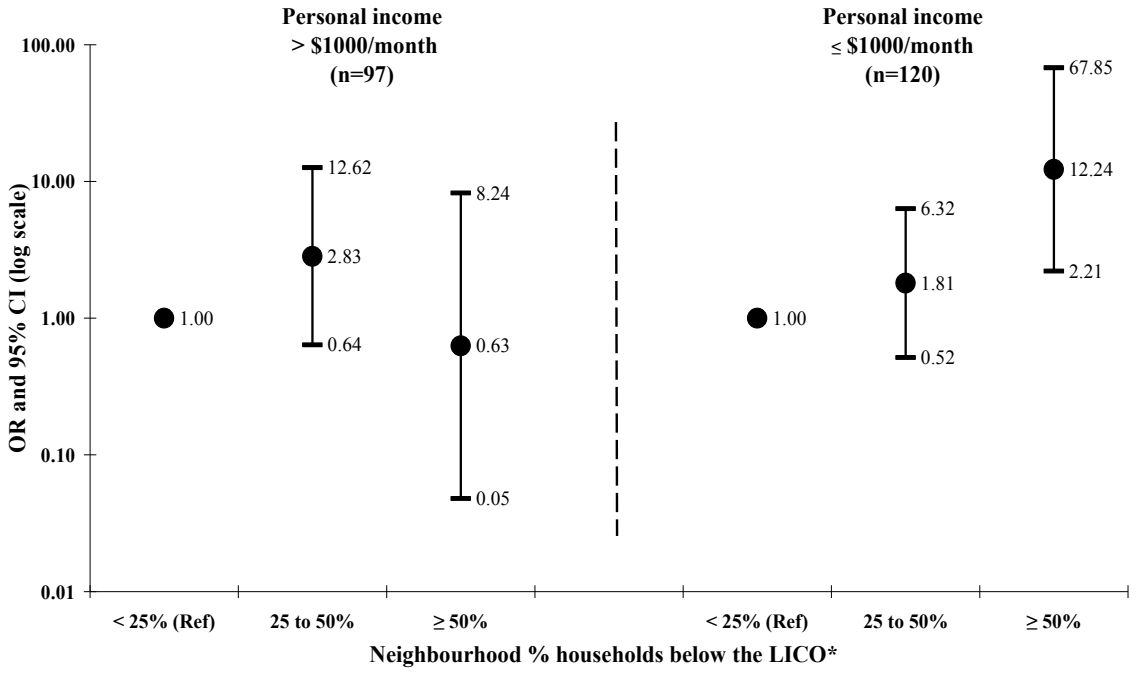
Table 2. Unadjusted and covariate-adjusted associations between high-risk injection behaviour and neighbourhood socioeconomic characteristics, for IDUs in inner city vs. surrounding areas on Montréal Island, St-Luc Cohort, 2004-2006*

	Inner city n=219			**Surrounding areas** n=249		
	OR (95% CI)			**OR (95% CI)**		
	Model 1 Crude model	**Model 2** Covariate-adjusted model	**Model 3** Covariate-adjusted model with both neighbourhood variables simultaneousy considered	**Model 1** Crude model	**Model 2** Covariate-adjusted model	**Model 3** Covariate-adjusted model with both neighbourhood variables simultaneously considered
% households below the LICO**						
<25% (Referent)n $_{\text{inner city}}$=27 n $_{\text{outer city}}$=24	1.00	1.00	1.00	1.00	1.00	1.00
25 to 50% n $_{\text{inner city}}$=165 n $_{\text{outer city}}$=195	1.55 (0.62-3.88)	1.52 (0.60-3.90)	2.20 (0.83-5.85)	2.27 (0.81-6.35)	2.17 (0.76-6.21)	2.13 (0.74-6.10)
>50% n $_{\text{inner city}}$=25 n $_{\text{outer city}}$=25	2.25 (0.70-7.22)	2.22 (0.66-7.40)	4.34 (1.15-16.35)	1.48 (0.40-5.51)	1.37 (0.35-5.31)	1.41 (0.36-5.51)
% adults with a university degree						
>30% (Referent) n $_{\text{inner city}}$=123 n $_{\text{outer city}}$= 68	1.00	1.00	1.00	1.00	1.00	1.00
≤30% n $_{\text{inner city}}$=94 n $_{\text{outer city}}$=176	0.66 (0.37-1.17)	0.54 (0.29-1.00)	0.41 (0.21-0.80)	0.75 (0.42-1.33)	0.79 (0.43-1.45)	0.86 (0.46-1.61)
Missing data	n=2	n=2	n=2	n=5	n=5	n=5

* Results adjusted for individual variables including age (less than 30 years vs. 30 years and more), gender (male vs. female), HIV status (positive vs. negative), total monthly income (less than 1000$ vs. 1000$ and more), and educational attainment (high school or less vs. better than high school).

** Low-income cut-off established by Statistics Canada where a household spends 20% more than the average same size household on shelter, food, and clothes.

Figure 1. Effect modification by personal income of the association between high-risk injection behaviour and neighbourhood % households below the LICO* among inner city IDUs, St-Luc Cohort, 2004-2006**



* Low-income cut-off established by Statistics Canada where a household spends 20% more than the average same size household on shelter, food, and clothes

* * Results adjusted for neighbourhood % adults with a university degree (more than 30% vs. 30% or less), and for individual variables including age (less than 30 years vs. 30 years and more), gender (male vs. female), HIV status (positive vs. negative), and educational attainment (high school or less vs. better than high school)