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Health behavior predictors of medication adherence among low health literacy people living with HIV/AIDS

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Abstract

One particularly vulnerable population for HIV treatment non-adherence is persons with poor health literacy skills. For these individuals, it is important to simplify medication taking as much as possible by integrating medication adherence into other routine health behaviors. The current study aims to ascertain the relationship between medication adherence and other health behaviors. Adults living with HIV (N=422) completed intake measures and three months of unannounced pill counts. Endorsement of diet and exercise behaviors at intake predicted higher medication adherence, over and above other known predictors of medication adherence such as HIV symptoms, depression, social support and stress. These results support integrating strategies for medication management into a constellation of routine health practices.

Keywords

HIV; medication adherence; health behavior; diet; exercise

The AIDS epidemic has slowed worldwide due at least in part to the development of potent antiretroviral therapies (ART). The number of AIDS-related deaths has decreased from 2.3 million in 2005 to 1.6 million in 2012 (UNAIDS, 2010). Stringent randomized controlled trials have shown ART is effective in reducing HIV viral load in turn making adherent individuals healthier and less likely to transmit the virus to sex partners (Cohen et al., 2011). However, despite these treatment advances, adherence to ART remains a significant problem for many people living with HIV. Parienti and collegues (2008) found that gaps in adherence as short as 2 days can cause loss of viral suppression. Additionally, non-adherence or sub-optimal adherence can lead to drug resistance, ultimately causing specific medication regimens to become ineffective (Bangsberg et al., 2004; Chesney, 2003). Thus, in concert with medical advances, there remains a strong behavioral component in maintaining the health of people living with HIV (PLWH).

Although medication adherence is a challenge for many PLWH, one particularly vulnerable population for HIV treatment non-adherence is individuals with poor health literacy skills.

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Health literacy is “a complex phenomenon involving access to and skillful use of health-related information to inform and improve health decision-making, behaviors and outcomes” (Wawrzyniak, Ownby, McCoy, & Waldrop-Valverde, 2013, pp. 295). Several studies have shown a robust relationship between poor antiretroviral adherence and lower reading ability as well as numeral literacy (Kalichman et al., 2008b; Osborn, Davis, Bailey, & Wolf, 2010; Waite, Passche-Orlow, Rintamaki, Davis, & Wolf, 2008; Waldrop-Valverde, 2010). Research has shown that low literacy PLWH are more likely to misunderstand medication instructions leading to missed doses or over dosing (Wolf et al., 2007). Given the challenges posed by low literacy, it is important to make medication taking as simple as possible. One suggestion for achieving this goal is to integrate medication adherence into the everyday health routines of the individual.

Medication adherence has long been recognized as a health behavior much like diet and exercise that can increase or decrease an individual's overall well-being. There are multiple factors underlying the association between all of these health behaviors including conscientiousness, motivation, self-discipline and social support. Nevertheless, randomized controlled trials of adherence interventions often treat other health behaviors as non-contaminating, non-treatment control conditions (For examples see Jemmott, 2008 and Kalichman et al., 2013). However, research has been lacking on the actual relationship between what are assumed to be unrelated health behaviors and medication adherence. Given that some of these health behaviors themselves involve an underlying degree of adherence, the linkage to medication adherence may be quite strong. For example, diet and exercise both depend on substantial adherence to achieve health benefits. The linkages among health behaviors can be conceptualized within a coaction framework. Coaction is the extent to which change in one health behavior may increase the odds of changing a second health behavior (Johnson et al., 2014; Paiva et al., 2012; Prochaska, 2008). Coaction and changing multiple health behaviors can maximize intervention resources as well as decrease overall health care costs (Evers and Quintiliani, 2013). However, before determining if multiple behaviors will facilitate ART adherence coaction, it is necessary to determine which common health behaviors are sufficiently bonded to exert coactivation (Noar et al., 2008).

Several studies have shown fairly consistent predictors of adherence, including HIV symptoms, shame (Konkle-Parker et al., 2008), depression (Springer et al., 2012), social support (Sandelowski et al., 2009) and alcohol use (Azar et al., 2010). These characteristics and behaviors both predict adherence and may serve as benchmarks in comparisons of relative impacts of health behaviors on adherence.

