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The Role of Self-Efficacy in HIV Treatment Adherence: Validation of the HIV Treatment Adherence Self-Efficacy Scale (HIV-ASES)

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Abstract

Adherence to HIV treatment, including adherence to antiretroviral (ART) medication regimens, is paramount in the management of HIV. Self-efficacy for treatment adherence has been identified as an important correlate of medication adherence in the treatment of HIV and other medical conditions. This paper describes the validation of the HIV Treatment Adherence Self-Efficacy Scale (HIV-ASES) with two samples of HIV+ adults on ART. Factor analyses support subscales measuring Adherence Integration (eigenvalue = 6.12) and Adherence Perseverance (eigenvalue = 1.16), accounting for 61% of the variance in scale items. The HIV-ASES demonstrates robust internal consistency (ρs > .90) and 3-month (*r*s > .70) and 15-month (*r*s > .40) test-retest reliability. Concurrent validity analyses revealed relationships with psychosocial measures, ART adherence, clinical status, and healthcare utilization. Findings support the use of the HIV-ASES and provide guidance for further investigation of adherence self-efficacy in the context of treatment for HIV and other diseases.

Keywords

HIV; AIDS; Adherence; Self-Efficacy

Introduction

High levels of adherence to antiretroviral therapy (ART) for HIV are critical for treatment success, and in some classes of ART medications, low adherence levels are linked to development of resistant virus (Bangsberg et al., 2006; Paterson et al., 2000). There is a growing body of research aimed at identifying determinants of ART adherence with a focus on developing interventions to reduce nonadherence (Amico, Harman, & Johnson, 2006; Cote & Godin, 2005; Fogarty et al., 2002; Johnson et al., 2003; Simoni, Frick, Pantalone, & Turner, 2003). Among the wide range of factors associated with ART adherence levels is adherence self-efficacy, or confidence in one's ability to adhere to a treatment plan (Bandura, 1989; Bandura et al., 1989). Scores on measures of self-efficacy for specific health behaviors have been linked to outcomes in a variety of medical contexts, including hypertension (Ogedegbe, Mancuso, Allegrante, & Charlson, 2003), asthma (Campbell et al., 2006; Ngamvitroj & Kang, 2006), diabetes (Gerber et al., 2006; Gleeson-Kreig, 2006; Sarkar, Fisher, & Schillinger, 2006), pain management (Gard, Rivano, & Grahn, 2005), and depression (Tonge et al., 2005) and self-efficacy is an important component in many theoretical models of health

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behavior. However, Forsyth and Carey noted a number of problems with the conceptualization and operationalization of scales described as measuring self-efficacy in the HIV prevention literature (Forsyth & Carey, 1998). In the context of HIV treatment adherence, self-efficacy has been reported as a correlate to adherence (Ammassari et al., 2002; Catz, Kelly, Bogart, Benotsch, & McAuliffe, 2000; Fogarty et al., 2002; Gifford et al., 2000; Johnson et al., 2003; Kalichman et al., 2001; Murphy, Greenwell, & Hoffman, 2002; Reynolds et al., 2004), but there is limited psychometric support provided for scales created to measure the construct. Kalichman and colleagues created a pictographic measure to assess ART adherence self-efficacy among low-literacy patients (Kalichman et al., 2005), but there is no published scale to measure broader concepts of HIV treatment adherence among general HIV-infected populations.

Adherence in the context of HIV treatment may be framed more broadly than compliance with ART medication taking. Aside from ART adherence, treatment guidelines call for regular monitoring of HIV progression, which involves regular provider visits. The purpose of this study was to assess the reliability and validity of the Adherence Self-Efficacy Scale (ASES), which was designed to measure self-efficacy for adherence to HIV treatment plans, including but not limited to taking HIV medications. For the purposes of this scale, treatment plans can include anything the individual does to take care of hi/her HIV disease, including taking antiretroviral therapy, nutrition, exercise, etc. The original instrument was developed for use in clinical trials of behavioral interventions related to stress and coping and treatment adherence. In this study, we analyze data from two samples of HIV+ men and women with a focus on evaluating construct validity, reliability, and concurrent validity of the ASES.

Methods

Participants

The analyses presented in this study are based on a total of 3,112 HIV+ participants in one of two behavioral intervention trials: the Balance Project (Study 1, *N*=264) and The Healthy Living Project (HLP; Study 2, *N*=2,848). All participants were on ART, and the Balance Project participants were required to meet a minimum level of self-reported distress associated with HIV medication side effects. The larger HLP sample of 2,848 were taken from screening for the HLP trial in four US cities and the subset of 633 were enrolled in the trial based on sexual risk behaviors, a primary focus of the HLP intervention.

