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Stress and Poverty Predictors of Treatment Adherence among People with Low-Literacy Living with HIV/AIDS

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Abstract

Objective—Emotional distress is among the more common factors associated with HIV treatment adherence. Typical barriers to adherence may be overshadowed by poverty experiences in the most disadvantaged populations of people living with HIV/AIDS, such as people with lower-literacy skills.

Purpose—This study examined the association of social, health and poverty-related stressors in relation to antiretroviral treatment (ART) adherence in a sample of people with low-literacy living with HIV/AIDS in the southeastern US.

Methods—One hundred eighty-eight men and women living with HIV/AIDS who demonstrated poor health literacy completed measures of social and health-related stress, indicators of extreme poverty as well as other factors associated with non-adherence. HIV treatment adherence was monitored prospectively using unannounced pill counts.

Results—Two thirds of the sample demonstrated adherence below 85% of pills taken. Multivariable analyses showed that food insufficiency and hunger predicted ART non-adherence over and above depression, internalized stigma, substance use and HIV-related social stressors.

Conclusions—Interventions for HIV treatment non-adherence with the most socially disadvantaged persons in developed countries should be re-conceptualized to directly address poverty, especially food insufficiency and hunger, as both a moral and public health imperative.

Keywords

HIV/AIDS; Stress; Poverty; Food security; HIV treatment adherence

Introduction

The benefits of antiretroviral therapy (ART) in treating HIV Infection are realized through expanded access and increased uptake of effective drug regimens. While the demand for close adherence varies for different combinations of medications (1–2), as well as the virological status of patients (3), a minimum of 85% adherence remains necessary for optimal clinical outcomes. (2) Previous research has found an array of factors that influence HIV treatment adherence including medication side-effects, depression, stigma experiences, cognitive impairment, and substance abuse. (4–6) Interventions that directly address barriers to adherence have shown promise. (7) For example, research demonstrating that medication side-effects interfere with adherence has led to interventions that emphasize side-effect and

symptom management. (8) In addition, studies have tested interventions for depression and substance use to directly improve ART adherence. (9)

Stress and stressful life events are associated with HIV disease progression which may reflect the effects of stress on treatment non-adherence. (10–12) Leserman et al. (13) found a linear association between the number of stressors experienced and medication non-adherence. Specifically, 22% of patients who experienced no stressors or just one stressor in the previous 2-weeks self-reported non-adherence, whereas 87% of patients reporting six or more stressors missed taking their medications. Overall, for every one stressor reported the odds of missing medications increased by 36%. Similarly, Mugavero et al. (14) found that less than 20% of patients who experienced fewer than five stressful life events were non-adherent to HIV medications while a majority of those who experienced at least 20 stressors were non-adherent. A similar pattern was observed for traumatic life events in relation to non-adherence. Mugavero et al. found that relationship difficulties, threats to personal safety, and life transition stressors were associated with poorer adherence. The role of stress in non-adherence has resulted in stress management and coping effectiveness training becoming one of most common approaches to improving ART adherence. (15)

Research has also identified socio-demographic characteristics related to adherence that are less amenable to change. Poor literacy skills, for example, are closely associated with treatment non-adherence. (16) HIV positive patients with limited reading literacy experience difficulty comprehending medication instructions and are less able to track their daily medication doses. (17–22) Poor literacy skills occur in the context of other obstacles to treatment adherence. For example, Delpierre et al. (23) reported that unemployment was associated with mortality and morbidity over and above delayed diagnosis and treatment status in more than 5000 patients receiving ART. In addition, insufficient food and hunger represent extreme poverty and have been associated with ART non-adherence. (24–26) Thus, poverty is emerging as an important barrier to ART adherence that may be especially prevalent in people with poor literacy skills.

Specific sources of stress such as social, health and poverty related stressors in disadvantaged populations may prove important in addressing HIV treatment non-adherence. We are not aware of previous research that has examined poverty markers as predictors of ART non-adherence in a low-literacy sample of people living with HIV/AIDS. The current study was conducted to fill this gap by testing the impact of poverty markers on ART adherence among people with low-literacy skills. We hypothesized that food insufficiency would predict HIV treatment adherence over and above other stressors as well as factors commonly associated with non-adherence, including depression, internalized stigma, and substance use.

