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EMPLOYMENT PREDICTS DECREASED MORTALITY AMONG HIV-SEROPOSITIVE ILLICIT DRUG USERS IN A SETTING OF UNIVERSAL HIV CARE

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Abstract

Objective—Given the link between employment and mortality in the general population, we sought to assess this relationship among HIV-positive people who use illicit drugs in Vancouver, Canada.

Methods—Data were derived from a prospective cohort study of HIV seropositive people who use illicit drugs (n=666) during the period of May 1996–June 2010 linked to comprehensive clinical data in Vancouver, Canada, a setting where HIV care is delivered without charge. We estimated the relationship between employment and mortality using proportional hazards survival analysis, adjusting for relevant behavioural, clinical, social and socioeconomic factors.

Results—In a multivariate survival model, a time-updated measure of full time, temporary or self-employment compared with no employment was significantly associated with a lower risk of death (adjusted HR=0.44, 95% CI 0.22 to 0.91). Results were robust to adjustment for relevant confounders, including age, injection and non-injection drug use, plasma viral load and baseline CD4 T-cell count.

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Contributors: THK, M-JSM, LAR and EW were responsible for study concept and design. THK and EW led the establishment of the study cohorts. M-JSM conducted statistical analysis, M-JSM and LAR interpreted all data and LAR drafted the manuscript. LAR, M-JSM, THK, SP, JSJM and EW revised the manuscript. All authors have read and approved the text as submitted to the *Journal of Epidemiology and Community Health*.

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Conclusions—These findings suggest that employment may be an important dimension of mortality risk of HIV-seropositive illicit drug users. The potentially health-promoting impacts of labour market involvement warrant further exploration given the widespread barriers to employment and persistently elevated levels of preventable mortality among this highly marginalised population.

INTRODUCTION

Labour market participation is closely linked to individual health status.¹ Observational research on employment and health among people living with HIV/AIDS (PHA) has focused on the impacts of HIV diagnosis and disease progression on labour market participation, employment's effects on health-related quality of life and the relationship between employment and antiretroviral therapy (ART) exposure and adherence.^{2–4} A limited number of studies have examined employment and individual morbidity and mortality among PHA.⁵ This research has rarely focused specifically on illicit drug users (DUs); a notable research gap given the elevated morbidity and mortality of HIV seropositive injection DUs, which remain even as the life expectancy of PHA increases as a result of modern ART. For instance, studies have shown that mortality among HIV seropositive injection DUs is higher than that of other HIV seropositive and drug-using populations.^{6–8} Research identifying factors associated with improved survival among PHA who use drugs is therefore urgently needed.

The role of labour market participation in the mortality risk of HIV seropositive DUs represents a potentially productive line of inquiry in this endeavour. In the general population, the existence, type, quality and quantity of employment significantly impact health,^{1, 9} including standardised all-cause mortality rates, which are higher for individuals who are unemployed.⁹ Because the relationship between employment and mortality is poorly understood among PHA in general, and among HIV positive illicit DUs in particular, the present study explores this relationship among a cohort of people living with HIV who use illicit drugs in Vancouver, Canada.

METHODS

This study uses data from the AIDS Care Cohort to evaluate Exposure to Survival Services (ACCESS), an ongoing, community-recruited prospective cohort of HIV-seropositive individuals who use illicit drugs in Vancouver, Canada. Described in detail elsewhere,^{10,11} enrolment efforts have focused on Vancouver's Downtown Eastside, an area of endemic poverty with an open drug scene and high levels of HIV infection.¹⁰ ACCESS is open to HIV-seropositive individuals who, at baseline, are 18 years of age or older, have used illicit drugs other than cannabinoids in the previous month and provide written informed consent. At baseline and semiannually thereafter, individuals answer an interviewer-administered questionnaire and provide a blood sample for analysis. ACCESS has been approved by the University of British Columbia/Providence Healthcare Research Ethics Board. Interview data were supplemented with participants' complete prospective clinical profile including CD4 T cell counts, plasma HIV-1 RNA viral load (pVL) observations and exposure to antiretroviral agents provided by the Drug Treatment Program of the British Columbia

Centre for Excellence in HIV/AIDS, the single, local centralised ART provider in British Columbia.^{10, 11} All HIV care, including antiretroviral medications, is provided free of charge in British Columbia and adherence can be accurately ascertained through confidential record linkages with the British Columbia Centre for Excellence in HIV/AIDS.

