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The Association between Health Literacy and HIV Treatment Adherence: Further Evidence from Objectively Measured Medication Adherence

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Abstract

Background—People with lower health literacy are vulnerable to health problems. Studies that have examined the association between literacy and medication adherence have relied on self-reported adherence, which is subject to memory errors, perhaps even more so in people with poor literacy.

Purpose—To examine the association between health literacy and objectively assessed HIV treatment adherence.

Methods—Men and women (N = 145) receiving antiretroviral therapies completed a test of health literacy and measures of common adherence markers. Medication adherence was monitored by unannounced pill counts.

Results—Median adherence was 71%; Participants with lower health literacy also demonstrated poorer adherence compared to individuals with higher literacy. Hierarchical regression showed literacy predicted adherence over and above all other factors. Sensitivity tests showed the same results for 80% and 90% adherence.

Conclusions—The association between literacy and adherence appears robust and was confirmed using an objective measure of medication adherence.

Introduction

Antiretroviral therapy represents the single most important advance in the treatment of HIV infection. Combinations of antiretroviral (ARV) medications dramatically reduce viral burden, improve health and quality of life of people living with HIV/AIDS, and contribute directly to significant declines in HIV-related mortality (1,2). Unfortunately, not everyone who is prescribed ARV therapies realizes their potential clinical benefits. Although a number of factors contribute to HIV treatment failure, inconsistent adherence to therapeutic regimens is one of the most critical factors implicated in suboptimal response to therapy (3–5). Adherence between 80% and 90% of pills taken as prescribed is now recognized as necessary for most HIV treatment regimens to suppress HIV replication (5–6). However, antiretroviral treatment adherence varies widely with as many as one in four HIV positive patients experiencing difficulty maintaining high levels of adherence (7).

Several factors are known to impede medication adherence, including physical side effects, emotional distress, substance use (8), internalized stigma (9), and poor social support (10).

Studies suggest that health literacy is another particularly important predictor of poor HIV treatment adherence. Lower literacy skills are closely related to knowledge and understanding of one's health, adherence to combination antiretroviral therapies, and health status in men and women living with HIV/AIDS (11–15). For example, individuals who miss taking at least one antiretroviral medication in a 2-day period have greater difficulty comprehending simple medical instructions (11–12,16). Graham et al. (17) found that 64% of patients with 9th grade reading levels or greater were taking 95% of their ARVs as indexed by pharmacy refills compared to 40% of patients with less than 9th grade reading. The association between health literacy and ARV adherence appears robust, with health literacy significantly predicting treatment adherence after controlling for HIV symptoms, income level, social support, attitudes toward health care providers, substance use, and even years of education. Adults with poor literacy skills are less likely to have undetectable viral loads, have lower CD4 cell counts, and have more HIV-related symptoms (12).

Antiretroviral treatment regimens require individuals to understand the importance of closely adhering to prescribed medications and the ability to follow dosing schedules. Interventions to increase and maintain adherence have relied on efforts to educate patients about the hazards of non-adherence, teach patients self-reminder skills, and instruct the use of timers, alarms, and other environmental cues. Many techniques used to increase treatment adherence directly rely on reading comprehension skills, such as medication inserts, daily calendars, outlines of meal schedules, reminder notes, daily checklists, condensed schedules, and charts. Although devices used to prompt persons for medication doses do not necessarily rely on reading comprehension skills per se, individuals with lower-literacy skills frequently misinterpret medical instructions and experience difficulty translating medical instructions into actions (18). In addition, memory cues remind individuals when it is time to take medications, but most cues do not specify which medications to take, required doses, dietary instructions, and other information necessary for antiretroviral treatment adherence. Lower-literacy can therefore interfere with the acquisition of information required to understand the importance of treatment adherence and the adoption of adherence strategies.

Previous studies of health literacy and HIV treatment adherence have been hampered by the methods used to estimate adherence. Indeed, nearly all previous studies of health literacy and treatment adherence have relied on patients to recall missed medication doses. Methodological reviews suggest that patient self-reports of medication adherence can be accurate when limited to short-term retrospective periods (19–20). However, no research has examined the reliability of self-reported adherence in lower-literacy populations. Poor reading skills may overlap with cognitive deficits that can interfere with memory and mental calculation necessary for self-reporting medication adherence. It is therefore possible that patients with lower health literacy experience more difficulty recalling their medications, artificially inflating the association between lower literacy and non-adherence.