Procedures

HIV+ individuals in the San Francisco Bay Area were screened for recruitment into the Balance Project, a clinical trial of an HIV treatment side effects coping intervention (Study 1). HIV+ individuals in San Francisco, Los Angleles, New York and Milwaukee were screened for inclusion in the Healthy Living Project (HLP), a clinical trial of a comprehensive cognitive-behavioral sexual risk reduction intervention that also included coping skills and treatment adherence intervention modules. Recruitment and screening of potential respondents for both trials were undertaken in community agencies and medical clinics serving HIV+ clients. Brochures, posters, media advertisements and word of mouth were used to recruit respondents. Respondents were at least 18 years of age, provided written informed consent and medical documentation of HIV infection, and were free of severe neuropsychological impairment or psychosis, as assessed by senior project personnel (Gore-Felton et al., 2005; HLP, 2007; Johnson et al., 2003; Weinhardt et al., 2004). The designs of both studies were similar with the following exception. Both studies utilized a wait list control randomized design and Study 1 (which is ongoing) utilized a double baseline design in which baseline assessments are repeated three months after enrollment and prior to randomization. For the purposes of this analysis, no follow-up data are presented on participants post receipt of behavioral intervention, as the

intervention would likely confound the test-retest reliability analyses reported here. Follow-up data on the control group of the HLP sample are included, as these participants did not receive intervention during the period preceding the assessments.

Participant interviews involved Audio Computer Assisted Self-Interviewing (ACASI) and Computer Assisted Personal Interviewing (CAPI) using QDS by Nova Research Company. ACASI allows respondents to listen to items via headphones while reading items on a computer monitor and to enter responses directly into the computer. This approach has been proposed as an effective method of decreasing social desirability and thereby enhancing veracity of self-report (Gribble, Miller, Rogers, & Turner, 1999; Turner et al., 1998). With CAPI, an interviewer reads items from a computer and enters responses directly into the computer. For both studies, adherence outcome and depression data were collected using ACASI and other measures were administered via CAPI.

Measures

Demographics/Background—Detailed background and demographic data included items such as respondent age, race/ethnicity, gender, sexual orientation, relationship status, educational level, employment status, self-reported most recent CD4 count and viral load.

Adherence Self-Efficacy—HIV Adherence Self-Efficacy Scale (HIV-ASES) was assessed with a 12-item scale of patient confidence to carry out important treatment-related behaviors related to adhering to treatment plans, including medication regimen adherence and following plans for nutrition, exercise, etc, in the face of barriers. Reponses range from 1 (cannot do it at all) to 10 (certain can do it). Sample item: “How confident are you that you can stick to your treatment plan when side effects interfere with daily activities?” Item scores were averaged for each respondent with higher scores indicating higher adherence self-efficacy. The items were originally created for use in HIV behavioral trials which include an emphasis on adherence. The individual survey items are shown in Table 2 and the Appendix.

The following measures were identified for inclusion in validity analyses based on expected associations with adherence self-efficacy as supported in the self-efficacy and adherence literatures.

Perceived Stress—The Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983), consisting of a series of 10 statements, assessed the degree to which a person described situations as stressful. A total score is provided by summing ratings on a 5-point scale ($\alpha = .83$).

Illness Intrusiveness—The Illness Intrusiveness Rating Scale (Devins, Armstrong, Mandin, & Paul, 1990) was administered, which measures the degree to which illness and/or treatment interferes with 13 life domains. This self-report measure consists of 13 items with a 7-point Likert response scale ranging from 1 (not very much) to 7 (very much) (α Sample 1 = .85, α Sample 2 = .81).

Social Problem Solving—Social Problem Solving was assessed with the Social Problem Solving Inventory-Revised (SPSI-R; D’Zurilla, Nezu, & Maydeu-Olivares, 2002; T. J. D’Zurilla, Nezu, & Maydeu-Olivares, 2004) a 25-item survey that provides scores for several facets of social problem solving. For the current analyses, we used the following scales: negative problem orientation (NPO; e.g., ”I doubt that I can solve difficult problems no matter how hard I try”), positive problem orientation (PPO; e.g., “I try to see my problems as challenges”), avoidant style (AS; e.g., “I wait to see if a problem goes away before trying to solve it myself”), and rational problem solving (RPS; e.g. “”Before trying to solve a problem,

I set a goal so that I know exactly where I am going"). The measure has been widely used and has been meaningfully predictive of health and risk behaviors (Elliott, Johnson, & Jackson, 1997), including ART adherence (Johnson, Elliott, Neilands, Morin, & Chesney, 2006). (α's =.72−.92).

Depression was assessed with the 21-item Beck Depression Inventory (BDI; Beck, 1967; Beck & Steer, 1984) (α Sample 1 = .85, Sample 2 = .88) which has been widely used in studies with HIV-infected patients to evaluate the severity of depressive symptoms (Griffin & Rabkin, 1997).

Coping Self-Efficacy—General coping self-efficacy was measured with the Coping Self-Efficacy scale (CSE; Chesney, Neilands, Chambers, Taylor, & Folkman, 2006). The CSE measures participants' perceived self-efficacy in coping with psychological challenges and threats. Respondents are asked, "When things aren't going well for you, or when you are having problems, how confident or certain are you that you can do the following?" The questionnaire then lists 13 coping behaviors that tap three distinct dimensions of adaptive coping: problem-focused coping (e.g., "Think about one part of the problem at a time"), emotion-focused coping (e.g., "Take your mind off unpleasant thoughts"), and social support (e.g., "Get emotional support from friends and family"). Respondents endorsed their confidence in carrying out these behaviors on an 11-point Likert scale, ranging from 0 ("Cannot do at all") to 5 ("moderately certain can do") to 11 ("certain can do"). Coefficient alpha values for the first two factors were high (α = .91 for both factors); the alpha for the social support factor was also strong (α = .80).

