

Health and Treatment Implications of Food Insufficiency among People Living with HIV/AIDS, Atlanta, Georgia

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ABSTRACT *HIV/AIDS is concentrated among the inner-city poor and poverty may directly interfere with HIV treatment. This study examined food insufficiency in relation to HIV-related health and treatment. A sample of 344 men and women living with HIV/AIDS in Atlanta, Georgia completed measures of food security, health, and HIV disease progression and treatment. HIV treatment adherence was monitored using unannounced pill counts. Results showed that half of people living with HIV/AIDS in this study lacked sufficient food, and food insufficiency was associated with multiple indicators of poor health, including higher HIV viral loads, lower CD4 cell counts, and poorer treatment adherence. Adjusted analyses showed that food insufficiency predicted HIV treatment non-adherence over and above years of education, employment status, income, housing, depression, social support, and non-alcohol substance use. Hunger and food insecurity are prevalent among people living with HIV/AIDS, and food insufficiency is closely related to multiple HIV-related health indicators, particularly medication adherence. Interventions that provide consistent and sustained meals to people living with HIV/AIDS are urgently needed.*

KEYWORDS *HIV/AIDS treatment, Food security, Food insufficiency, Poverty and health*

INTRODUCTION

With few exceptions, HIV/AIDS has emerged as a pandemic of the poor. Characteristics of impoverished communities such as closely knit sexual networks, substance abuse, exchanging sex to meet survival needs, limited access to health services, and co-occurring epidemics of other sexually transmitted infections contribute to the rampant spread of HIV. Hunger is the hallmark of poverty, and food scarcity may be an independent contributing factor to HIV/AIDS. Research conducted in Southern Africa shows that food insufficiency is associated with low rates of condom use, intergenerational sex partners, sexual exchange, and a lack of control in sexual relationships.¹ Importantly, the association between food insufficiency and sexual risks is not explained by income and education, showing that while access to food is obviously linked to other socioeconomic indicators, food insufficiency is independently associated with risks for HIV infection. The concentration of factors that facilitate

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HIV transmission in urban centers, such as substance use and poverty, has translated to high rates of these same problems in people living with HIV/AIDS.

Not surprisingly, conditions of poverty compromise health and further complicate the progression of HIV/AIDS. People living with HIV/AIDS in the USA are often homeless or living in unstable housing, conditions that are associated with poor health outcomes.² Hunger and food insufficiency are prevalent in people living with HIV/AIDS, even in the most well-resourced cities.³ For example, nearly half of HIV-positive individuals receiving drug treatment in British Columbia, Canada were identified as food insecure, a rate that was five times greater than the general Canadian population.⁴ Food insecurity was significantly greater among women and aboriginals and was associated with having more children, less education, a history of recreational injection drug and/or alcohol abuse, and unstable housing. Food scarcity and malnutrition can contribute to HIV disease progression by compromising health in general and complicating HIV wasting in particular.⁵ Food insufficiency can also interfere with the absorption of medications and pharmacokinetics of antiretroviral (ARV) therapies.⁶

In a study of homeless and marginally housed people living with HIV/AIDS in San Francisco, Weiser et al.⁷ found that one in three people were severely food insecure. In adjusted analyses, food insecurity was associated with being white, having recently been incarcerated, lacking health insurance, poor mental and physical functioning, and having a low T-cell (CD4 cell) count. Among those persons taking ARV therapies, more than half were food insecure, and food insecurity was associated with incomplete adherence and viral non-suppression in people who were less than 80% adherent.⁸ Thus, not having sufficient food was related to poor adherence and was independently associated with poor treatment outcomes. Ultimately, food insufficiency in combination with being underweight can contribute to the mortality of people living with HIV/AIDS.⁹

Hunger and food scarcity in US urban centers may extend beyond the homeless and marginally housed. The US region with the fastest growing HIV epidemic is the Southeast, which also has substantial poverty despite stable housing. The current study was conducted to examine the prevalence of food insecurity among people living with HIV/AIDS in a major southeastern US city. We also examined demographic, health, and treatment-related factors associated with food security. Finally, we tested the association between food sufficiency and HIV treatment adherence. We hypothesized that experiencing insufficient food would predict HIV treatment status and HIV treatment adherence. We specifically tested the hypothesis that food sufficiency would predict HIV treatment adherence over and above other common factors associated with adherence.