The purpose of the current study was to examine the relationship between health literacy and objectively assessed HIV treatment adherence. To our knowledge, only one study has previously reported the association between literacy skills and objectively measured medication adherence. Graham et al. (17) used pharmacy refill data as an objective measure of adherence and found that patients with higher literacy were more likely to demonstrate higher levels of adherence, lending support to the association between health literacy and HIV treatment adherence. The purpose of the current study was therefore to extend previous research by examining health literacy and ARV adherence objectively monitored by unannounced telephone-based pill counts. We hypothesized that people with lower-health literacy would demonstrate poorer HIV treatment adherence. We further hypothesized that lower-literacy would predict non-adherence over and above other common markers of ARV

adherence, specifically HIV symptoms, emotional distress, internalized stigma, social support, and alcohol use.

Methods

Participants

Men and women were recruited from AIDS service organizations, health care providers, social service agencies, and infectious disease clinics in metropolitan Atlanta, GA. Recruitment relied on provider referrals and word-of-mouth. Individuals interested in participating in the study phoned or walked into our research program to schedule an office appointment. The study entry criteria were age 18, proof of positive HIV status using a photo ID and matching ARV prescription bottle, and currently taking ARV medications.

Measures

Office assessments were administered using an instructor guided survey procedure. Participants were shown page by page how to complete the study measures by using a projected facsimile of the instruments, assuring that instructions for assessment instruments were carefully described and that participants were given privacy with minimal demand characteristics when responding. Participants who experienced difficulties completing the reading literacy screening test were administered all measures by interview (less than 10%). Participants completed measures assessing demographic and health information, mental health and alcohol use. HIV treatment adherence was monitored using unannounced telephone-based pill counts.

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. Participants were asked if they knew their most recent CD4 count and viral load test results and were then asked if they understood the meaning of their CD4 count and viral load, with responses recorded as understanding the meaning or not understanding the meaning of these health markers.

Health literacy—Health-literacy was assessed using the reading comprehension scale of the Test of Functional Health Literacy in Adults (TOFHLA, 21). The reading comprehension section of 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 4 options completes sentences. In accordance with standardized administration procedures the TOFHLA was completed within a 12-minute time limit. Scores ranged from 0 to 50 correct with the percent correct computed for the total score. We used the TOFHLA to form groups using median scores of 90% correct as the cut-off to define lower/higher literacy (21).

HIV treatment adherence—Participants enrolled in this study were taking ARV medications and consented to monthly unannounced telephone-based pill counts. Unannounced pill counts have been demonstrated reliable and valid in assessing HIV treatment adherence when conducted in participants' homes (22) and on the telephone (23–24). Unannounced pill counts conducted over the telephone require counting ability but no mental calculation. This procedure has been demonstrated valid in people with poor health literacy (23). Following an office-based training in the pill counting procedure, participants were called at an unscheduled time by a phone assessor. Repeated pill counts occurred over

three subsequent 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 and dispensed. Two consecutive pill counts were necessary for computing adherence. Adherence data reported here represents the averaged percentage of all ARV pills taken as prescribed in the four months following the office-based assessment.

Emotional distress, internalized stigma, social support and alcohol use—To assess current emotional distress we administered the Centers for Epidemiological Studies Depression Scale (CESD). Participants were asked how often they felt certain ways in the past 7 days, responding 0 = *no days*, 1 = *1–2 days*, 2 = *3–4 days*, 3 = *5–7 days* (25). Because the somatic depression items on the CESD overlap with HIV-related symptoms (26), we administered 13 cognitive and affective symptoms of depression items to limit confounding depression with HIV disease-related symptoms. Examples of items include the following: I was bothered by things that usually don't bother me, I felt I was just as good as other people (reversed), I felt depressed, I thought my life had been a failure, I felt fearful, I was happy (reversed), I talked less than usual, I felt sad, I felt lonely, I had crying spells, and I felt that people disliked me. Scores on the Cognitive and Affective Depression scale ranged from 0 to 39 and the scale was internally consistent, alpha = .87.

Internalized AIDS-related stigma was assessed using a five item scale focused on self-blame and concealment of HIV status (27). Example items include: Being HIV positive makes me feel dirty; I feel guilty that I am HIV positive; I am ashamed that I am HIV positive. Items were responded to on a 4-point scale 1 = *Strongly Disagree*, 4 = *Strongly Agree*. The scale was internally consistent, alpha = .75. We assessed perceived social support using 13 items drawn from the Social Support Questionnaire (28). The items reflect perceived tangible and emotional support: If I were sick and needed someone to take me to a doctor I would have trouble finding someone (reversed); I feel that there is no one I can share my most private concerns and fears (reversed); and I feel a strong emotional bond with at least one other person. These items were responded to on 4-point scales, 1 = *Completely true*, to 4 = *Completely false*, alpha = .83.