Social support—The global score on the Social Provisions Scale (SPS; Russell & Cutrona, 1991) was used to assess level, type, and perceived satisfaction with social support from one's social network (α >.70 on all subscales making up the global score). This measure was used because of the social support content of the SECope subscales.

Clinical Status—Immunologic functioning was assessed by self-report for CD4 counts in both studies using guidance from the literature on the validity of self-reported values (Cunningham, Rana, Shapiro, & Hays, 1997; Kalichman, Rompa, & Cage, 2000). Additionally, for a subset of HLP participants who enrolled in the HLP trial, actual laboratory values for viral load were obtained. From these values a dichotomous detectable viral load variable was created (0 = HIV RNA viral load value < 50 copies/ml^3; 1 = HIV RNA viral load >= 50 copies/ml^3).

Healthcare Utilization—Respondents were asked the number of primary care and emergency room visits they attended in the prior three months. We also asked in Study 2 whether respondents had made any additional appointments that they did not go to.

Medication Adherence—Recent self-reported antiretroviral medication adherence was assessed over a three-day period using an adherence survey developed for use in the AIDS Clinical Trials Group (ACTG; Chesney et al., 2000). Respondents indicated how many antiretroviral pills they had skipped during each of the previous three days. This measure has been used widely with diverse samples. For the present study, we calculated dichotomous adherence based on any missed pills (<100% adherent) versus no pills missed in the past three days (100% adherent). In Study 1, we supplemented the ACTG measure with a visual analog scale (VAS) developed by Walsh (Walsh, Pozniak, Nelson, Mandalia, & Gazzard, 2002) that assesses 30-day adherence reporting separately for each drug along a continuum anchored by 0% to 100%. This measure has shown to be correlated with other measures of adherence, such as electronic medication monitors (Oyugi et al., 2004; Walsh, Mandalia, & Gazzard, 2002). For the VAS, the mean percent adherence across all ART medications is derived.

Study 1 Data Analysis

An initial exploratory factor analysis (EFA) of the baseline ASES item responses from Study 1 was conducted to identify a likely factor structure. Factors were extracted using Mplus version 4.2 via maximum likelihood estimation. The number of factors retained was based jointly on an interpretable simple structure of factor loadings (i.e., each factor was strongly and unambiguously associated with its parent factor and no other factors), the number of eigenvalues of the sample correlation matrix exceeding 1.00, and the root mean square residual (RMR) falling below .05 (McDonald, 1985). Confirmatory factor analysis (CFA) using robust maximum likelihood estimation was performed on the follow-up data from Study 1 to explicitly test the factor structure derived from the baseline data. Global CFA model fit was evaluated by a robust chi-square test (Yuan & Bentler, 2000) and the following descriptive fit statistics to compare models: Comparative Fit Index (CFI; Bentler & Bonnett, 1980), Root Mean Square Error of Approximation (RMSEA; Browne & Cudek, 1993), and the Standardized Root Mean Square Residual (SRMR; Hu & Bentler, 1999).

Optimal internal consistency reliability values for the ASES scale and subscales were assessed via Raykov's coefficient ρ; 95% confidence intervals for ρ were computed based on the bias-corrected bootstrap with 5,000 or more bootstrap replications to needed to attain sufficient precision of interval estimates (Raykov, 1997; Raykov & Shrout, 2002). Temporal stability of the ASES' factor structure was evaluated by testing the equality of factor loadings across the two measurements in Study 2 (Steenkamp & Baumgartner, 1998). Test-retest correlations among the latent factors were then computed. After assessing the construct validity and the reliability of the latent factors, we studied the relationship of the factors with existing instruments with known psychometric properties and clinical utility. Concurrent and divergent validity were assessed by correlating latent factors with the established measurement instruments and clinical markers (e.g., detectable viral load) described above.

Study 1 Results

Sample Characteristics—Descriptive information for Study 1 is provided in Table 1. The sample was predominantly White and male, with significant minority representation by Black (18.6%) and Latino (16.3%) participants. Close to three fourths of the participants reported a homosexual orientation (73.9%). An overwhelming majority of participants in this study completed high school (92.4%), yet more than two thirds were not working (69.7%). Two thirds of the sample reported an undetectable viral load. The mean CD4 count across participants was 377.5 with a large standard deviation of 247.9, indicating a wide range of immunologic functioning in this group of research participants.