METHODS

Participants and Setting

Men and women were recruited from AIDS service organizations, healthcare providers, social service agencies, infectious disease clinics, and word-of-mouth in Atlanta, GA. Atlanta has over 23,000 reported cases of AIDS and an HIV/AIDS rate of 23 per 100,000 population, exceeding the average of 15 per 100,000 population in other major US cities.¹⁰ Atlanta's poverty rate is 21%, compared to the state of Georgia's 13%, and 12% of Atlanta's residents have incomes below 50% of the

poverty level. Joblessness in Georgia consistently exceeds US national unemployment rates.¹¹

Interested persons phoned our research site to schedule an appointment to participate. To meet study entry criteria, participants had to be 18 years old, have proof of positive HIV status using a photo ID with matching ARV prescription bottle, and currently be taking ARV medications. Data were collected between January 2008 and June 2009, and all procedures were approved by the University of Connecticut Institutional Review Board.

Measures

Measures were collected using an instructor-guided, self-administration procedure in groups of four to eight persons. Participants were shown page by page how to complete the study measures by using a projected facsimile of the instruments, assuring that instructions for each measure were carefully described and that participants were given privacy with minimal demand characteristics when responding. Participants who experienced difficulty reading the measures were interviewed (fewer than 10%). Participants completed surveys assessing demographic and health information, food security, HIV treatment status, and common barriers to treatment and adherence. HIV treatment adherence was objectively monitored using unannounced, telephone-based pill counts.

Demographic Characteristics Participants were asked their age, years of education, income, ethnicity, sexual orientation, and employment status. Using locator information collected for tracking participants in the study, we determined whether individuals were currently residing in a homeless shelter. We also asked participants whether they had worried about having a safe place to sleep at night in the previous year.

Food Security To measure food security, we adapted items from the US Food Security Scale.¹² Our adaptation used six of the eight original items that focus on food anxiety (one item), meal quality (one item), and food sufficiency (four items) in the previous year. To reduce participant burden, we omitted one item concerning food running out because of its overlap with other items, and one item that concerned weight loss because it would be confounded with the effects of chronic conditions in HIV infection. We also added one item concerned with having to choose between food and medications because of their costs (see Table 1). Participants indicated whether they had experienced each of the food insufficiency indicators over the previous year to estimate the annual prevalence of food insecurity. The Food Security Scale has been validated in past research in US urban settings and is used by the US Census Bureau.¹²

Health Characteristics We assessed HIV-related symptoms using a previously developed and validated measure of 14 common symptoms of HIV disease.¹³ Participants also indicated whether they knew their viral load and, if so, whether their most recent viral load was detectable or undetectable. We also asked whether their viral load had changed since their previous test. These same items were repeated with reference to CD4 (T-Cell) counts.

HIV Treatment Status and Adherence Participants reported whether they were currently taking HIV treatments and, if so, they were asked to complete a self-report adherence rating scale to assess HIV treatment adherence in the previous month. This measure has demonstrated excellent concurrent validity with objective

TABLE 1 Food insufficiency in the previous year among people living with HIV/AIDS

