

# Food Insecurity Is Associated with Incomplete HIV RNA Suppression among Homeless and Marginally Housed HIV-Infected Individuals in San Francisco

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## Abstract

**Introduction:** There is growing international concern that food insecurity may negatively impact antiretroviral (ARV) treatment outcomes, but no studies have directly evaluated the effect of food insecurity on viral load suppression and ARV adherence. We hypothesized that food insecurity would be associated with poor virologic response among patients on ARVs and that this association would be modified by adherence.

**Methods:** Participants were ARV-treated homeless and marginally housed persons receiving adherence monitoring (unannounced pill counts at the person's place of residence) in the Research on Access to Care in the Homeless (REACH) Cohort. Food insecurity was measured by the Household Food Insecurity Access Scale (HFIAS) developed by Food and Nutrition Technical Assistance based on validation studies in 8 countries. The primary study outcome was suppression of HIV viral RNA to <50 copies/ml. We used logistic regression to assess whether food insecurity was associated with VL suppression, and also stratified analyses by level of adherence (>80% versus ≤80%) to determine whether adherence modified these associations.

**Results:** Among 104 participants, the mean age was 46.5 years, 33% of participants were white, 64% were male, and 66% had completed high school. Fifty-one percent were food secure, 24% were mildly or moderately food insecure and 25% were severely food insecure. Severely food insecure participants were less likely to have adherence ≥80%. In adjusted analyses, severe food insecurity was associated with a 72% lower odds of viral suppression (95% CI=0.10-0.84, p=0.02) when controlling for all covariates. In analyses stratified by adherence level, severe food insecurity was associated with an 85% lower odds of viral suppression (95% CI=0.02-0.99, p<0.05) among those with ≤80% adherence and a 66% lower odds among those with >80% adherence (95% CI=0.06-1.81, p=0.21).

**Conclusions:** Food insecurity is associated with incomplete viral suppression in the urban poor of San Francisco, one of the best-resourced settings for HIV-positive individuals in the United States. This effect was most pronounced among non-adherent individuals. These findings suggest that addressing fundamental human needs, such as access to food, should be an integral component of public health HIV programs serving impoverished populations in the United States.

## Background

- Food insecurity is defined as having uncertain or limited availability of nutritionally adequate or safe food or the inability to procure food in socially acceptable ways.
- Urban poor people and those living with HIV/AIDS (PLWA) have a high prevalence of food insecurity.
- Food insecurity is associated with poor physical and mental health; it has been associated with postponing needed care and medications.
- Food insecurity may negatively affect HIV disease progression and antiretroviral (ARV) treatment efficacy; there are limited empirical data on this issue.
- There are several possible mechanisms for how food insecurity may impact HIV RNA:

### Behavioral mechanism

- PLWA report food insecurity as a barrier to ARV adherence in several qualitative studies.

### Biologic mechanisms

- Food insecurity is associated with malnutrition and wasting, known to be associated with worse clinical outcomes.
- Food insecurity may impact ARV pharmacokinetics, leading to sub-optimal drug levels and virologic rebound.

## Hypotheses

- Food insecurity is associated with incomplete HIV RNA suppression.
- Adherence to ARVs influences the association between food insecurity and HIV RNA suppression.

## Methods

### Study Design

- Cross sectional survey nested in a prospective cohort study

### Study Procedures

- HIV-positive participants recruited from San Francisco homeless shelters, free-meal programs, and single-room-occupancy hotels between July 1996 and October 2001 (REACH cohort)
- Quarterly assessment of CD4 counts and VL, and structured questionnaire with information on health status and health services utilization
- Adherence measured with monthly unannounced pill counts
- Inclusion criteria:
  - age ≥18
  - on 3 ARVs in early 2006
  - receiving adherence monitoring in first quarter of 2006