Participants also completed the first three items of the Alcohol Use Disorder Identification Test (AUDIT; 10), 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 were used to index quality and frequency of current alcohol use (29).

Data analyses

We first conducted descriptive analyses for the sample which included comparisons between participants who were defined as lower and higher health literacy. To test our first hypothesis that specified lower health literacy would be associated with poorer HIV treatment adherence, we used logistic regression analyses with lower/higher literacy groups defined as 90% correct on the TOFHLA entered as the dependant variable predicted by clinically relevant levels of treatment adherence. To test our second hypothesis which specified that the lower literacy would predict non-adherence over and above other markers of non-adherence we performed a hierarchical logistic regression with 85% HIV treatment adherence entered as the dependant variable and demographics, health characteristics, emotional distress, internalized stigma, social support, alcohol use, and finally health literacy entered as predictors. We also conducted sensitivity analyses to examine the same hierarchical associations using 80% and 90% adherence as the model dependant variable. We report odds ratios and 95% confidence intervals for each variable tested.

Results

A total of 145 people living with HIV/AIDS receiving ARV therapy participated in this study. The median adherence was 71.1% of pills taken as prescribed and the median TOFHLA score was 90% correct responses. Among the 145 study participants, 100 were men, 44 women, and 1 male-female transgender person. The majority of the sample was African-American (93%) with 6% white, and 1% other ethnicities. The mean age was 44.9 (SD = 6.3) and the mean years of education was 12.3 (SD=2.1). Table 1 shows the characteristics of participants with lower and higher health literacy. As expected, individuals with lower health literacy scores had obtained significantly less education than persons with higher health literacy scores. There were no other differences between groups in demographic and health characteristics.

Also shown in Table 1, participants with lower health literacy were significantly less likely to have taken medications at three different levels of clinically meaningful adherence, 80%, 85%, and 90% of pills taken, confirming our first hypothesis. Table 2 shows the results of the hierarchical logistic regression model which entered (a) demographic and health characteristics, (b) emotional distress, internalized stigma, and social support, (c) alcohol use, and (d) literacy scores as predictors of 85% ARV adherence. The final model confirmed our hypothesis that lower literacy was associated with poorer adherence over and above all other factors entered into the model, including years of education.

Sensitivity analyses using 80% adherence as the dependent variable in the model indicated that greater alcohol use was significantly associated with not achieving 80% ARV adherence, adjusted OR = 0.74, 95%CI 0.57–0.97. Lower literacy was also associated with not achieving 85% adherence, adjusted OR = 3.94, 95%CI 1.63–9.50. The sensitivity analyses for adherence defined as 90% of pills taken showed that only lower-literacy was associated with ARV non-adherence, adjusted OR = 4.96, 95%CI 1.55–15.88.

Discussion

This study confirms previous research that has demonstrated a reliable association between health literacy and self-reported ARV adherence. These findings also replicate the one previous study that used an objective measure of adherence, pharmacy refills to show that health literacy is associated with ARV adherence (17). The relationship between health literacy and ARV adherence therefore appears robust, explaining variance in medication adherence over and above emotional distress, stigma, social support and alcohol use. Importantly, health literacy skills account for non-adherence to ARVs above and beyond years of education, indicating that years of education cannot be considered a reasonable proxy for literacy skills (18). Although the current findings show that low-literacy predicts non-adherence beyond the adherence factors assessed in this study, it is important to note that factors not measured in our study, such as treatment attitudes, may mediate the association between literacy and adherence (9,17). These findings suggest that interventions to improve HIV treatment adherence must be accessible to people with poor reading skills and call for the design of ARV adherence interventions tailored to lower-literacy populations.

The current study findings should be interpreted in light of its methodological limitations. The sample size in the current study was relatively small, reducing statistical power to detect associations among factors. It is therefore possible that with a larger sample we would have seen more significant associations between adherence and the correlates of adherence included in the study. Although our sample was geographically constrained to one US city, the current findings are consistent with previous research conducted in other regions. Like

past studies, the current findings relied on the TOFHLA as the index of health literacy. It is possible that there are unique features of this test that account for the observed associations with adherence. Future research should examine the association between health literacy and objectively measured ARV adherence using alternative literacy assessments. With these limitations in mind, we believe that the current results offer important new information for advancing research and interventions for ARV treatment adherence.