	Men (N=268)		Women (N=76)		χ^2	p Value
	N	%	N	%		
Food anxiety and meal quality						
I worried whether my food would run out before I got money to buy more.	178	79	48	64	0.1	.56
I couldn't afford to eat balanced meals	157	59	42	55	0.3	.99
I had to choose between paying for medicine or buying food	75	28	24	32	0.4	.66
Food sufficiency						
Did you or other adults in the household cut the size of your meals or skip meals because there wasn't enough money for food	95	35	29	38	0.2	.65
Did you eat less than you felt you needed to because there wasn't enough money for food	113	42	40	53	2.6	.66
Were you hungry, but didn't eat, because you couldn't afford enough food?	84	35	21	28	1.4	.22
Did you or other adults in your household not eat for a whole day because there wasn't enough money for food?	54	20	19	25	0.8	.36
Number of indicators of food insufficiency						
0	133	50	33	43	4.9	.29
1-2	60	22	24	32		
3	36	13	8	9		
4	39	15	12	16		

measures of adherence.^{14,15} The self-report visual analog rating scale asks participants to mark a line at the point showing how much of each drug they have taken in the last month. We used the standard response format of 100 points anchored by 0%, 50%, and 100%. The specific instructions read as follows "We would be surprised if most people take 100% of their medications. On the line below 0% means you have taken no HIV medications this past month, 50% means you have taken half of your medication this past month and 100% means you have taken every single dose this past month. What percent of your HIV medications did you take?" Participants indicated the percentage of medication doses taken by marking a line on the continuum.

Participants also consented to monthly, unannounced telephone-based pill counts, constituting a prospective measure of adherence. Unannounced pill counts are reliable and valid in assessing HIV treatment adherence when conducted in participants' homes¹⁴ and on the telephone.^{16,17} Participants were provided with a cell phone that restricted service for project contacts and emergency use (e.g., 911). Following an office-based training in the pill-counting procedure, participants were called at unscheduled times by a phone assessor. Pill counts occurred over 21- to 35-day intervals and were conducted for each of the ARV medications participants were taking. Pharmacy information from pill bottles was also collected to verify the number of pills dispensed between calls. Adherence was calculated as the ratio of pills counted relative to pills prescribed, taking into account the number of pills dispensed. Two

consecutive pill counts were necessary for computing adherence. Adherence data reported here represents the percentage of pills taken as prescribed, following the initial office-based assessment, averaged across time and ARV medications.

Barriers to Treatment and Adherence We used five items to index whether participants were experiencing common barriers to HIV treatment and treatment adherence. Items included running out of medications prior to getting a refill, experiencing side effects, the cost of medications, and two items concerning transportation. These items were responded to as either Yes or No pertaining to participants' current situation. We also assessed common barriers to care and treatment adherence, including depression, using the 15 cognitive/affective non-somatic depression items from the Centers for Epidemiologic Studies Depression scale, $\alpha=.90$.^{13,18} The Social Support Questionnaire included availability of support and validation of support, responded to on four-point scales, from 1=Definitely true to 4=Definitely false, $\alpha=.90$.¹⁹ Frequency of current alcohol use was assessed with the first item from the Alcohol Use Disorders Identification Test.²⁰ Participants also indicated whether they used marijuana, cocaine, methamphetamine, and other drugs in the previous month. Because frequencies of drug use were low in our sample, we created an index for drug use by summing the number of different nonalcohol drugs that were used in the previous month.

Data Analyses

Descriptive analyses for food security and demographic characteristics were performed using contingency table χ^2 tests for categorical variables and independent t tests for continuous variables. Participants who indicated that they had reduced meals, ate less, went hungry, or did not eat for at least 1 day because food was scarce were defined as food insecure. Food security groups were compared on demographic, health, and treatment variables using logistic regressions. Analyses for CD4 cell counts and viral load were conducted for those participants indicating that they had knowledge of these test results. We tested the association between food security and HIV treatment adherence controlling for other significant correlates. For these analyses, we defined adherence using both 80% and 90% thresholds of medication doses taken as measured by unannounced pill counts. Results from logistic regressions report odds ratios and 95% confidence intervals (95%CI).