### Analysis

- Primary outcome: VL suppression <50 copies/ml
- Primary independent variable: food insecurity measured by the Household Food Insecurity Access Scale (HFIAS)
- Using multivariable logistic regression, controlled for
  - Demographics
  - Drug and alcohol use
  - ARV adherence by pill counts (>80% vs. ≤80%)
  - Prior HAART use
  - Recent incarceration and homelessness
  - Symptoms of depression (BDI)
  - ART regimen type
  - Nadir CD4 count
- Models stratified by adherence level to determine whether adherence is an effect modifier

## Results

Table 1. Participant Characteristics †

Characteristic	All Participants N=104	Food Security Categories 1,2,3; N=78 (75.0%)	Food Security Category 4 (Severely Food Insecure) N=26 (25.0%)
Age (mean, SD)	46.5 ±(7.9)	46.8 (±8.0)	45.9 (±7.6%)
White	34 (32.7%)	25 (73.5%)	9 (26.5%)
Male	66 (63.5%)	51 (77.3%)	15 (22.7%)
≥High school education	69 (66.4%)	53 (76.8%)	16 (33.2%)
Income (≥median of \$785/month)	52 (50.0%)	37 (71.2%)	15 (28.9%)
Recent incarceration	4 (3.9%)	3 (75.0%)	1 (25.0%)
Recent homelessness	3 (2.9%)	2 (66.7%)	1 (33.3%)
Fully suppressed regimen†	90 (86.5%)	67 (74.4%)	23 (25.6%)
History of injection drug use past 30 days	19 (18.3%)	12 (63.2%)	7 (36.8.0%)
Problem Drinking	6 (5.8%)	4 (66.7%)	2 (33.3%)
BDI score (mean, SD)	11.7 (10.1)	10.1 (9.2)**	16.8 (11.3)**
Mono or dual NRTI use prior to HAART	92 (88.5%)	69 (75.0%)	23 (25.0%)
Months on HAART prior to study (mean, SD)	41.8 (31.6)	40.9 (31.3)	43.4 (33.1)
Nadir CD4 (mean, SD)	228 (202)	229 (197)	223 (220)
Pill count adherence >80%	58 (55.8%)	48 (62.8%)*	10 (17.2%)*
VL <50 copies/ml	58 (55.8%)	49 (64.5%)**	9 (15.5%)**

† P values compare severely food insecure versus all other participants for each characteristic; ‡ Food security categories 1, 2, and 3 include food secure and mildly or moderately food insecure; # Fully suppressed regimen is defined as taking ritonavir boosted PI or NNRTI-based regimen; \* p<=.05; \*\* p<=.01.

Table 2. Factors Associated with Viral Suppression <50 copies/ml among Homeless and Marginally Housed HIV-Infected Participants in San Francisco\* (n=104)

Characteristic	Odds Ratio (OR) (0.95CI)	Adjusted OR without adherence (0.95CI)	Adjusted OR with adherence (0.95CI)
Severely food insecure (HFIAS category 4 vs. categories 1, 2, 3)	0.31 (0.12 – 0.79)	0.28 (0.10 – 0.84)	0.33 (0.11 – 1.00)
Age (per year)	1.03 (0.98 – 1.08)	—	—
White (vs. nonwhite)	1.44 (0.63 – 3.23)	—	—
Male (vs. female)	0.87 (0.39 – 1.95)	—	—
≥High School education	1.30 (0.58 – 2.95)	—	—
Income ≥ mean	0.73 (0.34 – 1.59)	—	—
Recent incarceration	0.25 (0.03 – 2.50)	—	—
Fully suppressed regimen	0.66 (0.21 – 2.14)	—	—
Drug use past 30 days	0.45 (0.20 – 1.04)	0.68 (0.26 – 1.78)	1.17 (0.40 – 3.45)
Problem drinking	0.14 (0.02 – 1.28)	0.20 (0.02 – 1.95)	0.26 (0.02 – 2.79)
BDI score (per unit)	1.00 (0.96 – 1.04)	—	—
Mono or dual NRTI use prior to HAART	0.38 (0.01 – 1.49)	0.15 (0.03 – 0.88)	0.21 (0.03 – 1.30)
Months on HAART prior to study (per 3 months)	1.04 (0.99 – 1.08)	1.06 (1.01 – 1.12)	1.07 (1.01 – 1.13)
Nadir CD4 (per 10 cells)	1.03 (1.01 – 1.06)	1.04 (1.01 – 1.07)	1.03 (1.00 – 1.06)
Adherence >80%	5.92 (2.53-13.89)	—	4.70 (1.67-13.26)

