Severe food insecurity is associated with elevated unprotected sex among HIV-seropositive injection drug users independent of HAART use

Kate Shannon[1,2,3], **Thomas Kerr**[1,2,3], **M-J Milloy**[1,3], **Aranka Anema**[1], **Ruth Zhang**[1], **Julio S. G. Montaner**[1,2], and **Evan Wood**[1,2,3]

[1]BC Centre for Excellence in HIV/AIDS, University of British Columbia, Vancouver, British Columbia, Canada

[2]Division of AIDS, Department of Medicine, University of British Columbia, Vancouver, British Columbia, Canada

[3]School of Population and Public Health, University of British Columbia, Vancouver, British Columbia, Canada

Abstract

Objective—Despite emerging evidence of a significant adverse relationship between food insecurity and sexual risk-taking, data have been primarily derived from resource-constrained settings and HIV-negative populations. To our knowledge, this study is the first to longitudinally evaluate the relationship between food insecurity and unprotected sex among HIV-seropositive people who inject drugs [injection drug users (IDUs)] both on and not on HAART.

Design—Longitudinal analyses were restricted to HIV-positive IDUs who completed baseline and at least one follow-up visit in a prospective cohort (AIDS Care Cohort to evaluate Exposure to Survival Services, 2005–2009).

Methods—We constructed a multivariate logistic model using generalized estimating equations (GEEs) to assess an independent relationship between severe food insecurity (e.g., hunger due to lack of access or means to acquire food) and unprotected vaginal/anal sex.

Results—Among 470 HIV-positive IDUs, the median age was 42 years (interquartile range 36–47) with 61% men and 39% women. The prevalence of severe food insecurity was 71%, with no differences by HAART use. Severe food insecure IDUs were marginally less likely to have a suppressed HIV-1 RNA viral load (31 vs. 39%, *p*=0.099). In multivariate GEE analyses, severe food insecurity [adjusted odds ratio=2.68, 95% confidence interval 1.49–4.82] remained independently correlated with unprotected sex among HIV-positive IDUs, controlling for age, sex/gender, married/cohabiting partner, binge drug use, homelessness, and HAART use.

Conclusion—These findings highlight a crucial need for structural HIV interventions that incorporate targeted food assistance strategies for IDUs. Given recent evidence of poor virological response among food insecure individuals on HAART, innovative HIV care models should integrate targeted food security programs and early access to HAART.

Keywords

food insecurity; HAART; HIV/AIDS; injection drug use; sexual risk

INTRODUCTION

There is now global recognition that epidemics of food insecurity and HIV are closely linked [1–4], with over 900 million undernourished individuals worldwide [5]. Although the vast majority of research to date has been derived from developing countries [5], the limited data available from resource-rich settings suggest a high prevalence of food insecurity among HIV-positive individuals [6,7]. In North America, 6–9% of households in the general population are estimated to be food insecure [8,9], while among HIV-positive individuals on HAART, 48–49% are estimated to be food insecure, with 21% meeting the definition of severely food insecure with the presence of acute hunger [6,7]. Although several international bodies, including WHO and the World Food Program, have called for targeted nutritional interventions that are systematically linked to HIV interventions [1–3], there remains a concerning lack of data on food insecurity among HIV-positive individuals in developed country settings. Of particular importance, in many inner city communities in North America, the majority of HIV-positive people who inject drugs [injection drug users (IDUs)] rely on food banks and shelters to obtain food, and yet the epidemiology of food insecurity among IDUs and intersections with sexual and drugs risks remain largely unknown.

In studies of HIV-positive individuals on treatment, food insecurity has been associated with lower adherence, adverse antiretroviral pharmacokinetics, worsening clinical outcomes, including a poor immunological response, and elevated mortality [6,10–13]. In addition to adverse clinical outcomes, a study among HIV-negative individuals in southern Africa now suggests a significant adverse relationship between food insecurity and sexual risk-taking, including elevated likelihood of unprotected sex and exchanging of sex for food or other resources [14]. Similarly, in a case–control study of African–American men and women with heterosexually acquired HIV infection in south Carolina, hunger due to lack of access to food was independently associated with HIV infection [15]. Although these cross-sectional data offer important research to suggest potential sexual risk pathways between food insecurity and risk of HIV acquisition, there is a dearth of research among HIV-positive individuals in resource-rich settings, particularly among drug-using populations. This study, therefore, aims to evaluate longitudinally the impact of severe food insecurity – hunger due to lack of access or means to acquire food – on sexual risk-taking among HIV-positive IDUs both on and not on HAART.