Construct Validity Analyses—Exploratory factor analyses of the baseline data extracted two factors with eigenvalues greater than 1.00 from the 264 respondents who provided responses to the ASES questions. The first factor (eigenvalue = 6.12) consisted of nine items measuring participants' *integration* of treatment into their daily lives (sample item: "In the past month, how confident have you been that you can integrate treatment into your daily routine?"). The second factor (eigenvalue = 1.16) contained three items measuring participants' beliefs in their ability to remain *perseverant* in adhering to their treatment regimens in the face of HIV-related adversity (sample item: "In the past month, how confident have you been that you can continue with your treatment even when you are feeling discouraged about your health?"). The items and their factor loadings are shown in Table 2. The RMR for this two-factor solution was .047. Loadings of items onto their parent factors exceeded |.50|; secondary loadings were |.35| or lower, with most secondary loadings falling below |.20|. The Integration and Perseverance factors were moderately positively correlated (r = .60).

We next fit a confirmatory factor analysis (CFA) to the follow-up data to assess global model fit of the EFA implied factor structure. The 205 respondents who returned for the follow-up measurement and who provided responses to the ASES items served as the analysis sample. The overall fit of this model was generally good: χ^2(N=205; DF=53) = 89.55, $p < .0001$; CFI = .95, RMSEA = .06, and SRMR = .05. Standardized factor loadings and 95% confidence intervals appear in Table 2. The Perseverance and Integration factors were considerably correlated at $r = .82$ (95% CI = .71, .93). A test of factor structure equality compared a factor analysis model replicating the ASES factor structure across the two measurements with no equality constraints to a more restricted model in which factor loadings were assumed to be equal. The fit of the less restricted model that did not assume equal factor loadings over time was adequate: χ^2(N=264; DF=234) = 436.79, $p < .0001$; CFI = .91, RMSEA = .06; SRMR = .05. By contrast, the fit of the more restricted model that assumed equal factor loadings was comparable: χ^2(N=264; DF=94) = 446.68, $p < .0001$; CFI = .91, RMSEA = .06; SRMR = .06. A chi-square difference test comparing the two models was not significant, χ^2(N=264; DF=10) = 7.33, $p = .69$, indicating that the more restrictive model assuming equality of the ASES factor loadings over time fit the data as well as the less restrictive model that did not make this assumption. Accordingly, we chose the model assuming equal factor loadings as the basis for the test-retest reliability correlations described below.

Reliability Analyses—Global composite internal reliability for the ASES was strong (ρ = .91; 95% CI = .89, .93) at baseline and (ρ = .91; 95% CI = .89, .93) at follow-up. Internal reliability values for the Integration and Perseverance factors are shown in Table 2. Three-month test-retest correlations of latent factors showed strong test-retest reliability for both Integration ($r = .71$; 95% CI = .62, .80) and Perseverance ($r = .71$, 95% CI = .56, .86).

Concurrent and divergent validity—To assess concurrent validity, the latent Integration and Perseverance factors were correlated with the available scale scores described previously in the Methods section. In selecting measures for concurrent validity testing, we identified constructs whose relationships with ASES subscales were consistent with the self-efficacy literature and with the content each subscale was purported to assess. Table 3 provides the correlation coefficients for Integration and Perseverance with the variables of interest. Findings were generally in line with expectations: adherence self-efficacy Integration and Perseverance were positively correlated with self-reported adherence, positive problem solving, coping, social support, and CD4 T-cell counts. Adherence self-efficacy Integration and Perseverance were negatively correlated with skipping medications, negative problem solving orientation, perceived stress, and depression. Of note, Integration and Perseverance factors were negatively associated with the number of primary care appointments reported by participants, suggesting that participants with lower levels of Integration and Perseverance sought medical care from primary care providers more frequently.

Study 2 Data Analysis

The factor structure derived in Study 1 was fitted to the Study 2 data in subsequent CFAs to verify the generalizability of the factor structure. Optimal internal consistency reliability for the ASES subscales was assessed via Raykov's coefficient ρ and test-retest correlations among the latent factors were computed using the same analytic methods as those described above for Study 1. Concurrent, divergent, and predictive validity were also examined using the same methods as were used Study 1.

Study 2 Results

Sample Characteristics—Descriptive information for Study 2 is provided in Table 1. A total of 3,816 individuals participated in Study 2. Of those participants, 968 were not taking ART at baseline, yielding a baseline analysis *N* of 2,848. Of these 936 were enrolled in the

clinical trial and thus were eligible for follow up. Of those, 633 (67.7%) were on ART. Fifteen-month follow up data were available for 523 of the 633 respondents (82.6%) who were on ART at baseline. Of these participants, approximately half (N = 275; 52.6%) were in the lagged control group and had not been exposed to the study's intervention protocol. Of those participants, 43 (15.6%) were not taking ART at follow up, resulting in a total Study 2 follow up sample of 232. In general, sample characteristics from Study 2 paralleled those of Study 1, though Study 2 featured a higher proportion of females (24.5%), Black (48.3%), and heterosexual (43.1%) respondents. Compared with Study 1, fewer Study 2 participants reported an undetectable viral load at the most recent measurement (47.3%), though the mean CD4 self-reported T-cell count for these participants was higher (427.6) than CD4 counts reported by Study 1 participants. A logistic regression of ART usage status at follow-up onto the two ASES factors showed no difference between in the odds of ART usage at follow-up based on Integration (OR = .76; 95% CI = .41, 1.41) and Perseverance (OR = 1.25, 95% CI = .72, 2.17). In the analyses of follow-up data reported below, only the subset of respondents who were on ART at follow-up (N = 232; 84.4%) were considered.