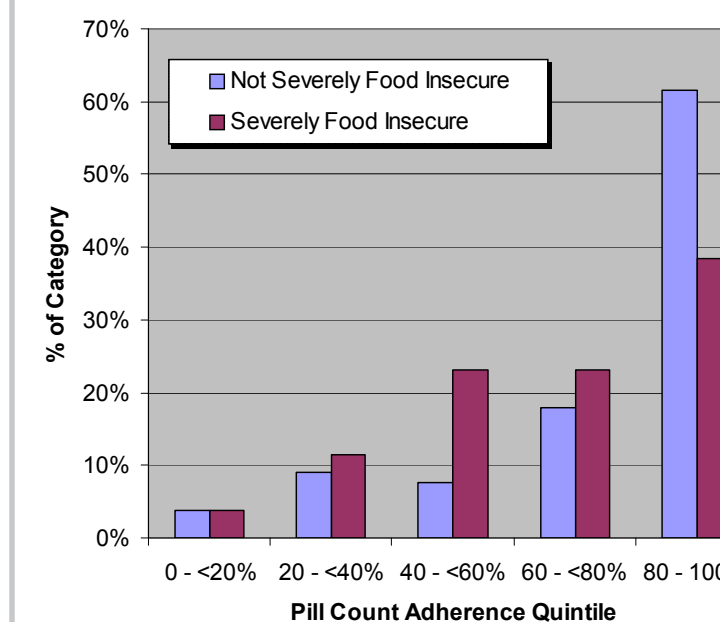
\*The multivariate regression model was derived including all variables with a p value <=0.2.

Table 3. Adjusted Factors Associated with Viral Suppression <50 copies/ml Stratified by Adherence Level\* (N=104)

Characteristic	Adherence >80% N=58 Adjusted OR (0.95 CI)	Adherence ≤80% N=46 Adjusted OR (0.95 CI)
Severely food insecure (HFIAS category 4 vs. categories 1, 2, 3)	0.34 (0.06 – 1.81)	0.15 (0.02 – 0.99)
Drug use past 30 days	0.29 (0.05 – 1.76)	2.37 (0.48 – 11.65)
Mono or dual NRTI use prior to HAART	0.22 (0.03 – 1.52)	0.10 (0.003 – 3.92)
Months on HAART prior to study (per 3 months)	1.05 (1.01 – 1.08)	1.04 (0.96 – 1.13)
Nadir CD4 (per 10 cells)	1.01 (0.97 – 1.05)	1.07 (1.01 – 1.13)

\*The multivariate regression model was derived including all variables with a p value <=0.2. In separate models stratified by regimen type (NNRTI versus PI), effect of food insecurity on viral load seen only in PI-based regimens.

Figure 1. Adherence Quintile by Food Security Status



## Limitations

- Cross-sectional survey design limits causal inference
- Small sample size
- No measures of nutritional status

## Conclusions

- Half of urban poor, HIV-infected individuals in well-resourced North American setting are food-insecure.
- Food insecurity independently increases risk of incomplete VL suppression in urban poor individuals.
- Effect is most pronounced in non-adherent individuals.

## Implications

- Addressing fundamental human needs, such as access to food, should be an integral component of HIV programs serving impoverished populations worldwide.