This study used all baseline and follow-up observations from ACCESS participants enrolled between May 1996 and June 2010. Participants recruited during this period were eligible provided they had a CD4 T-cell count observation within ± 180 days of baseline interview. The endpoint of analyses was all-cause mortality, established through a linkage with the province's Vital Statistics agency.¹¹ The primary explanatory variable was a binary indicator of employment, defined as self-reported income from regular, temporary or self-employment in the 6 months prior to interview compared with no employment. This measure of employment is differentiated from sex work, which, although currently legal in Canada is restricted by related legal prohibitions¹² and is significantly associated with exposure to social, structural, HIV risk and health-related harms.^{13,14} Following studies using clinical markers of disease progression as proxies for functionality or health status, we consider as covariates baseline CD4 T-cell count (per 100 cells) to control for individuals entering the study at different stages of disease progression; average pVL in the 6 months prior to interview (per log₁₀ increase); year of recruitment; and adherence to ART in the 6 months prior to interview (adherent ($\geq 95\%$) vs less adherent ($<95\%$, including non ART use)), derived from pharmacy refill data, as previously described.^{10,11} Briefly, adherence in each 6-month period was measured as the number of days for which ART was dispensed divided by the number of days of ART eligibility. Thus, if an individual was dispensed 90 days of medication and was eligible for treatment for 180 days over a 6-month period, adherence was 0.5 (50%). We defined incomplete adherence to ART as any level $<95\%$ adherence.

Because of potential confounding we also considered age (per 10-year increase); gender (female vs male); self-reported Aboriginal ancestry (yes vs no); unstable housing (living in a hotel, hostel, jail or prison, or being homeless; yes vs no); illicit drug use (abstinent vs only non-injection vs any injection); non-fatal overdose (yes vs no); enrolment in methadone maintenance therapy (yes vs no); sex work participation (yes vs no) and incarceration (yes vs no). Sex work was included as a potential confounder given previous research demonstrating significant negative associations between sex work and employment.^{15, 16} All variables referred to the 6 months prior to follow-up excepting age, gender, Aboriginal ancestry, year of enrolment and baseline CD4 T-cell count.

We first examined the frequency and distribution of employment and other explanatory variables at baseline stratified by mortality during the study period. We examined significant differences in the likelihood of mortality during the study period across baseline characteristics using Pearson χ^2 tests. Second, we estimated the relationship between employment and mortality through a series of univariate and multivariate proportional hazards survival models, employing an a priori multivariate model building protocol. Briefly, after constructing a full model including all explanatory variables, we developed a reduced model using a manual stepwise approach whereby each model excluded the covariate from the previous model that produced the smallest relative change in the

employment variable. We continued this process until the maximum change from the full model exceeded 5%. This strategy, as in previous analyses,^{17, 18} retains those covariates with greater relative influence on the relationship between the outcome of interest and the primary covariate of interest.

RESULTS

Between May 1996 and June 2010, among 666 ACCESS participants who contributed 2808 person years of follow-up time we observed 194 deaths, representing an incidence of 6.9 per 100 person years (95% CI 5.9 to 7.9). At baseline, 246 (36.9%) participants were female, 238 (35.7%) reported Aboriginal ancestry and 99 (14.9%) reported employment. At baseline individuals who reported being non-employed, injecting cocaine or using crack cocaine at least daily, had higher pVL, had an earlier year of recruitment and were not exposed to ART were more likely to die during the study period (table 1).

In proportional hazards survival analysis, employment was associated with a lower risk of mortality in univariate (HR: 0.42; CI 0.21 to 0.86, $p=0.017$) and multivariate analyses (adjusted HR: 0.44; CI 0.22 to 0.91, $p=0.026$). The final model, displayed in table 2, was adjusted for age ($p<0.001$), Aboriginal ancestry ($p=0.76$), non-injection drug use ($p=0.541$), injection drug use ($p=0.099$), baseline CD4 T cell count ($p=0.036$) and pVL ($p<0.001$). Potential effect modifiers that are a priori confounders, such as gender, were examined and did not significantly affect the coefficient for employment status.

DISCUSSION

Our results demonstrate that HIV seropositive illicit DUs reporting regular, temporary or self-employment income were at significantly lower risk of death than those reporting no employment. This association remained when relevant behavioural, clinical, social and structural indicators, including age, Aboriginal ancestry, drug use and disease state were considered. This suggests that employment may be an important dimension in the overall mortality risk of HIV-seropositive DUs.