RESULTS

A total of 268 men and 76 women living with HIV/AIDS completed the study. The majority (92%) of participants were African American. Forty-two percent of participants identified as gay, 15% bisexual, and 43% heterosexual. Eighty percent of participants reported a monthly income of less than \$1,000, and 83% of participants were unemployed.

Table 1 shows responses to the food security items among men and women. The majority of participants reported worrying about having sufficient food and the quality of food they had eaten. In addition, one in four participants indicated that they have had to choose between buying food and paying for medications in the previous year. Overall, more than half of the sample had experienced insufficient food in the previous year as indicated by at least one standard marker of food sufficiency. Most frequently, participants had eaten less than they felt they needed to

because they did not have enough money for food, and 30% of participants had been hungry but could not eat because they could not afford enough food. As shown in Table 1, there were no differences between men and women on any of the food security items.

Demographic Characteristics and Food Security Comparisons on demographic characteristics of participants who indicated experiencing food insufficiency in the past year and those who did not experience food insufficiency are shown in Table 2. Overall, food insufficiency was related to multiple socioeconomic factors including

TABLE 2 Demographic and health characteristics of food secure and food insecure people living with HIV/AIDS

	Food secure (N=166)		Food insecure (N=178)		OR	95%CI
	N	%	N	%		
Men	133	80	135	76		
Women	33	20	43	24	1.3	0.8–2.1
African American	155	93	162	91	0.8	0.5–1.4
Heterosexual	68	41	78	44	Reference	
Gay	73	44	72	41	0.8	0.5–1.3
Bisexual	25	15	26	15	0.9	0.5–1.7
Unemployed	130	78	155	87	1.9*	1.1–3.3
Looking for work	44	32	84	50	0.5**	0.3–0.7
Income under \$1,000/month	122	77	143	84	0.6	0.3–1.1
Homeless or living in shelter	16	10	27	15	1.7	0.9–3.2
Worried about having a place to live in the past year	53	32	133	75	6.3**	3.9–10.1
Undetectable viral load ^a	87	52	72	40	1.7*	1.1–3.0
Most recent viral load ^b						
Stayed the same	72	44	44	25	Reference	
Increased	27	16	37	20	2.2**	1.2–4.2
Decreased	43	26	54	30	2.1**	1.1–4.6
Most recent T cells ^c						
Stayed the same	25	17	21	14	Reference	
Increased	90	62	72	48	0.6	0.3–1.1
Decreased	30	21	57	38	1.3	0.6–2.9
Currently taking HIV treatments	110	67	98	55	1.7*	1.1–2.5
	M	SD	M	SD	t	
Age	45.3	7.9	43.5	7.7	2.1*	
Education	12.7	1.9	12.5	2.0	1.4	
Years since testing HIV positive	14.2	6.9	12.4	2.3	2.3*	
HIV symptoms	2.9	3.2	5.0	3.8	5.5**	
Most recent CD4 cell count ^c	512.7	316.1	422.3	314.3	2.2*	
Self-report adherence rating	92.7	13.1	84.7	22.5	3.2**	
Unannounced pill count adherence	89.8	14.8	81.4	22.9	2.7**	

* $p < .05$ ** $p < .01$

^a Based on 249 participants who knew their viral load

^b Based on 277 participants who knew of changes in their most recent viral load

^c Based on 275 participants who knew their CD4 cell count

unemployment, currently looking for work, housing security, and younger age. In contrast, gender, sexual orientation, monthly income, and education were not associated with having experienced food insufficiency.

Health Status and Barriers to Treatment Participants who experienced food insufficiency in the past year reported more HIV symptoms, were significantly less likely to have an undetectable viral load, and were more likely to indicate that their viral load had recently changed (see Table 2). Food insufficiency was also associated with lower CD4 cell counts. These differences occurred despite people with insufficient food reporting fewer years since testing HIV positive. Individuals who had experienced food insufficiency were also less likely receiving HIV treatments. Among those who were treated, food insufficiency was related to poorer adherence to prescribed medications on both the self-report rating scale and unannounced pill counts.