METHODS

Study population

Data were derived from the AIDS Care Cohort to evaluate Exposure to Survival Services (ACCESS), a prospective observational cohort of HIV-seropositive IDUs in Vancouver, Canada that has been described in detail previously [16,17]. Briefly IDUs were recruited through snowball sampling and extensive street outreach methods in the city's inner city community (Downtown Eastside). Individuals were eligible if they were aged 18 years or older, HIV seropositive, and injected drugs in the past 6 months. At baseline and bi-annual follow-up, participants completed a standardized interviewer-administered questionnaire and provided blood samples for disease monitoring. The current analyses include all participants who were recruited and completed at least one follow-up visit (December 2005 to May 2009).

Data linkages to the British Columbia drug treatment program

As previously described [16,17], the local setting is somewhat unique in that there is a province-wide centralized antiretroviral dispensation program and HIV/AIDS laboratory, enabling a complete prospective profile of all patient CD4 cell counts, plasma HIV-1 RNA levels, and HAART use [18]. Providence Healthcare/University of British Columbia Research Ethics Board has provided approval for the study. Plasma HIV-1 RNA is measured using the Roche Amplicor Monitor assay (Roche Molecular Systems, Mississauga, Canada).

Variable selection

The primary outcome of interest was unprotected sex (vaginal and/or anal) in the previous 6 months. The primary explanatory variable was severe food insecurity, defined according to international United Nations and World Food Program guidelines, based on a 'yes' response to either or both of questions eliciting 'going hungry due to lack of access or means to acquire food' [4]. Mild-to-moderate food insecurity, including insufficient diversity of food, was not considered unless participants met the criteria for severe food insecurity: the presence of acute hunger. Individual and structural covariates of interest considered a priori as potential confounders [6,7] included homelessness, binge drug use, and HAART. All variables were based on semi-annual follow-up intervals with a recall period of 6 months. Based on the confidential linkage to the centralized antiretroviral dispensary, we included HIV-1 RNA level (>=500 vs. < 500 copies/ml) and CD4 cell count (<200, 200–350 copies/μl, vs. >350 copies/μl). If more than one measure of viral load or CD4 cell count were available in any 6-month period, we used the mean of all available measurements.

Statistical analyses

Bivariate GEE analyses were conducted to examine the relationship between explanatory variables and our primary outcome of unprotected vaginal/anal sex. As repeated measures were available for each participant, we conducted marginal longitudinal analyses using generalized estimating equations (GEEs) to analyze correlated data [19,20]. Standard errors were calculated using an exchangeable correlation structure, adjusted by multiple observations for each individual, to allow us to examine periods of food insecurity and unprotected sex both within and across individuals. A multivariate GEE model was fitted based on *a priori* protocols of potential confounders [6,7] and variables with a *p* value less than 0.10 in bivariate analyses. Variables were retained as significant in our final multivariate GEE model at *p* less than 0.05. All statistical procedures were performed using SAS version 8.0 (SAS, Cary, North Carolina, USA) and all *p* values reported were two-sided.

Results

Of a total of 491 HIV-positive individuals who injected drugs in the ACCESS cohort, 470 were included in the analyses, contributing to 1310 observations over baseline and four follow-up visits (21 were excluded due to missing data on food insecurity). Of the total, 39% were women, with a median age of 42 years [interquartile range (IQR) 36–47]. Approximately half were on HAART (n = 217), with 71% of IDUs reporting severe food insecurity. As indicated in Table 1, individuals who were severely food insecure were significantly more likely to be living in the inner city community (73 vs. 56%, *p* < 0.001), frequent non-injection crack cocaine user (48 vs. 26%, *p* < 0.001), homeless (35 vs. 19%, *p* < 0.001), frequent heroin injector (24 vs. 11%, *p* < 0.001), and frequent cocaine injector (12 vs. 6%, *p* = 0.043). Severely food insecure individuals were also marginally more likely to be younger (41.6 vs. 42.4 years, *p* = 0.061) and less likely to have a suppressed HIV-1 RNA viral load (31 vs. 39%, *p* = 0.099). There were no statistically significant differences in individuals reporting and not reporting severe food insecurity by sex/gender or HAART use.