Methods

Participants and setting

Participants were 130 men and 58 women recruited from AIDS service organizations, health care 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 case rate of 23 per 100,000 population, exceeding the average rate of 15 per 100,000 population in other major US cities. (27) We notified AIDS service providers and infectious disease clinics in Atlanta about the study opportunity. Interested persons phoned our research site to schedule an intake appointment. Participants completed verbally administered informed consent. Data were collected between October 2008 and August 2009 and all study procedures were approved by the University of Connecticut Institutional Review Board.

The study entry criteria were (a) age 18 or older, (b) proof of positive HIV status and current use of ART with a photo ID with name matching a current antiretroviral prescription bottle, and (c) scoring below 90% correct on the Test of Functional Health Literacy for Adults (TOFHLA). (28) The TOFHLA consists of three standard reading passages: instructions written for patients receiving an upper gastrointestinal series, the patient rights and responsibilities section of a Medicaid application form, and patient informed consent for surgery. The scale includes 50 multiple-choice items, in which selecting the correct word among four options completes sentences. In accordance with standardized administration procedures the TOFHLA was completed within a 12-minute time limit.

Measures

Psychosocial assessments were administered using audio-computer-assisted structured interviews (ACASI). Participants viewed assessment items on a 15-inch color monitor, heard items read by machine voice using headphones, and responded by clicking a mouse. Research has shown that ACASI procedures yield higher rates of sensitive behaviors and are more reliable than face-to-face interviews. (29) In addition to the self-report measures, a neuropsychological screening test was administered in face-to-face interview, HIV treatment adherence was assessed using unannounced phone-based pill counts. Participant viral load and CD4 cell counts were collected from provider medical records.

Demographic and health characteristics—Participants were asked their age, years of education, income, ethnicity, and employment status. We assessed HIV related symptoms by asking participants to indicate if they had experienced 14 common symptoms of HIV disease. Medication side-effects were assessed in a separate measure asking participants whether they had experienced 12 reactions commonly associated with medication toxicities. (30) Participant's most recent CD4 cell count and viral load test results were obtained from their providers' medical records following consent and signed releases.

ART adherence—Participants enrolled in this study were taking ART and consented to unannounced telephone-based pill counts. Unannounced pill counts are reliable and valid when conducted in participants' homes (31) and on the telephone. (32–33) Unannounced pill counts conducted over the telephone require counting ability but do not require mental calculation. This procedure has been demonstrated valid in people with poor health literacy. (33) All participants were given a free cell phone for completing phone assessments.

At an intake session that included informed consent, participants were trained to count their medications using the following steps after answering the telephone: (a) bring all medications that are in the home to a comfortable flat surface near the telephone, including closed bottles, pocketed doses, and pill boxes; (b) sort medications into clusters; (c) select a medication and tell the pill counter the prescription (Rx) numbers, refill dates, number of refills remaining, and dispensed quantities; (d) report to the pill counter lost or gained pills since their previous count and whether the drug was taken that day; (e) count pills using pharmacist tray and cup provided by the study; if using a pillbox, open each compartment to count the pills without removing them from containers; (f) repeat procedure to double count all pills.

Two pill counts occurred over 21 to 35 day interval and were conducted for each of the HIV medications participants were taking. Adherence was defined by the difference between pills counted at the two consecutive times divided by the pills prescribed, taking into account the number of pills dispensed, pills lost, gained, and taken that day. Stopped medications were adjusted for number of days between the previous pill count and the stop date. Medication refill information, specifically the Rx numbers, filled dates, and remaining number of refills

were used to verify the accuracy of medications dispensed between pill counts. The prospective adherence data reported here represents the percentage of all ART taken as prescribed in the month following the office-based assessment.