Table 3 shows that food insufficiency was associated with nearly every barrier to treatment and treatment adherence. Participants who experienced insufficient food were significantly more likely to run out of medications, to experience side effects, and to report not being able to afford their medications. We also found that food insufficiency was associated with not having transportation, using drugs, experiencing depression, and lacking social support. Thus, the only common barrier to HIV treatment adherence that was not associated with food sufficiency was alcohol use.

Food Insufficiency and HIV Treatment Adherence We conducted prospective logistic regression models predicting HIV treatment adherence over the next 2 to 3 months after the baseline assessment. Two models were tested: the first defined

TABLE 3 Barriers to HIV treatments among food-secure and food-insecure people living with HIV/AIDS

	Food secure		Food insecure		OR	95%CI
	N	%	N	%		
I sometimes run out of my medications before I can get a refill. ^a	18	14	30	28	2.4*	1.2–4.6
I experience side effects from my antiretroviral medications. ^a	46	42	55	56	1.8*	1.1–3.1
I cannot afford the cost of medications. ^b	4	7	19	24	4.2**	1.3–13.1
I was not able to get where I needed to go because I did not have transportation.	53	32	137	77	7.3**	4.5–11.8
I could not get to a clinic or doctor because I did not have transportation.	35	21	102	57	4.9**	3.1–8.0
Current alcohol use ^c	88	53	88	50	0.8	0.7–1.1
Other drug use ^d	45	27	70	39	1.7*	1.1–2.7
	M	SD	M	SD	t	
Depression	9.2	7.8	15.4	8.7	7.0**	
Social support	3.2	0.7	2.8	0.7	5.9**	

* $p < .05$ ** $p < .01$

^a Analyzed for the 110 food secure and 98 food insecure participants taking HIV treatments

^b Analyzed for the 56 food secure and 80 food insecure participants not taking HIV treatments

^c Analyzed for the entire sample

^d Substance use in the past month

adherence as 80% of medications taken, with 23% of participants falling below this threshold; and the second model defined adherence as 90% of medications taken, with 44% of participants falling below this threshold. The models tested factors associated with adherence including years of education, employment status, income, housing status, depression, social support, substance use, and food insufficiency. Results for both models are shown in Table 4, indicating that only two factors significantly predicted adherence over and above the others: alcohol use and food insufficiency.

DISCUSSION

The current study confirms previous research from vastly different settings in North America to show that a significant level of hunger and food scarcity afflicts people living with HIV/AIDS. Most of our participants expressed feeling worried about whether they would have enough food, and 51% had insufficient food in the previous year. One in four participants stated that they had to choose between accessing food or medicine in the past year, and one in four individuals who were both food insecure and not being treated with HIV therapies indicated that they could not afford their medications. These rates of food insecurity mirror the more than half of HIV-positive participants reported in other studies conducted in well resourced cities in the USA and Canada.^{4,8} Food insufficiency among people living with HIV/AIDS across studies is remarkably similar in vastly different samples, circumstances, and social conditions.

We also found that food insufficiency was associated with several HIV-related health markers, including HIV symptoms, CD4 cell counts, and viral load, despite the shorter time that lapsed since the food-insecure group had tested HIV positive. One possible explanation for this pattern of results is that individuals who experience food insecurity also get tested later in the course of their HIV infection. Alternatively, food insecurity and its association with limited treatment access may accelerate HIV disease processes. It is also possible that poor treatment outcomes

TABLE 4 Two multivariate logistic regression models predicting HIV treatment adherence defined as 80% and 90% of medications taken