Construct Validity Analyses—Results from the analysis of baseline data indicated satisfactory model fit: χ^2(N=2848; DF=53) = 840.98, $p < .0001$; CFI = .92, RMSEA = .07, SRMR = .04. Results from fitting the same model to the follow-up data yielded similar though somewhat better model fit: χ^2(N=232; DF=53) = 100.24, $p < .0001$; CFI = .95, RMSEA = .06, SRMR = .04. Factor loadings from these analyses appear in Table 2. As was the case in Study 1, the Integration and Perseverance factors were strongly correlated at baseline (r = .84, 95% CI = .81, .86) and at follow-up (r = .85, 95% CI = .75, .95). In general, factor loadings and intercorrelations were very similar across the two samples and within Study 2.

A test of factor loading equality compared a factor analysis model replicating the ASES factor structure across the two baseline measurements from Study 2 with no equality constraints to a more restricted model in which factor loadings were assumed to be equal. Respondents who reported ART use at both measurement points (N = 232) comprised the sample for these analyses. The fit of the less restricted model that did not assume equality of the item loadings over time was adequate: χ^2(N=232; DF=234) = 413.15, $p < .0001$; CFI = .93, RMSEA = .06; SRMR = .05. By contrast, the fit of the more restricted model that assumed measurement invariance of the ASES factor structure was similar: χ^2(N=232; DF=244) = 429.30, $p < .0001$; CFI = .93, RMSEA = .06; SRMR = .06. A chi-square difference test comparing the two models was not significant, χ^2(N=232; DF=10) = 16.21, p = .09, indicating that the more restrictive model assuming equality of the ASES factor loadings over time fit the data as well as the less restrictive model that did not make this assumption. Based on this finding, we selected the model assuming equal factor loadings as the basis for the test-retest reliability correlations described below.

Reliability Analyses—Global composite reliability in the Study 2 baseline data was very similar (ρ = .919; 95% CI = .914, .924) to Study 1's internal reliability values. Internal Reliability for the Study 2 follow-up data was also strong (ρ = .93; 95% CI = .91, .94). Internal reliability values for individual factors are shown in Table 2. Though attenuated in comparison with the three month test-retest reliability examined in Study 1, fifteen month test-retest reliability was satisfactory with r = .49 (95% CI = .35, .63) for Integration and r = .43 (95% CI = .27, .59) for Perseverance. Taken collectively, these findings suggest that the ASES has robust internal consistency and test-retest reliability.

Concurrent and Divergent Validity—Results from correlating Integration and Perseverance adherence self-efficacy factors in Study 2 were highly similar to those from Study 1. These findings are shown in Table 3. Adherence self-efficacy Integration and Perseverance were positively correlated with self-reported positive problem solving, social support, and self-

reported CD4 T-cell counts at baseline. Adherence self-efficacy Integration and Perseverance were negatively correlated with skipping medications, negative problem solving orientation, avoidant problem solving style, perceived stress, depression, and number of primary care appointments. In Study 2, adherence self-efficacy factors were negatively associated with having a detectable viral load at baseline.

Higher standings on the ASES factors were associated with fewer primary care visits in the preceding three months in both samples and fewer emergency room visits in the prior three months of baseline for Study 2 and follow up for Study 1. Primary care visits were dichotomized into two groups (0–2 visits and 3 or more visits) and the mean ASES scores of the two groups were then compared. Across both studies and timepoints, 0–2 visits had higher ASES scores than 3+ visits; results were significant for Study 2 baseline Integration and follow up Perseverance, as well as Study 1 baseline Perseverance (means=7.52 vs. 7.36, p=0.046; means=7.64 vs. 7.06, p=0.004; and means=7.64 vs. 7.06, p=0.03, respectively). Study 2 baseline Perseverance, follow up Integration, and Study 1 follow up Perseverance were marginally significant (means=7.17 vs. 6.97, p=0.07; means=7.53 vs. 7.13, p=0.07; and means=7.65 vs. 7.03, p=0.05, respectively). However, it is unclear the degree to which more advanced disease state accounts for this relationship, as greater number of visits was associated with lower CD4 counts. The same dichotomization of primary care visits was used to compare group means of CD4. For both studies, 0–2 baseline primary care visits had significantly higher mean CD4 counts than 3 or more baseline visits (means=457.3 vs. 338.5, p=0.0005 for Study 1 and means=457.9 vs. 394.4, p<0.0001 for Study 2). For Study 2, 0–2 follow up visits had marginally significantly higher mean CD4 counts than 3 or more follow up visits (means=454.1 vs. 383.3, p=0.06). We also compared ASES scores for those respondents in Study 2 who reported not attending at least one scheduled appointment in the prior three months (n = 1083) with those reporting no missed appointments (n = 1759). There was a significantly higher mean score for both factors for those not reporting missed visits compared to those with missed visits (Integration means 7.71 vs. 7.01; Perseverance means 7.64 vs. 6.66, ps < .0001).