Common correlates of treatment adherence—To screen for significant gross perceptual, motor and cognitive dysfunction we administered a standard format of the Clock Drawing Test. Participants were asked to draw the entire face of a clock depicting the time “10 after 11” using standard instructions where the administrator did not repeat the directions. The clock drawing test was scored using a five item procedure demonstrated reliable and valid by Shua-Haim et al. (34). The participant received a score of 1 if their representation fit the description of the item, or 0 if not. The items measured the approximate drawing of a clock face (contour, hands, numbers present), numbers in sequence (no repeats, chronological order), correct spatial arrangement (3 numbers per quadrant), presence of clock hands (2 distinct clock hands), and approximate correct time. Scores ranged from 0 to 5 with lower scores indicating greater impairment.

Emotional distress was assessed with the Centers for Epidemiological Studies Depression Scale (CESD). Participants were asked how often they experienced specific thoughts, feelings and behaviors in the past 7 days, responding *0 = no days, 1 = 1–2 days, 2 = 3–4 days, 3 = 5–7 days*. (35) Participants completed the 20 item full CESD scale. Scores range from 0 to 60 with those greater than 16 suggestive of depression, $\alpha = .85$. In addition, internalized stigma was assessed using seven items on the Internalized AIDS Stigma Scale, representing negative self-perceptions and self-abasement in relation to being a person living with HIV/AIDS. The items reflect Goffman’s (36) dimensions of stigma and focus on self-blame and concealment of HIV status. Example items include: “It is difficult to tell people about my HIV infection”; “I am ashamed that I am HIV positive”; “I hide my HIV status from others”. Items were responded to on a 4-point scale, *0 = not at all, 3 = very much*. The mean response was computed with scores ranging from 0 to 3 and the scale was internally consistent, $\alpha = .86$. To assess substance use, participants also completed the first three items of the Alcohol Use Disorder Identification Test (AUDIT), a self-report instrument designed to identify individuals for whom the use of alcohol places them at risk for developing alcohol-related problems. The first three items of the AUDIT index quantity and frequency of current alcohol use. (37) Participants also indicated if they had used marijuana, cocaine, nitrite inhalants (poppers), amphetamines, any injected drug and any other illicit drugs in the previous 3-months. The number of drugs used was summed to create a drug use index.

HIV-related social and health stressors—Participants were asked whether they experienced 16 HIV-related stressful life events in the previous three months. Eight of the stressors were related to social relations and eight concerned health circumstances. The HIV-related stressors were adapted from previous studies of mental health and HIV/AIDS. (38) Stressors were responded to dichotomously for having occurred (yes/no). Three indexes were created by summing the number of stress experiences; social relations, health, and total HIV-related stress, each internally consistent with alpha coefficients of .72, .70, .78, respectively. For each stress event endorsed, participants also rated the amount of stress they attributed to the experience on a 3-point scale, *0 = no stress, 1 = a little stress, 2 = a lot of stress*. Mean stress severity ratings were computed for the three stress indexes.

Poverty experiences—To measure poverty experiences, we focused on the most basic dimensions of poverty; housing and access to food. For housing, participants were asked whether they were concerned about having a place to stay. For food security, we asked about personal access to food using an adapted version of the US Food Security Scale. (39) We used six of the eight original items that focus on food anxiety, meal quality, and food

sufficiency in the previous year. To reduce participant burden we omitted one item concerning food running out because of its overlap with other items. One item concerning weight loss was omitted to avoid confounding with HIV symptoms. We added one item that asked about having to choose between food and medications because of costs. The poverty experiences were summed to create a poverty index, $\alpha = .86$.

Data analyses

We conducted analyses to examine factors that predicted ART adherence obtained by unannounced pill counts and defined as 85% of pills taken over the subsequent month. Comparisons were made between participants with lower adherence and higher adherence on demographic, health, and behavioral characteristics using bivariate logistic regressions. Based on the bivariate analyses, we tested a multivariable logistic regression model for independent associations between participant characteristics and adherence. The multivariable model included non-redundant factors that were found significant ($p < .05$) in the bivariate analyses and did not overlap directly with treatment adherence, i.e., HIV viral load and health-related stressors. In a sensitivity analysis, the final multivariable model was repeated with adherence defined as 75% of pills taken. Statistical significance for all analyses was defined as $p < .05$.