The current study aims to ascertain the relationship between medication adherence and other common health behaviors among people with low literacy skills living with HIV. Positive relationships among distinct health behaviors would suggest an integrative approach to health care messages and unifying medication adherence with related health behaviors to prompt coaction. In the current study, we examined health behaviors within the context of other predictors of adherence to determine the extent of the interdependence of these relationships.

We hypothesized that health behaviors (communication about health, sleep and relaxation, diet and exercise, and vitamins and supplements) would significantly predict medication adherence for people living with HIV who have limited health literacy. Additionally, we hypothesized that health behavior composites would predict adherence over and above other common predictors of adherence.

Methods

Study Overview

The current analyses use data from the three month baseline period of a larger randomized controlled trial that targeted medication adherence for people living with HIV who had limited health literacy (Kalichman et al., 2013). Information regarding demographics and self-reported behaviors were assessed at intake, prior to any intervention activities, via audio-computer assisted self-interview (ACASI). Participants were then followed for three months, also before any intervention, using monthly-unannounced pill counts to assess medication adherence. Participants were compensated for all completed study activities and the University Institutional Review Board approved the study protocol.

Population, eligibility and sample size

This study was conducted in Atlanta, Georgia, an area with a growing HIV epidemic. Georgia has over 41,000 people living with HIV/AIDS (Georgia Department of Public Health, 2012). Participants were recruited from Atlanta-metro area HIV clinics and through word of mouth. Enrollment occurred between November 2008 and April 2011. Eligible participants met the following criteria: (a) being 18 or older, (b) HIV positive status, (c) currently taking antiretroviral medications, and (d) low health literacy as determined by scoring below 90% correct on the Test of Functional Health Literacy in Adults (TOFHLA; Parker et al., 1995).

Measures

Upon enrollment, all participants completed intake measures including demographic information (gender, race/ethnicity, age, income, employment status, education) via ACASI. Additionally, participants completed a variety of measures focused on health and psychosocial variables that previous research has shown to be predictors of adherence. Information regarding participant's health behaviors was collected, as were chart-abstracted viral load and CD4 cell counts. Finally, unannounced pill counts provided objective measures of adherence.

Known predictors of adherence

HIV symptoms: The number of HIV symptoms that a participant was experiencing was assessed by a 14-item scale (adapted from Kalichman et al., 2000). Items consist of common symptoms associated with HIV such as fatigue, sore throat, rashes or bruising, and unintentional weight loss. We calculated a composite using the summation of all 14 items, alpha = .70.

Shame: To assess levels of shame associated with having HIV, participants completed an HIV-related shame measure consisting of ten items (adapted from Persons et al., 2010). Participants were asked about thoughts and feelings over the past 3 months, responses were *0 = not at all, 1= a little bit, 2 = quite a bit and 3 = very much*, alpha = .67.

Depression: The Centers for Epidemiological Studies Depression scale (CESD) was used to assess emotional distress (Radloff, 1977). Participants completed the full 20-item CESD, alpha = 87. Items focused on how often a participant had specific thoughts, feelings and behaviors in the last 7 days. Responses were *0 = 0 days, 1 = 1-2 days, 2 = 3-4 days, 3= 5-7 days*. For this scale, scores range from 0 to 60, with scores greater than 16 indicating possible depression.

Social support: Social support was assessed through the 14-item (adapted from Brock et al., 1996) scale. Items measured tangible, emotional, and informational support. Responses were *1 = completely true, 2 mostly true, 3 = mostly false and 4 = completely false*. Responses were recoded such that higher scores indicate more social support. Possible scores ranged from 14 to 56, alpha = .80.

Stressors: To assess levels of stress, participants completed 17 items focusing on the past 3 months (adapted from Leserman et al., 1999) Participants indicated whether or not each specific event had occurred within the past 3 months. Composite scores ranged from 0 to 17, alpha = .74.