We also explored group differences in mean ASES scores based on gender, race/ethnicity and age. There were no differences in ASES scores by gender in either study, although there was a trend toward lower Integration scores among transgender respondents in Study 2 (means=7.44 vs. 6.65, p=0.04 and means=7.51 vs. 6.65, p=0.03 for males and females vs. transgender, respectively). In both studies, African American respondents reported lower Integration scores than White respondents (means=7.72 vs. 7.26, p=0.004 for Study 1 and means=8.31 vs. 7.47, p<0.0001 for Study 2) and in Study 2, Integration scores were lower for African American respondents than for Latino respondents (means=7.72 vs. 7.54, p=0.005). No differences by race were observed in Perseverance scores. Age had small, but non-significant positive correlations with both ASES factors for the smaller Study 1 sample (r = .09 for Perseverance; r = .08 for Integration). The corresponding correlations were statistically significant larger Study 2 sample, however (r = .15 for Perseverance; r = .12 for Integration, p < .001).

Discussion

Our findings provide solid support for the reliability and validity of the HIV Adherence Self-Efficacy Scale (ASES). The two factors that emerge, Integration and Perseverance, make intuitive sense as aspects of treatment adherence that are within the control of the patient. Failure to integrate treatment into one's life has been identified in prior research as a consistent obstacle to medication adherence (Chesney, 2000; Fogarty et al., 2002; Johnson et al., 2003). Likewise, perseverance in the face of treatment challenges is a consistent theme in the HIV treatment literature that is in line with the motivational requisite for adequate treatment adherence (Fisher, Fisher, Amico, & Harman, 2006).

The ASES factors performed reliably in our investigations. Integration and Perseverance were meaningfully linked to validated measures of related psychosocial constructs as well as indicators of medication adherence, healthcare utilization, and clinical status.

As expected, higher ASES levels were related to lower depression and greater problem solving skills, social support, and general coping self-efficacy. Likewise, greater adherence self-efficacy was associated with rating one's illness and treatment as less intrusive on one's life. Perhaps most importantly, higher levels of both ASES factors were associated with better ART medication adherence at baseline and at follow up on validated measures of ART adherence administered in the two studies. Likewise, higher ASES levels were linked to higher reported CD4 counts and to a lower likelihood of a detectable viral load as confirmed by laboratory assay.

We noted several trends in ASES scores that are consistent with findings in ART medication adherence research. We saw no difference between men and women in their ratings of adherence self-efficacy, which is consistent with published rates of medication adherence across gender. African Americans reported lower scores on ASES Integration but not Perseverance factors, which may help to explain prior findings in which African Americans report lower rates of ART adherence. Likewise, older respondents tended to report higher Integration and Perseverance scores which may also help to explain the correlation of adherence with age seen in the literature.

Adherence self-efficacy may be an important factor in understanding healthcare utilization among people living with HIV. Lower adherence self-efficacy was associated with an increasing likelihood of reporting not attending scheduled healthcare appointments. This association supports our framing of adherence as broader than a narrow focus on following a medication regimen, suggesting that the construct of self-efficacy for adherence applies to appointment attendance and possibly other aspects of treatment. Findings from our samples suggest that lower self-efficacy may be related to higher numbers of primary care appointments and emergency room visits. While the current data do not allow an estimation of how clinically indicated the number of visits reported were, the trends observed in these samples warrant more in-depth investigation. Such patterns of use may represent sporadic and costly utilization of services which may be associated with poorer health outcomes. Alternately, our findings suggest that such high utilization of care may be indicative of more advanced disease status (as indicated by lower CD4 counts) which may correlate with lower adherence self-efficacy. Therefore, it may be that low adherence self-efficacy results in sporadic healthcare utilization (such as ER visits) or that the high demand of frequent care visits indicated by poorer health status leads to poorer adherence self-efficacy.

There are limitations of note in the current study. First, we relied on patients' reporting of key data, including medication adherence. It is possible that more objective measures, including electronic medication adherence monitoring, may have yielded alternative results. Second, our use of convenience samples limits the degree to which our results can be generalized to other populations. Nevertheless, by using a large number and range of recruitment sites, we were able to obtain a sample demographically representative of the HIV epidemic in each subgroup in the US (CDC, 2001). However, due to the relatively small number of women and members of some groups such as Asians and Pacific Islanders, more work is needed to validate the measures in these populations. Third, although our selection of factors was driven by empirical data, it is likely that some aspects of treatment adherence are not captured by our measure. Finally, because most analyses reported in this paper were cross sectional, we cannot determine causal relationships between ASES factors and other variables of interest, such as healthcare utilization and medication adherence over time.