Results

All participants in the study were retained over the one month of data collection. Among the 188 participants, 55% ($N = 105$) were treated with a protease inhibitor (PI) boosted (pharmacokinetic enhanced) ART regimen (boosted-PI). Also common in our sample were non-nucleoside reverse transcriptase inhibitor-based (NNRTI) regimens ($N = 57$, 30%). Less common were unboosted PI ($N = 14$, 7%), integrase inhibitors ($N = 11$, 6%), and multiple nucleoside/nucleotide reverse transcriptase inhibitor ($N = 5$, 2%) regimens. Across combinations of ART, the median adherence was 77% and the mean was 68% ($SD = 27.8$). A total of 20 (11%) participants had perfect (100%) adherence, 53 (28%) had obtained 90% or greater adherence, 127 (67%) had taken less than 85% and 95 (50%) had taken less than 75% of their prescribed ART in the subsequent month. One in four participants had taken less than half of their prescribed ART. (see Figure 1) Examining adherence within treatment regimens showed that even participants on the most forgiving combinations of ART, boosted PI-regimens, were at risk for viral resistance (Mean = 66.3%, $SD = 27.0$). Lower adherence was associated with poorer viral suppression, lower CD4 cell counts, more HIV symptoms, and more treatment side-effects. (see Table 1).

Common correlates of non-adherence

Results showed that participants with poorer adherence reported more symptoms of depression and greater internalized AIDS stigma. In addition, lower adherence was associated with use of illicit drugs. We did not find adherence related to gross cognitive functioning assessed by the Clock Test or frequency/quantity of alcohol use (see Table 2).

AIDS-related social and health stressors

Analyses of social and health stressors in relation to ART adherence are shown in Table 3. Few individual stressors were significantly associated with adherence and individuals with poorer adherence did not report significantly different total frequencies of stressors. However, poorer adherence was significantly related to experiencing greater severity of social and health stressors.

Poverty experiences

In contrast to social and health stressors, there was a clear and consistent association between markers of food insecurity and ART adherence. Poorer adherence was significantly related to nearly every indicator of food insufficiency including having to choose between food and medications, running out of food, cutting back meals, and going hungry (see Table 4). The summed index of poverty experiences was also significantly associated with non-adherence.

Multivariable models

Table 5 shows the results of the prospective regression model for predicting 85% ART adherence in the subsequent month. Results indicated that only illicit drug use and poverty experiences significantly predicted ART non-adherence. These associations were tested in the sensitivity analysis where adherence was defined by 75% of pills taken. Results showed that illicit drug use was no longer significantly associated with 75% adherence. Poverty experiences were the only factor significantly associated with poorer ART adherence over and above the other factors in the lower-adherence model.

Discussion

Social and health-related stressors were associated with ART adherence. In particular, perceived severity of stressors predicted treatment non-adherence to a greater degree than frequency of stressful events. These findings also add to a growing literature that shows food insufficiency and hunger are significant barriers to ART adherence.(40) Similar to past research, we observed sub-optimal HIV treatment adherence in this sample of lower-literacy people living with HIV/AIDS. (41–42) Nearly two thirds of participants demonstrated adherence below 85% of pills taken, indicating risk for developing resistance to even the most forgiving ART regimens. (1,43) In addition, nearly one in four participants were less than 50% adherent, placing them at great risk for treatment failure and disease progression. However, it should be noted that ART adherence less than 50% is associated with lower risk for treatment resistant viral mutations than adherence between 50% and 95%. (44)

The current findings replicate previous research to show that depression and internalized stigma are associated with medication adherence. In addition, we found that substance use was associated with adherence. Overall, the pattern of results from our bivariate analyses demonstrated previously observed associations in this sample of lower-literacy people living with HIV/AIDS. The multivariable model showed that poverty experiences predicted 85% and 75% treatment non-adherence over and above other factors. These findings demonstrate a strong association between poverty experiences, in particular food insufficiency and hunger with HIV treatment adherence, among socially disadvantaged people living with HIV/AIDS in the US.