Over the observation period, there were 789 and 245 events, respectively, of severe food insecurity and unprotected sex, and proportions were not statistically significantly different across follow-ups.

Table 2 shows the bivariate and multivariate GEE results. In our final multivariate GEE model, adjusting for age, sex/gender, married/cohabitating partner, homelessness, binge drug use, and HAART use, severe food insecurity remained independently correlated with unprotected sex (adjusted odds ratio = 2.58, 95% confidence interval 1.49–4.82) among HIV-positive IDUs. Given hypothesized role of sex/gender in modifying this relationship, we subsequently tested for interaction of gender and food insecurity (non-significant) and conducted sex-stratified models to examine differences in the effect size for men and women (results not statistically significantly different).

DISCUSSION

In this study, close to two-thirds of HIV-positive IDUs reported severe food insecurity over the 2-year follow-up, a prevalence significantly higher than previously documented among cross-sectional samples of marginalized HIV-positive individuals in North America [19]. Of concern, HIV-positive IDUs who were severely food insecure were slightly less likely to have a suppressed HIV-1 RNA viral load at baseline, and severe food insecurity remained independently correlated with a two and half-fold elevated proportional odds of engaging in unprotected vaginal or anal sex.

Although this study does not delineate the mechanism between severe food insecurity and unprotected sex, there are several plausible risk pathways. First, cross-sectional data from sub-Saharan Africa suggest that food insecurity is associated with transactional sex, the exchange of sex for basic resources (e.g., food, shelter, money) among women, known to drive unprotected sex [21–24]. Second, competing resource demands of food and drugs among HIV-positive IDUs may shape prioritization of risks in the absence of alternative means to acquire basic necessities. Third, physiological evidence demonstrates that immediate hunger can reduce the coping mechanisms of individuals [25], which could mediate sexual decision-making and negotiation of condom use among both men and women.

To our knowledge, these results are the first to longitudinally document a direct correlation between severe food insecurity and unprotected sex among HIV-positive individuals. Given recent research suggesting a temporal shift toward a sexually driven HIV epidemic among IDUs following wide-spread needle exchange access in many North American cities [26], this study identifies an important sexual risk pathway for sustained HIV transmission that requires immediate attention. Furthermore, food insecurity can lead to malnutrition, which increases the risk of HIV transmission through sex and drug risk routes by compromising an individual's immunostatus and gut and genital mucosal integrity [6]. Whereas earlier research suggests gendered patterns of food insecurity and sexual risk [27–29], our results demonstrate an elevated odds of unprotected sex that persists among HIV-positive food insecure IDUs, regardless of gender. At the same time, HIV-positive women in this sample were 50% more likely to report unprotected sex than HIV-positive men, confirming earlier work documenting gendered patterns in negotiation of male condom use that require targeted and couple-focused interventions.

Given that HAART use, in combination with condoms, is now recognized as a critical HIV prevention strategy at the population level [26], and recent cross-sectional data from San Francisco showing food insecurity to be associated with poor virological response among individuals on HAART, these findings call for innovative structural interventions that

combine early access to HAART with targeted food security for IDUs as critical to effective HIV prevention and treatment scale-up. Among nondrug-using populations in resource-poor settings, ecological analysis of US President's Emergency Plan for AIDS Relief programs across seven sub-Saharan African countries has shown nutritional support to be strongest predictor of non-attrition from HAART [30]. Our results highlight a critical need to pilot and rigorously evaluate structural HIV interventions that incorporate food assistance programs for IDUs within harm reduction and treatment programming, including supporting housing models, mobile outreach, syringe distribution, and substitution therapy. Further, consideration should be given to strategies that account for the potential competing resource demands of food and drugs.