Alcohol use: To assess each participant's level of alcohol use, the first 3 items of the AUDIT, also known as the AUDIT-C. The AUDIT-C has been found valid in various populations (Frank et al., 2008). In our sample, it had acceptable internal consistency (alpha = .77).

Health behavior composites—Each participant reported their engagement in twelve health behaviors engaged in over the previous 3-months, responses were *never = 0, sometimes = 1, and often = 2*. Items were grouped into logical categories to create 4 distinct health behavior composites (Specific behaviors within each composite are shown in the results). Within these composites, health behaviors were intended to represent a heterogeneous grouping of related-practices. First, the communication about health composite contained three items such as “I have asked my doctor questions about my health care in the past 3 months”. Second, the sleep and relaxation composite contained three items including, “I have made time in my day to relax in the past 3 months”. Third, the diet and exercise composite contained three items such as “I have limited my diet to healthy foods in the past 3 months”. Finally, the vitamins and supplements composite was comprised of two items: “I have taken vitamins in the past 3 months” and “I have used food supplements (proteins, wheat germ) in the past 3 months” Use of vitamins and supplements are examined separately. (See Table 2 and Table 3) Alpha coefficients for the composites ranged from .47 to .67, reflecting their intended diversity of behaviors within each composite.

Viral load and CD4 cell counts—Participants were asked to obtain their latest viral load and CD4 cell counts from their health care provider and these records could be no older than 3 months. If the participant was unable to obtain current reports from their health care

provider (less than 5%), blood was drawn by a certified phlebotomist at intake. Health care providers and blood assays use several cut-offs to determine undetectable viral load. For consistency across viral load chart values, we defined undetectable viral load as <50 copies/mL.

ARV adherence—Medication adherence was assessed monthly for 3 months after the intake interview using unannounced pill counts (Kalichman et al., 2008a). Following an in-office training session, every month an adherence assessor called each participant on their study-provided cell phone to count their pills. For each assessment, the assessor asked the participant to gather all of their bottles of antiretroviral medication. The assessor then asked the participant to count the number of pills in each bottle out loud twice. Then using information from the medication bottles (i.e. prescription number, dispense date, dispense amount and dosage information) the assessor calculated adherence for each medication. Pill counts were performed monthly to coincide with dispensing practices and to obtain sufficient pills for stable denominators in the adherence ratio. Adherence is calculated as the ratio of the number of pills taken between phone calls relative to the number of pills prescribed for the period of time between phone calls. To obtain the most stable estimate of adherence, we took the mean of the monthly adherence values.

Statistical Analyses

To be included in the analyses, participants had to complete at least one medication adherence pill count over the 3-months follow-up. Bivariate linear regressions were performed for demographic variables and the known predictors of adherence to determine which characteristics independently predicted adherence. Demographic predictors that were significant at $p<0.05$ were controlled for in subsequent multivariate regressions. Additionally, bivariate linear regressions were performed for each health behavior as well as separately for the four health behavior composite scores. Finally, a multivariate linear regression was performed to examine the relationship between the health behaviors while controlling for known predictors of adherence. Known predictors that were significant in the bivariate regression models ($p<0.05$) were included in the multivariate model.

Results

A total of 437 of participants completed the baseline ACASI and at least one medication adherence pill count. Thirty-seven participants did not complete any pill counts. These participants were compared to those who completed at least one pill count and they were not significantly different on basic demographics or psychosocial measures. However, they did significantly differ on reading ability; participants who did not complete any unannounced pill counts had significantly lower TOFHLA scores (M = 0.60) than those that completed at least one pill count (M = 0.74, $t(36.43) = -2.73$, $p = 0.01$).

The pill counts across the three months demonstrated associations among the adherence values (alpha = 0.70). On average it requires 2.77 attempts to reach participants for their pill counts, (SD = 3.24). The average length of time between calls was 30 days (SD = 8.1). The average adherence across the 3 months of measurement was significantly skewed (skewness = -1.6, SE = 0.12); the mean was 83.46% adherent (SD = 17.55%) and the median was

89.67%. To correct for this skew in the data, the adherence variable was cubed resulting in an acceptable skewness of -0.69, SE = 0.12).