The findings from this study should be interpreted in light of the methodological limitations. Our study relied on self-reported emotional distress, stress and behavior. These measures were therefore subject to potential social desirability bias. In addition, all of the measures except for medication adherence were collected at a single cross-sectional time point. We also used standardized measures that had different time frames for depression, stress, and poverty experiences, cautioning against direct comparisons of responses. For example, we do not know if stress and depression coincided and we do not know how long participants experienced stress or how close in time these experiences were to the assessments. Our stress measure was not comprehensive and focused narrowly on health and relationship stressors. Future research that addresses a greater number of stress domains is warranted. 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. Despite these limitations, the current research has implications for understanding factors associated with ART adherence in socially disadvantaged people living with HIV/AIDS.

Our results raise questions about whether cognitive and behavioral approaches to medication adherence will demonstrate long-term benefits in the most disadvantaged populations of people living with HIV/AIDS. Although reducing depression, stigma, and social and health-related stress improves ART adherence in well resourced populations (15), the overwhelming effects of poverty, particularly food insufficiency and hunger, may overshadow the benefits of psychosocial interventions such as stress management. Directly addressing hunger in Africa improves HIV treatment adherence (45) and even though the differences between developing and developed countries are vast, sustained access to food should be considered an adherence intervention in all disadvantaged populations of people living with HIV/AIDS. Beyond a moral imperative, the public health urgency of providing housing and food to people with HIV/AIDS is apparent (46–47) and will likely improve treatment adherence. AIDS treatment and care services require re-examination to reverse the damaging effects of inadequate housing and food insufficiency in people living with HIV/AIDS.

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Abbreviations

ART	Antiretroviral therapy
ACASI	Audio-computer administered self-assessment
AIDS	Acquired immune deficiency syndrome
AUDIT	Alcohol Use Disorders Identification Test
CESD	Centers for Epidemiologic Studies Depression
NNRTI	Non-nucleoside transcriptase inhibitor
PI	Protease inhibitor
TOFHLA	Test of Functional Health Literacy for Adults

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Figure 1.
Distribution of one month prospective ART adherence measured by unannounced phone-based pill counts.

Table 1

Demographic, health, and psychosocial factors in relation to one-month prospective ART adherence.

Characteristic	Less than 85% adherent (N = 127)				85% or more adherent (N=61)				OR	95%CI
	N	%	N	%	N	%	N	%		
Men	89	70	41	67						
Women	38	30	20	33					1.14	0.59–2.20
African-American	118	93	55	90						
White	6	5	4	6						
Other race	3	2	2	3					0.80	0.32–2.02
Income < \$10,000	89	70	43	70						
\$11–20,000	27	21	13	21						
>\$20,000	11	9	5	9					1.01	0.66–1.56
Employed	5	4	3	5					0.87	0.63–1.19
Undetectable viral load	92	76	42	91					0.30*	0.10–0.91
	M	SD	M	SD						
Age	46.1	7.1	47.3	7.1					1.02	0.98–1.07
Years education	11.9	1.9	4.6	1.9					1.00	0.85–1.18
CD4 cell count	433.8	515.4	778.7	1570.5					1.01*	1.00–1.01
Log viral load	2.2	0.9	1.8	0.4					0.43*	0.21–0.92
HIV symptoms	6.9	2.8	5.8	2.7					0.87*	0.77–0.98
Treatment side-effects	5.6	5.1	3.1	3.3					0.87*	0.80–0.94

Note:

* p < .05,

** p < .01

Table 2

Common correlates of ART adherence in relation to one-month prospective adherence.

Characteristic	Less than 85% adherent (N = 127)		85% or more adherent (N=61)		OR	95%CI
	M	SD	M	SD		
Clock Drawing Test	4.3	1.4	4.7	1.2	1.25	0.98–1.58
CESD-Depression	16.6	8.9	11.8	9.2	0.93**	0.90–0.97
Internalized AIDS stigma	0.7	0.6	0.4	0.5	0.52*	0.30–0.91
Alcohol use	5.9	3.7	6.8	3.6	1.07	0.98–1.16
Drugs used	0.6	0.8	0.2	.05	0.41**	0.22–0.75

Note:

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

Table 3

Health and social-related stressors in association to one month prospective ART adherence.