Our findings are consistent with previous studies that found probabilities of death and disease progression to be lower for working PHA,⁵ although none of these focused specifically on DU. Our results are particularly relevant given previous research linking injection drug use with higher mortality rates among HIV-seropositive individuals.^{6,19} Results are also consistent with research in the general population identifying employment as a key differentiating factor in rates of all-cause mortality.⁹

While employment discriminates between levels of mortality risk in the current analysis, this association may have been produced by a health selection effect, whereby individuals with poorer health and higher likelihood of mortality may be selected out of employment.²⁰ It may also result from an indirect causal effect whereby individuals who report employment generate income in safer environments, than, for example, those engaged in sex work, the drug trade or street-based income-generating activities, which have been associated with elevated levels of risk and harm.²¹ Finally, the association may be attributable to a direct impact of employment on health behaviour that may be psychosocial, psychophysiological,

material or behavioural.^{1,3} Notably, there is growing consensus that processes of selection and causation are applicable to the consistent association found between employment and health.^{22,23} Further research is necessary to determine the degree to which each of these processes are relevant in the current context. Future studies could examine the effects of cumulative exposure of employment (ie, job tenure) or time-lagged analyses of the effects of employment transitions or employment losses on individual morbidity and mortality.

These results may include the potential for unmeasured confounding from factors not considered here; the limited generalisability common to all observational studies; and the potential for social desirability or recall bias due to self-reported non-clinical indicators. However, the inclusion of covariates found to be associated with elevated morbidity and mortality in this context,^{11,24} combined with there being no clear reason that study participants at risk of death would under-report employment, suggest that these limitations are unlikely to significantly impact our results. In addition, although mortality data used in the study were derived from a population level data, it is possible that some individuals characterised as lost to follow-up died outside of the province. Past studies have suggested this is unlikely to have biased our results.²⁵ Similarly, all available behavioural data were used in analyses to avoid biases associated with listwise and casewise data deletion methods.²⁶

Low employment rates and widespread barriers to employment among HIV-seropositive DUs have significant implications considering the association between employment and decreased mortality risk found here. The potentially important health-promoting impacts of employment suggest that understanding the feasibility and clinical relevance of participation in the labour market may inform a potentially important component of HIV-related support and care. In addition to the benefits of labour market participation for HIV-seropositive individuals, which include socioeconomic integration and improved quality of life,^{1,3} the current study points to employment as a promising avenue for reducing persistently elevated levels of preventable HIV/AIDS-related mortality among HIV seropositive illicit DUs.

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References

1. Bamba C. Work, worklessness and the political economy of health inequalities. *J Epidemiol Commun H.* 2011; 65:746–50.