Participant Characteristics

In general, the study sample was largely male, African-American and made $10,000 or less annually (see Table 1). On average, participants were 46 years old (SD = 7.8). The majority of participants were either unemployed or receiving disability, though this was not significantly associated with adherence. Women were significantly more likely to be adherent than men. As expected, higher CD4 cell counts predicted greater medication adherence. There were several psychosocial variables that significantly predicted adherence. Greater shame and less social support both significantly predicted lower adherence. Experiencing more stressful events was related to lower adherence although not significantly. Finally, higher alcohol use significantly predicted lower adherence.

Bivariate Linear Regressions

Bivariate linear regressions were performed for individual health behaviors and separately for their composites (Table 2). The bivariate linear regression for communication about health was significant such that the more an individual endorsed communicating to others about their health the more likely they were to be adherent. The items “I have gathered information on things that affect my health” and “I have discussed my health with friends or family” were both significant.

The sleep and relaxation composite did not significantly predict adherence, however, endorsement of the item “I have avoided stress” was trending on predicting higher adherence. The diet and exercise composite significantly predicted higher adherence. Although all of the items comprising this composite are trending to predict higher adherence, only one, “I have limited my diet to healthy foods,” significantly predicted higher adherence. Finally, vitamins and supplements use did not significantly predict adherence; the two items appeared to have diverging trends such that the item “I have taken vitamins” slightly predicted higher adherence whereas the item “I have used food supplements” was related to lower adherence, although neither significantly.

Multivariate Linear Regression

A multivariate linear regression was performed incorporating known predictors of adherence and health behavior composites (Table 3). Because of the diverging trends seen in the bivariate regression, the two items comprising the vitamins and supplements composite were included separately in the multivariate regression instead of the composite. The model did not exhibit signs of multicollinearity (VIFs 1.03-1.55). When controlling for other variables, being a female predicted higher adherence. Alcohol use was the only known predictor of adherence to remain significant in the multivariate model; Greater use of alcohol predicted lower levels of adherence. HIV shame and social support became non-significant. For the health behaviors, two were significant; greater endorsement of diet and exercise behaviors predicted higher adherence. Finally, endorsement of using supplements showed the opposite relationship; greater use of supplements predicted lower adherence.

Discussion

The major finding in this study was that the diet and exercise composite predicted antiretroviral adherence over and above several established predictors of medication adherence. This relationship was really driven by the diet-focused item “I have limited my diet to healthy foods.” There are several explanations that may account for this relationship. Firstly, diet and medication adherence may share common underlying factors such as discipline, organization, access to basic resources (e.g. food, medication refills) and time management skills. Those who engage in a healthy diet may also be more concerned about their health overall. This may lead to an overall increase in health consciousness and following recommendations both for the management of HIV as well as for general wellness. Additionally, several underlying factors may be driving these relationships. For example, factors deemed to be important in adherence to a diet have also been shown to be important for antiretroviral medication adherence. For example, Burke and colleagues (2006) found that diet self-efficacy was associated with adherence to a diet low in saturated fat. Several studies have also found self-efficacy to be important in antiretroviral adherence (Nokes et al., 2012; Vissman et al., 2011). Thus, many of the same motivations and cognitions can be beneficial or inhibit adhering to different health behaviors. This finding supports a coactivation hypothesis for healthy diet and antiretroviral adherence.

The present analysis also suggests that higher usage of supplements predicted lower adherence. This finding is consistent with research on complementary and alternative medicine (CAM) among PLWH. For example in a cohort of HIV positive women, Owen-Smith and colleagues (2007) found that women who were using CAM, specifically immunity boosters and vitamins, were more likely to report missing one or more doses of antiretroviral medication in the past month. Jernewall and colleagues (2005) also found a similar pattern among HIV positive Latino gay and bisexual men. Given the severity of the consequences of missing ART (Parienti et al., 2008), the implications of dietary supplement use on ART adherence should be a priority of future research.