Stressor	Less than 85% adherent (N = 127)			85% or more adherent (N=61)		
	N	%		N	%	
Social-related stress						
Friend was seriously ill	43	34		18	30	0.81 0.42–1.58
Tried to meet new people	78	61		38	62	1.03 0.55–1.94
Experienced discrimination	28	22		10	16	0.69 0.31–1.53
Disclosed HIV to family	26	21		11	18	0.69 0.39–1.86
Disclosed HIV to friend	34	27		15	25	0.89 0.44–1.80
Disclosed HIV to sex partner	34	27		13	22	0.75 0.36–1.56
Started new relationship	22	17		9	15	0.83 0.35–1.92
Ended a relationship	21	16		3	5	0.26* 0.07–0.91
Sum Social Stressors Index (M, SD)	2.3	2.0		1.9	1.7	0.91 0.77–1.07
Health-related stress						
Change in viral load	51	40		19	31	0.67 0.35–1.28
Change in CD4 count	58	46		29	47	1.07 0.58–1.98
Started new medication	20	16		8	13	0.82 0.34–1.99
Had a serious illness	20	16		8	13	0.80 0.33–1.95
Hospitalized	17	13		5	8	0.57 0.20–1.65
Change in health	43	34		10	16	0.38* 0.18–0.82
Changed doctor	22	17		6	10	0.52 0.19–1.36
Change in appearance	39	31		17	28	0.87 0.44–1.71
Sum Health Stressors Index (M, SD)	2.1	2.0		1.7	1.8	0.88 0.74–1.04
Total Stressors Index (M, SD)	4.3	3.4		3.5	2.85	0.91+ 0.83–1.00
Stress Severity Index (M, SD)	0.8	0.5		0.6	0.5	0.54* 0.29–1.01

Note:

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

Table 4

Housing and food insufficiency in association to one month prospective ART adherence.

Experience	Less than 85% adherent (N = 127)		85% or more adherent (N=61)		OR	95%CI
	N	%	N	%		
Worried about having a place to stay	61	48	21	34	0.56	0.30–1.06
Had to choose between paying for food and medications	39	30	8	13	0.34**	0.15–0.78
Ran out of food and had no money for more	85	67	23	38	0.29**	0.15–0.56
Worried about food running out	94	74	26	42	0.26**	0.13–0.49
Cut down quantities or skipped meals to conserve food	44	35	9	15	0.33**	0.14–0.72
Lacked food and ate less than needed	47	37	9	15	0.29**	0.13–0.65
Lacked food and was hungry	30	24	6	10	0.35*	0.14–0.90
Lacked food and did not eat for a whole day	13	10	5	8	0.66	0.26–2.30
Sum of poverty-related stressors (M, SD)	3.3	2.3	1.7	2.1	0.73**	0.62–0.86

Note:

+ p < .06,

* p < .05,

** p < .01

Table 5

Multivariable models testing factors in association to one month prospective adherence defined as 85% and 75% of medications taken.

	< 85% Adherence		< 75% Adherence	
	OR	95%CI	OR	95%CI
Social stressors	0.92	0.73–1.15	0.91	0.74–1.11
Social stress severity index	1.48	0.67–3.23	1.35	0.65–2.82
CESD-Depression	0.95	0.89–1.01	0.99	0.94–1.04
Internalized AIDS stigma	1.07	0.48–2.40	0.51	0.24–1.05
Drug use	0.48 [*]	0.24–0.93	0.65	0.39–1.06
Poverty-related stress	0.72 ^{**}	0.59–0.89	0.74 ^{**}	0.62–0.88

Note:

*
p < .05,

**
p < .01;

< 85% N = 127, ≥ 86% N = 61; < 75% N = 93, ≥ 76% N = 95