2. Dray-Spira R, Legeai C, Le Den M, et al. Burden of HIV disease and comorbidities on the chances of maintaining employment in the era of sustained combined antiretroviral therapies use. *AIDS*. 2012; 26:207–15. [PubMed: 22008658]
3. Rueda S, Raboud J, Mustard C, et al. Employment status is associated with both physical and mental health quality of life in people living with HIV. *AIDS Care*. 2011; 23:435–43. [PubMed: 21271396]
4. Goldman DP, Bao Y. Effective HIV treatment and the employment of HIV+ adults. *Health Serv Res*. 2004; 39:1691–712. [PubMed: 15533182]
5. Delpierre C, Cuzin L, Lauwers-Cances V, et al. Unemployment as a risk factor for AIDS and death for HIV-infected patients in the era of highly active antiretroviral therapy. *Sex Transm Infect*. 2008; 84:183–6. [PubMed: 18192292]
6. Murray M, Hogg RS, Lima VD, et al. The effect of injecting drug use history on disease progression and death among HIV-positive individuals initiating combination antiretroviral therapy: collaborative cohort analysis. *HIV Med*. 2012; 13:89–97. [PubMed: 21819529]
7. Mocroft A, Brettle R, Kirk O, et al. Changes in the cause of death among HIV positive subjects across Europe: results from the EuroSIDA study. *AIDS*. 2002; 16:1663–71. [PubMed: 12172088]
8. Tyndall MW, Craib KJP, Currie S, et al. Impact of HIV infection on mortality in a cohort of injection drug users. *JAIDS*. 2001; 28:351–7. [PubMed: 11707672]
9. Roelfs DJ, Shor E, Davidson KW, et al. Losing life and livelihood: a systematic review and meta-analysis of unemployment and all-cause mortality. *Soc Sci Med*. 2011; 72:840–54. [PubMed: 21330027]
10. Strathdee SA, Palepu A, Cornelisse PGA, et al. Barriers to use of free antiretroviral therapy in injection drug users. *JAMA*. 1998; 280:547–9. [PubMed: 9707146]
11. Milloy MJ, Kerr T, Buxton J, et al. Social and environmental predictors of plasma HIV RNA rebound among injection drug users treated with antiretroviral therapy. *J Acq Immun Def Synd*. 2012; 59:393–9.
12. Van Der Meulen, E.; Durisin, EM.; Love, V. *Selling sex: experience, advocacy, and research on sex work in Canada*. Vancouver, CA: UBC Press; 2013.
13. Shannon K, Rusch M, Morgan R, et al. HIV and HCV prevalence and gender-specific risk profiles of crack cocaine smokers and dual users of injection drugs. *Subst Use Misuse*. 2008; 43:521–34. [PubMed: 18365948]
14. Shannon K, Kerr T, Allinott S, et al. Social and structural violence and power relations in mitigating HIV risk of drug-using women in survival sex work. *Soc Sci Med*. 2008; 66:911–21. [PubMed: 18155336]
15. Richardson L, Wood E, Kerr T. The impact of social, structural and physical environmental factors on transitions into employment among people who inject drugs. *Soc Sci Med*. 2013; 76:126–33. [PubMed: 23157930]
16. Richardson L, Wood E, Li K, et al. Factors associated with employment among a cohort of injection drug users. *Drug Alcohol Rev*. 2010; 29:293–300. [PubMed: 20565522]
17. Maldonado G, Greenland S. Simulation study of confounder-selection strategies. *Am J Epidemiol*. 1993; 138:923–36. [PubMed: 8256780]
18. Milloy MJ, Kerr T, Buxton J, et al. Dose-response effect of incarceration events on nonadherence to HIV antiretroviral therapy among injection drug users. *J Infect Dis*. 2011; 203:1215–21. [PubMed: 21459814]
19. Larsen MV, Omland LH, Gerstoft J, et al. Impact of injecting drug use on mortality in Danish HIV-infected patients: a nation-wide population-based cohort study. *Addiction*. 2010; 105:529–35. [PubMed: 20402997]
20. Bartley M, Plewis I. Does health-selective mobility account for socioeconomic differences in health? Evidence from England and Wales, 1971 to 1991. *J Health Soc Behav*. 1997; 38:376–86. [PubMed: 9425781]
21. DeBeck K, Shannon K, Wood E, et al. Income generating activities of people who inject drugs. *Drug Alcohol Depend*. 2007; 91:50–6. [PubMed: 17561355]
22. Korpi T. Accumulating disadvantage. Longitudinal analyses of unemployment and physical health in representative samples of the Swedish population. *Eur Soc Rev*. 2001; 17:255–73.

23. McDonough P, Amick BC. The social context of health selection: a longitudinal study of health and employment. *Soc Sci Med*. 2001; 53:135–45. [PubMed: 11380159]
24. Wood E, Hogg RS, Yip B, et al. Higher baseline levels of plasma human immunodeficiency virus type 1 RNA are associated with increased mortality after initiation of triple-drug antiretroviral therapy. *J Infect Dis*. 2003; 188:1421–5. [PubMed: 14624366]
25. Hogg RS, Yip B, Chan KJ, et al. Rates of disease progression by baseline CD4 cell count and viral load after initiating triple-drug therapy. *JAMA*. 286:2568–77. [PubMed: 11722271]
26. Beunckens C, Molenberghs G, Thijs H, et al. Incomplete hierarchical data. *Stat Methods Med Res*. 2007; 16:457–92. [PubMed: 17656453]

What is already known on this subject?

In the general population, the existence, type, quality and quantity of employment are closely linked with individual health, including mortality.

Among persons living with HIV/AIDS, employment is associated with health-related quality of life, but it is unclear whether it is connected to individual mortality, particularly among HIV seropositive illicit drug users.

What does this study add?

This study identifies an association between employment and decreased risk of mortality among people living with HIV/AIDS who also use illicit drugs.

This research establishes employment as a previously unexplored avenue for HIV-related support and care and for reducing persistently elevated levels of HIV-AIDS related mortality among this population.

Table 1

Baseline characteristics of 666 HIV-seropositive individuals who use illicit drugs, Vancouver, Canada, 1996–2010