Turning to the other factors in the analysis, it was unexpected that the only previously known factor of adherence to stay significant in the multiple regression model was alcohol use. This finding provides further evidence of the integral role that alcohol can play in treatment non-adherence (Grodensky et al., 2012). An unexpected finding in these results was that female gender predicted better adherence, which varies from the literature. In a systematic review Puskas and colleagues (2011) found that, in general, female gender often predicts lower adherence. They assert, however, that women are not a homogenous group and specific populations may reverse this trend. Thus, the present results may be considered an exception to the general trend in the HIV adherence literature, possibly due to the overall sample's lower health literacy status. Additionally, women in this study were, in general, middle aged. Thus, they may not have the same demands as younger women with young families. Furthermore, only a small number of women were working at the times of the study, which may have eliminated that demand and increased medication adherence for these particular women.

There are several limitations that should be considered during the interpretation of these results. First, the prospective design of the current study does not allow for examination of these phenomena as a dynamic process. Although the current analysis suggests that health behaviors can predict adherence 3 months later, we were unable to observe the daily interactive roles that these behaviors may play. Future research based on daily processes, such as through daily diaries would provide further detail on these relationships (Tennen et al., 2003; Kahneman et al., 2004). Additionally, the health behaviors focused on in these analyses were neither extensive nor expansive. Health behaviors were limited to twelve general items and responses were limited to three frequency categories (*never, sometimes, and often*). In addition, the behavioral composites only consisted of a few heterogeneous items (3-4 items) (Cortina, 1993; Tavakol & Dennick, 2011). Thus, the current analyses should be interpreted cautiously. Future research should cover a more extensive, detailed set of health behaviors and a more expansive response set to tease apart these relationships. Additionally, the HIV shame measure also had a relatively low Cronbach's alpha (alpha = 0.67). This may have contributed to why this particular known predictor of medication adherence was significant in the bivariate regression but became non-significant when entered into the multivariate regression.

Another limitation of these analyses is that they do not rule out a third, unknown variable that may drive both adherence behaviors and diet behaviors. In addition to the factors discussed previously, high motivation level, better coping skills or personality traits such as conscientiousness may also explain these relationships (Hill and Roberts, 2011; O'Cleirigh et al., 2007; Penedo, et al., 2003). Lastly, these analyses are limited bythe demographic charactistics of the sample. This study focused on a small subset of HIV epidemic. The majority of participants were African-American, middle aged, and heterosexual. Additionally, the trends found here may not translate to higher health literacy PLWH or to other regions of the United States. With these limitations in mind, we believe our results have implications for medication adherence interventions.

The findings in this study support the notion of integrated approaches to adherence. Rather than considering medication adherence as a behavior isolated from other health practices, the relationships between health behaviors should be emphasized to maximize intervention efforts (Evers and Quintiliani, 2013). The concept of coaction should be applied to interventions and further tested in this population. The general trend that diet predicts better adherence in this sample indicates that intervening on diet alone or diet and medication adherence together may result in increased medication adherence (Prochaska, 2008). Additionally, integrated programs may capitalize on common underlying factors that promote adherence to multiple health behaviors. For example, motivational interventions may be used to bolster multiple health practices rather than addressing single practices individually. Integrating medication and diet routines may be particularly useful when simplified as a unitary behavior, particularly for people with lower health literacy. Future research should focus on identifying and capitalizing on factors such as conscientiousness that may underlie multiple health behaviors.