This study has several limitations. First, as with all observational data, variables are self-reported and may be subject to social desirability or recall bias. Second, our measure of food insecurity does not capture the full range of mild-to-moderate food insecurity, such as lack of diversity or nutrients of available food, and additional research using standardized measures of food insecurity among IDUs is warranted.

In summary, these findings highlight a crucial need for structural HIV interventions that incorporate targeted food assistance strategies for HIV-positive IDUs. Given evidence of poor virological response among food insecure individuals on HAART, innovative HIV care and treatment models that integrate targeted food security programs and early access to HAART will be crucial to realizing the positive prevention and treatment benefits of HAART.

Acknowledgments

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Table 1

Baseline individual and structural characteristics of 470 HIV-positive people who inject drugs in the AIDS Care Cohort to evaluate Exposure to Survival Services, stratified by severe food insecurity.

	Severe food insecurity		
	Yes (n=335)	**No (n=135)**	**p**
Median age (IQR)	41.6 years (35.6–47.5)	42.4 years (37.0–48.2)	0.061
Female sex (vs. male)	131 (39%)	51 (38%)	0.789
Aboriginal ethnicity (vs. non-Aboriginal)	136 (41%)	55 (41%)	0.977
Married/cohabitating	90 (27%)	37 (27%)	0.905
Homeless	118 (35%)	26 (19%)	<0.001
Inner city residency	245 (73%)	75 (56%)	<0.001
Frequent crack smoking	161 (48%)	35 (26%)	<0.001
Frequent heroin injection	82 (24%)	15 (11%)	0.001
Frequent cocaine injection	41 (12%)	8 (6%)	0.043
HAART use	50 (51%)	67 (55%)	0.412
CD4 cell count			
<200 copies/μl	87 (27%)	38 (28%)	0.737
200–350 copies/μl	107 (33%)	42 (31%)	0.707
>350 copies/μl	132 (40%)	55 (41%)	Reference
HIV-1 RNA viral load (log10) <500 copies/ml	102 (31%)	53 (39%)	0.099

IQR: Interquartile range

Table 2

Bivariate and multivariate generalized estimating equation analyses of correlates of unprotected sex among HIV-positive people who inject drugs both on and not on HAART in the AIDS Care Cohort to evaluate Exposure to Survival Services, 2005–2008.

	Unadjusted ORs (95% CI)	Adjusted ORs (95% CI)
Age (continuous, years)	0.95 (0.92–0.98)*	0.97 (0.94–0.99)
Female sex	1.54 (1.00–2.37)*	1.50 (1.02–2.22)
Aboriginal ethnicity	1.03 (0.67–1.59)	–
Married/cohabitating	5.05 (3.40–7.85)*	4.56 (3.01–6.57)
Severe food insecurity	2.98 (1.56–5.05)*	2.68 (1.49–4.82)
Homeless	1.17 (0.80–1.72)	–
Inner city residency	0.87 (0.60–1.26)	–
HAART use	0.78 (0.44–1.23)	–
CD4 cell count		
<200 copies/μl	1.43 (0.86–2.49)	–
200–350 copies/μl	1.35 (0.85–2.17)	–
>350 copies/μl	Reference	
HIV-1 RNA viral load (log10) <500 copies/ml	0.92 (0.80–1.06)	–
Current STI	1.25 (0.82–1.92)	–
Frequent crack smoking	1.31 (0.93–1.83)	–
Frequent cocaine injection	1.54 (0.95–2.49)	–
Frequent heroin injection	1.53 (0.99–2.35)	–
Binge drug use (injection and/or non-injection)	1.63 (1.10–2.44)*	1.56 (1.08–2.55)

CI: Confidence interval; OR: Odds ratio; STI: Sexually transmitted infection

*
Variables significant at p <0.10 in bivariate analyses and entered into the multivariate model. Final multivariate model adjusted for age, sex/gender, married/cohabitating partner, binge drug use, homelessness, and HAART use