Current findings offer direction for future investigations of the role of adherence self-efficacy on key outcomes. First, prospective studies can determine the causal relationship of ASES scores and medication adherence, healthcare utilization, and clinical outcomes over time. For instance, it is unclear whether more advanced disease status is a cause or an effect of lower self-efficacy for treatment adherence. Of particular value would be an exploration of ASES scores as patients initiate therapy and are followed over time. Second, intervention studies can determine whether and how ASES factors are amenable to intervention and whether a change in ASES scores confers benefit in the form of better treatment adherence over time and resulting improved clinical outcomes. Third, the ASES allows for the quantification of a potential key mediator to explain disparities in treatment access, utilization, and adherence across genders, racial and ethnic groups, and other populations such as substance abusers and the mentally ill. Finally, how ASES factors relate to patterns of healthcare utilization may provide valuable insight into the economics of patient-centered factors such as self-efficacy and the potential cost effectiveness of interventions targeting adherence self-efficacy.

In summary, the ASES demonstrates robust reliability and validity, lending support for its use in HIV treatment adherence research. Higher adherence self-efficacy Integration and Perseverance relate to better reported ART adherence, better psychosocial functioning, and are associated with intriguing patterns in healthcare utilization including a lower likelihood of missing scheduled appointments. The ASES may be a useful tool in research and clinical practice to anticipate and address potential treatment adherence problems. Although developed in the context of HIV treatment, the ASES may lend itself to adaptations for adherence in other disease management contexts.

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Appendix: HIV-ASES Items

I am going to ask you about situations that could occur during your treatment for HIV. Treatment can involve different things for different people. Sometimes, this might refer to taking medications, and other times it could refer to other things that you do to deal with HIV such as diet and exercise or taking vitamins. So, in these questions, when I ask you about your "treatment" or your "treatment plan," I am talking not only about any medications that you might be taking for HIV, but also other things that make up your self-care.

For the following questions I will ask you to tell me in **the past month, including today**, how confident you have been that you can do the following things. Use this response scale ranging from 0 ("cannot do at all") to 10 ("completely certain can do").

[Note: The term "clinic" may be replaced by "doctor's office" if participant does not receive care in clinic settings.]

Cannot do at all	00
	01
	02
	03
	04
Moderately Certain Can Do	05
	06
	07
	08
	09
Completely Certain Can Do	10

In the <u>past month</u>, how confident have you been that you can:

1. Stick to your treatment plan even when side effects begin to interfere with daily activities?
2. Integrate your treatment into your daily routine?
3. Integrate your treatment into your daily routine even if it means taking medication or doing other things in front of people who don't know you are HIV-infected?

4. Stick to your treatment schedule even when your daily routine is disrupted?
5. Stick to your treatment schedule when you aren't feeling well?
6. Stick to your treatment schedule when it means changing your eating habits?
7. Continue with your treatment even if doing so interferes with your daily activities?
8. Continue with the treatment plan your physician prescribed even if your T-cells drop significantly in the next three months?
9. Continue with your treatment even when you are feeling discouraged about your health?
10. Continue with your treatment even when getting to your clinic appointments is a major hassle?
11. Continue with your treatment even when people close to you tell you that they don't think that it is doing any good?
12. Get something positive out of your participation in treatment, even if the medication you are taking does not improve your health?

Table 1

Sample Characteristics

	Study 1 Baseline N = 264	Study 2 Baseline N = 2848[a]	Study 2 Follow up N= 232[b]
Age — mean years (SD)	46.5 (8.1)	42.5 (7.6)	42.3 (7.5)
Gender — n (%)			
Male	227 (86.0)	2110 (74.1)	192 (82.8)
Female	30 (11.4)	699 (24.5)	40 (17.2)
Other	7 (2.7)	39 (1.4)	—
Race/Ethnicity — n (%)			
Black	49 (18.6)	1375 (48.3)	94 (40.5)
White	145 (54.9)	754 (26.5)	79 (34.1)
Latino/a	43 (16.3)	527 (18.5)	39 (16.8)
Other	27 (10.2)	190 (6.7)	20 (8.6)
Sexual Orientation — n (%)			
Homosexual	195 (73.9)	1234 (43.4)	142 (61.2)
Heterosexual	42 (15.9)	1225 (43.1)	63 (27.2)
Bisexual/Other	27 (10.2)	384 (13.5)	27 (11.6)
Education — n (%)			
< HS graduate	20 (7.6)	723 (25.4)	48 (20.7)
HS or more	224 (92.4)	2125 (74.6)	184 (79.3)
Biomarker Viral Load Undetectable — n (%)	—	401 (75.0)	138 (78.4)
Self-Report CD4 count — mean (SD)	377.5 (247.9)	427.6 (292.2)	481.0 (311.2)
Currently Not Working—n (%)	184 (69.7)	2007 (70.7)	160 (69.3)

Notes: Study 1 follow up demographic data are similar to Study 1 baseline data and are not presented to save space. Study 2 follow up data were collected fifteen months after baseline.

[a] Baseline biomarker $N = 535$ for viral load.

[b] Follow-up biomarker $N = 176$ for viral load.