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Table 1

Bivariate linear regressions of study participant characteristics and adherence

Characteristic	N	%	B	SE	β
Gender					
Male	302	69.1			
Female	135	30.9	0.081	0.029	0.133**
Race					
White	18	4.1	(Reference)		
African-American	405	92.7	-0.043	0.052	-0.040
Hispanic or Latino	6	1.4	-0.101	0.116	-0.042
Asian/Pacific Islander	1	0.2	0.138	0.283	0.023
Other	6	1.4	0.141	0.116	0.058
Income					
$0-$10,000	325	74.4			
$11,000-$20,000	79	18.1			
$21,000-$30,000	25	5.7			
Over $30,000	7	1.6	-0.003	0.020	-0.008
Employment Status					
Unemployed	144	33	(Reference)		
Working Receiving	21	4.8	-0.085	0.063	-0.065
Disability Benefits	263	60.2	0.019	0.028	0.033
Student	2	0.5	0.066	0.200	0.016
Other	7	1.6	0.077	0.108	0.034
Viral Load					
Undetectable	249	57			
Detectable	164	37.5	-0.037	0.028	-0.064
CD4 T Cell Count					
Below 200	99	22.7			
Above 200	312	71.4	0.085	0.032	0.129**
	M	SD	B	SE	β

Characteristic	N	%	B	SE	β
Age	46.5	7.8	0.002	0.002	0.054
TOFHLA Score (0-.9)	0.7	0.2	-0.002	0.066	-0.001
HIV Symptoms (0-14)	6.6	2.8	-0.003	0.005	-0.034
Shame (0-30)	9.9	5.1	-0.006	0.003	-0.111*
Depression (0-60)	16.5	10.1	-0.001	0.001	-0.045
Social Support (14-56)	41.1	7.4	0.004	0.002	0.113*
Stress (0-18)	5	3.2	-0.008	0.004	-0.089+
Alcohol (0-12)	1.6	2.3	-0.018	0.006	-0.147**

+ p<0.10,

* p<0.05,

** p<0.01;

Note: data was missing for one participant for the race and income questions; 24 participants had missing data for their viral load; 26 participants had missing data for their CD4 cell count

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Table 2

Health behavior item endorsement for the past 3 months and bivariate linear regression on adherence

Item	M (SD)	B	SE	β
Communication about Health (alpha = 0.57)	***3.83 (1.35)***	***0.027***	***0.010***	***0.128*** **
I have gathered information on things that affect my health	1.20 (0.59)	0.047	0.023	0.097 *
I have asked my doctor questions about my health care	1.53 (0.56)	0.035	0.024	0.069
I have discussed my health with friends or family	1.10 (0.69)	0.045	0.019	0.111 *
Sleep and Relaxation (alpha = 0.61)	***3.83 (1.28)***	***0.014***	***0.011***	***0.064***
I have avoided stress	1.23 (0.54)	0.044	0.025	0.085 +
I have gotten enough sleep	1.27 (0.60)	0.028	0.023	0.060
I have made time in my day to relax	1.33 (0.57)	-0.001	0.024	-0.001
Diet and Exercise (alpha = 0.67)	***4.51 (1.77)***	***0.016***	***0.008***	***0.102*** *
I have exercised to stay healthy	1.11 (0.61)	0.017	0.023	0.036
I have limited my diet to healthy foods	1.11 (0.62)	0.053	0.022	0.114 *
I have watched my weight	1.25 (0.70)	0.023	0.019	0.057
I have eaten a balanced diet	1.09 (0.65)	0.033	0.021	0.077
Vitamins and Supplements (alpha = 0.47)	***1.64 (1.22)***	***-0.004***	***0.011***	***-0.016***
I have taken vitamins	1.05 (0.79)	0.010	0.017	0.027
I have used food supplements (protein, wheat germ)	0.59 (0.71)	-0.023	0.019	-0.057

+ p<0.10,

* *p*<0.05,

** p<0.01

Table 3
Multivariate linear regression predicting adherence

Variables	B	SE	β
Demographics			
Gender	0.076	0.029	0.124**
Known predictors of adherence			
Shame	-0.004	0.003	-0.068
Support	0.001	0.002	0.015
Alcohol	-0.015	0.006	-0.124**
Health behaviors			
Communication about Health Composite	0.017	0.011	0.081
Sleep and Relaxation Composite	-0.005	0.012	-0.024
Diet and Exercise Composite	0.018	0.009	0.114*
Vitamins	0.003	0.018	0.008
Supplements	-0.049	0.021	-0.124*

+ p<0.10,

* *p*<0.05,

** p<0.01