Variable	<80% Adherence		<90% Adherence	
	Adj OR	95%CI	Adj OR	95%CI
Education	0.9	0.7–1.2	0.9	0.7–1.2
Unemployment	1.1	0.3–3.5	2.3	0.9–6.4
Income < \$1000	0.9	0.3–2.6	0.8	0.3–2.0
Unstable housing	0.6	0.3–1.8	1.8	0.7–4.2
Depression	1.0	0.9–1.1	0.9	0.9–1.0
Social Support	1.4	0.8–2.4	1.6	1.0–2.8
Alcohol use	0.5**	0.3–0.7	0.5**	0.4–0.7
Drug use	2.8	0.9–8.1	1.6	0.6–3.7
Food insufficiency	0.3*	0.1–0.8	0.3*	0.1–0.9

Analyzed for the 208 participants taking HIV treatments

** $p < .01$, * $p < .05$

and illness are themselves barriers to accessing food and precede food insecurity. Unfortunately, our study does not allow for directional or bidirectional interpretation. Food insecurity was associated with multiple barriers to HIV treatment and care including unstable housing, delays in refilling medications, medication side effects, lack of transportation, substance use, depression, and lack of social support. These results paint a constellation of poverty within which food scarcity may serve as a marker for extreme conditions. As demonstrated in previous research,⁸ treatment adherence overrides other factors in predicting outcomes, particularly viral suppression. However, among those with suboptimal adherence, food insecurity was significantly associated with viral non-suppression. Once again, the current study shows that along with alcohol use, food insufficiency predicts treatment non-adherence over and above other factors associated with both poverty and non-adherence. This same pattern of results occurred at two different thresholds of medication adherence. Thus, in addition to the obvious health threats posed by hunger and food scarcity, people living with HIV/AIDS may suffer direct effects of food insufficiency in terms of their HIV-related health and disease progression.

The findings from this study should be interpreted in light of its methodological limitations. With the exception of medication adherence, our study relied on self-reported health and behavior. In addition, all of the measures except for the medication adherence pill count data were collected using a cross-sectional survey. We also used a one-year window to define food insecurity whereas other health indicators were more proximal to the assessment. We do not know how long participants experienced insufficient food or how close in time the experience was to the assessments in this study. In addition, although we assessed multiple socio-economic factors associated with food insufficiency, there are aspects such as nutritional status, body mass, means of finding food, and nutritional quality of food accessed that were not evaluated. Finally, our results are based on a convenience sample of people living with HIV/AIDS in one southern US city. Caution is therefore warranted before generalizing these findings to other populations of people living with HIV/AIDS. With these limitations in mind, the current research has implications for understanding the role of food insufficiency in HIV treatment and disease management.

Our study confirms previous research showing that as many as half of people living with HIV/AIDS in urban centers of developed countries experience hunger and insufficient food. Findings are quite consistent across studies of diverse populations, showing that food insecurity is a significant health threat to people living with HIV/AIDS. Our community-recruited sample of mostly housed people living with HIV/AIDS demonstrated high rates of food insufficiency that were comparable to rates among homeless people living with HIV/AIDS⁸ and substance abuse clients.⁴ Solving all of the problems of the urban poor is certainly daunting given the complexity of intertwined challenges that define poverty. However, our data suggest that merely feeding people can be considered an independent intervention that may have substantial impacts on public health. Food can impede HIV wasting, and eating is necessary for the proper absorption of some ARV medications.^{3,6} In addition, the independent association between food insufficiency and HIV treatment adherence observed in this study demonstrates that providing people with access to food and reducing their alcohol intake may have positive effects on treatment adherence, which in turn will result in improved health benefits. The concept of increasing access to food to improve HIV-related health and treatment adherence was tested in a study conducted with HIV-positive persons in Zambia.²¹ The researchers provided basic

food supplements to people living with HIV and observed improved HIV treatment adherence. Increasing access to food and improving nutrition can, therefore, have a significant impact on the health of people living with HIV/AIDS, including on HIV treatment adherence and on avoiding viral resistance. Expanding access to food for the poor should remain a social and moral imperative as well as public health priority.

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