Characteristic	No mortality (N=472)	Mortality (N=194)	OR 95% CI	p Value
Employment status *				
No	389 (82.4)	178 (91.8)	1.00	
Yes	83 (17.6)	16 (8.2)	0.42 (0.24 to 0.74)	0.002
Age (per additional 10 years)				
Median (IQR)	3.9 (3.1–4.6)	3.8 (3.2–4.4)	0.99 (0.95 to 1.03)	0.557
Gender				
Male	302 (64.0)	118 (60.8)	1.00	
Female	170 (36.0)	76 (39.1)	1.14 (0.81 to 1.61)	0.480
Aboriginal ancestry				
No	296 (62.7)	132 (68.0)	1.00	
Yes	176 (37.3)	62 (32.0)	0.79 (0.55 to 1.13)	0.213
Unstable housing *				
No	141 (29.9)	48 (24.7)	1.00	
Yes	331 (70.1)	146 (75.3)	1.29 (0.89 to 1.90)	0.187
Drug use *				
None [†]	13 (2.8)	1 (0.5)	1.00	
Only non-injection	53 (11.1)	3 (1.5)	0.74 (0.07 to 7.66)	0.999
Any injection	406 (86.0)	190 (97.9)	6.08 (0.79 to 46.85)	0.075
Non-fatal overdose *				
No	422 (89.4)	165 (85.1)	1.00	
Yes	50 (10.6)	29 (14.9)	1.30 (0.91 to 2.43)	0.116
MMT enrollment *				
No	333 (70.6)	147 (75.8)	1.00	
Yes	139 (29.4)	47 (24.2)	0.77 (0.52 to 1.12)	0.184
Sex work participation *				
No	369 (78.2)	149 (76.8)	1.00	
Yes	103 (21.8)	45 (23.2)	1.08 (0.73 to 1.62)	0.758
Incarceration *				
No	377 (79.9)	144 (74.2)	1.00	
Yes	95 (20.1)	50 (25.8)	1.38 (0.93 to 2.04)	0.121
ART adherence				
<95%	329 (69.7)	163 (84.0)	1.00	
95%	143 (30.3)	31 (16.0)	0.44 (0.28 to 0.67)	<0.001
Baseline CD4 T cell count (per 100 cells)				
Median (IQR)	3.7 (2.3–5.3)	3.4 (2.2–5.0)	0.98 (0.91 to 1.06)	0.604
PVL (log10) *				
Median (IQR)	3.7 (1.7–4.7)	4.7 (3.9–5.1)	1.75 (1.49 to 207)	<0.001

Characteristic	No mortality (N=472)	Mortality (N=194)	OR 95% CI	p Value
Year of enrolment				
Median (IQR)	2006 (1998–2008)	1996 (1996–1999)	0.80 (0.77 to 0.84)	<0.001

* Refers to the 6-month period preceding the baseline interview.

[†] Sixteen of 666 individuals report no drug use in the 6 months preceding baseline because they were rolled into the study from a previous cohort of HIV-seropositive drug users or cohort of HIV-seronegative drug users following seroconversion.

Table 2

Univariate and multivariate Cox proportional hazard survival analyses of factors associated with time to all-cause mortality among 666 people who use illicit drugs, Vancouver, Canada, 1996–2010

Characteristic	Unadjusted HR (95% CI) [†]	p Value	Adjusted HR (95% CI)	p Value
Employment* (yes vs no)	0.42 (0.21 to 0.86)	0.017	0.44 (0.22 to 0.91)	0.026
Age (per additional 10 years)	1.58 (1.33 to 1.89)	<0.001	1.79 (1.48 to 2.18)	<0.001
Gender (female vs male)	0.97 (0.73 to 1.30)	0.850		
Aboriginal ancestry (yes vs no)	0.67 (0.49 to 0.91)	0.009	0.75 (0.54 to 1.03)	0.076
Unstable housing* (yes vs no)	1.08 (0.81 to 1.45)	0.599		
Non-injection drug use* (abstinent vs any)	0.85 (0.52 to 1.42)	0.555	0.85 (0.51 to 1.42)	0.541
Injection drug use* (abstinent vs any)	0.76 (0.50 to 1.14)	0.183	0.71 (0.47 to 1.07)	0.099
Non-fatal overdose* (yes vs no)	0.74 (0.38 to 1.45)	0.380		
MMT enrolment* (yes vs no)	0.87 (0.64 to 1.16)	0.338		
Sex work participation* (yes vs no)	0.67 (0.42 to 1.08)	0.099		
Incarceration* (yes vs no)	0.86 (0.58 to 1.30)	0.479		
Baseline CD4 T cell count (per 100 cells)	0.93 (0.87 to 0.99)	0.032	0.93 (0.87 to 0.99)	0.036
ART adherence* (95% vs <95%)	0.78 (0.56 to 1.07)	0.127		
PVL* (per log ₁₀ increase)	1.21 (1.08 to 1.35)	0.001	1.31 (1.17 to 1.46)	<0.001
Year of enrolment (per year)	0.99 (0.94 to 1.03)	0.501		

* Refers to the 6-month period preceding the follow-up interview.

ART, antiretroviral therapy; MMT, methadone maintenance therapy; PVL, plasma viral load copies per millilitre.