Table 2

Adherence Self-Efficacy Scale: Standardized Factor Loadings and Reliability Coefficients with 95% Confidence Intervals

	Study 1		Study 2	
Factor	**EFA**	**CFA (Follow Up)**	**CFA (Baseline)**	**CFA (Follow Up)**
Integration In the past month, how confident have you been that you can:	.90 (.88, .92)	.90 (.88, .93)	.91 (.90, .91)	.92 (.90, .94)
1. stick to your treatment plan even when side effects begin to interfere with daily activities?	.82	.71 (.62, .79)	.74 (.72, .77)	.85 (.80, .90)
2. integrate your treatment into your daily routine?	.75	.67 (.57, .77)	.77 (.75, .80)	.83 (.77, .89)
3. integrate your treatment into your daily routine even if it means taking medication or doing other things in front of people who don't know you are HIV-infected?	.55	.54 (.44, .65)	.59 (.56, .62)	.58 (.45, .72)
4. stick to your treatment schedule even when your daily routine is disrupted?	.83	.77 (.71, .84)	.77 (.75, .79)	.82 (.76, .87)
5. stick to your treatment schedule when you aren't feeling well?	.74	.77 (.68, .78)	.78 (.76, .80)	.82 (.76, .88)
6. stick to your treatment schedule when it means changing your eating habits?	.52	.68 (.59, .78)	.72 (.69, .74)	.75 (.65, .86)
7. continue with your treatment even if doing so interferes with your daily activities?	.72	.78 (.70, .87)	.82 (.80, .84)	.82 (.75, .88)
10. continue with your treatment even when getting to your clinic appointments is a major hassle?	.52	.79 (.70, .87)	.72 (.69, .75)	.77 (.67, .86)
11. continue with your treatment even when people close to you tell you that they don't think that it is doing any good?	.51	.75 (.68, .84)	.62 (.58, .65)	.67 (.56, .79)
Perseverance In the past month, how confident have you been that you can:	.75 (.67, .81)	.78 (.70, .84)	.79 (.77, .80)	.80 (.74, .85)
8. continue with the treatment plan your physician prescribed even if your T-cells drop significantly in the next three months?	.87	.64 (.52, .76)	.66 (.63, .69)	.69 (.58, .81)
9. continue with your treatment even when you are feeling discouraged about your health?	.52	.92 (.86, .99)	.87 (.85, .89)	.85 (.78, .92)
12. get something positive out of your participation in treatment, even if the medication you are taking does not improve your health?	.52	.53 (.40, .66)	.52 (.48, .55)	.53 (.38, .68)

Note: EFA = Exploratory Factor Analysis; CFA = Confirmatory Factor Analysis. $N = 264$ for Study 1 baseline measures; $N = 205$ for Study 1 follow-up measures; $N = 2848$ for Study 2 baseline measures, and $N = 232$ for Study 2 follow-up measures. Item rows display factor loadings; factor rows display ρ internal consistency reliability coefficients. For CFA loadings and reliability coefficients, lower and upper 95% confidence limits are displayed in parentheses in the following format: (lower limit, upper limit).

Table 3

Concurrent and Divergent Validity Result from Studies 1 and 2.

	Adherence Self-Efficacy Scale Factors			
	Study 1		Study 2	
Validation Scale	**Integration**	**Perseverance**	**Integration**	**Perseverance**
Adherence: Visual Analog Scale (BL)	.46**	.36**	—	—
Adherence: Visual Analog Scale (FU)	.35**	.22**	—	—
Adherence: < 100% (BL)	−.22**	−.19**	−.38***	−.25***
Adherence: < 100% (FU)	.22*	−.10	−.31***	−.19*
SPSI-R: Rational Problem Solving	.22**	.13	.34***	.40***
SPSI-R: Positive Problem Orientation	.18**	.18**	.35***	.39***
SPSI-R: Negative Problem Orientation	−.31***	−.23***	−.36***	−.32***
SPSI-R: Avoidant Style	−.26***	−.13	−.26***	−.23***
CSE: Problem-focused coping	.38***	.33***	—	—
CSE: Emotion-focused coping	.20**	.23**	—	—
CSE: Social support	.18*	.20*	—	—
Perceived Stress Scale	−.27***	−.27***	−.40***	−.35***
Social Provisions Scale	.23***	.26**	.35***	.33***
Beck Depression Inventory	−.22***	−.26**	−.39***	−.36***
Illness Intrusiveness	−.28***	−.27***	—	—
Primary Care Appointments	−.24*	−.25**	−.08**	−.06*
Emergency Room Visits (BL)	−.11	−.14	−.15***	−.11**
Emergency Room Visits (FU)	−.23*	−.11	−.09	−.08
CD4 Self-Report	.23***	.23***	.12***	.09***
Detectable Viral Load Biomarker	—	—	−.17***	−.11**

Notes: All instruments listed were measured at baseline, except for adherence, emergency room visits, and detectable VL, which were measured at both baseline (BL) and follow-up (FU). $N = 264$ for Study 1 baseline measures; $N = 205$ for Study 1 follow-up measures; $N = 2848$ for Study 2 baseline measures, and $N = 232$ for Study 2 follow-up measures.

* $p < .05$;

** $p < .01$;

*** $p < .001$.