Failure to closely adhere to ARV therapies seriously jeopardizes the potential benefits of HIV treatment advances. Because HIV develops rapid resistance and cross-resistance to ARVs, providers may be reluctant to prescribe combination therapies to patients they believe will not be able to adhere, such as those patients who cannot demonstrate their understanding of dosing schedules. Drug resistance places serious limits on treatment efficacy and non-adherence may pose public health risks through the transmission of drug resistant strains of HIV. The associations we observed between health literacy and treatment adherence may therefore be a best case scenario because patients with the poorest health literacy may represent the least likely to be prescribed antiretroviral medications (30–31). Identifying low-literacy as a factor in poor treatment adherence portends compelling opportunities for interventions to improve antiretroviral adherence. Unlike many of the other factors related to treatment non-adherence such as adverse medication side effects, mental health problems, substance abuse, and cognitive decline, low-literacy can be directly addressed through behavioral interventions aimed to directly improve adherence.

A significant number of people living with HIV/AIDS in this study demonstrated poor ARV adherence at levels indicative of risk for viral resistance. An easy to implement, effective, and low-cost intervention for increasing HIV treatment adherence in lower-literacy populations has the potential to offer significant social and public health benefits. Interventions for lower-literacy populations should break complex skills into simple achievable steps, provide instructions with limited verbal content, and build specific behavioral skills central to the task of taking medication as directed. Recasting adherence interventions aimed at increasing accessibility for lower-literacy populations may increase access and efficacy for all patients. Tailoring existing adherence interventions for lower-literacy populations as well as designing interventions targeted to lower-literacy populations is a public health priority.

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Table 1

Characteristics of people living with HIV/AIDS with lower and higher health literacy.

Characteristic	Lower-Literacy (N = 71)		Higher-Literacy (N = 74)		OR	95%CI
	M	SD	M	SD		
Age	44.5	6.5	45.2	6.1	1.01	0.96–1.07
Education	11.5	2.0	12.9	1.9	1.48**	1.21–1.80
Years since testing HIV+	13.8	6.2	13.2	6.1	0.98	0.93–1.03
HIV symptoms	4.0	3.2	4.7	3.9	1.05	0.95–1.14
Depression	10.9	6.6	8.7	7.8	0.95	0.91–1.00
Internalized stigma	10.3	3.9	9.5	3.5	0.95	0.97–1.03
Social support	35.0	5.2	35.9	5.6	1.03	0.87–1.09
Alcohol score	0.95	1.5	1.4	1.9	1.16	0.96–1.41
	N	%	N	%		
Male	46	65	55	74		
Female	25	35	19	26	0.63	0.31–1.29
	Lower-Literacy (N = 71)		Higher-Literacy (N = 74)			
Characteristic	N	%	N	%	OR	95%CI
Did not know CD4 count	54	76	63	85	0.56	0.23–1.29
Does not understand meaning of CD4 count	28	41	21	28	0.56	0.28–1.13
Did not know viral load	38	54	50	69	0.54	0.27–1.08
Does not understand meaning of viral load	33	49	22	31	0.48*	0.23–0.95
Adherence						
< 80% pills taken	54	78	44	60	2.45*	1.17–5.12
< 85% pills taken	58	84	51	69	2.37*	1.06–5.35
< 90% pills taken	64	91	57	77	3.18**	1.17–8.62

Note

* p < .05,

** p < .01

Table 2
Hierarchical regression predicting 85% ARV adherence from common markers of non-adherence.

Characteristic	Non-Adherent (N = 109)			Adherent (N = 36)			Adjusted	
	M	SD		M	SD		OR	95%CI
Age	44.9	6.5		44.9	5.8		0.98	0.91–1.05
Education	12.3	2.1		12.0	2.1		0.83	0.67–1.05
Years since testing HIV+	13.9	5.8		12.5	7.0		0.97	0.91–1.03
HIV symptoms	4.6	3.6		3.5	3.4		0.88	0.77–1.01
Depression	9.9	7.1		9.3	8.0		1.01	0.93–1.09
Internalized stigma	9.9	3.7		9.9	4.1		0.99	0.87–1.13
Social support	35.6	5.4		35.2	5.5		0.97	0.89–1.06
Alcohol use	1.2	1.8		1.0	1.6		0.87	0.67–1.13
Lower literacy (n, %)	58	53		11	32		3.77**	1.46–9.93

Note:

** p < .01