

# Revision and validation of the medication adherence self-efficacy scale (MASES) in hypertensive African Americans

Senaida Fernandez · William Chaplin ·  
Antoinette M. Schoenthaler · Gbenga Ogedegbe

Accepted: August 19, 2008 / Published online: September 11, 2008  
© Springer Science+Business Media, LLC 2008

**Abstract** Study purpose was to revise and examine the validity of the Medication Adherence Self-Efficacy Scale (MASES) in an independent sample of 168 hypertensive African Americans: mean age 54 years ( $SD = 12.36$ ); 86% female; 76% high school education or greater. Participants provided demographic information; completed the MASES, self-report and electronic measures of medication adherence at baseline and three months. Confirmatory (CFA), exploratory (EFA) factor analyses, and classical test theory (CTT) analyses suggested that MASES is unidimensional and internally reliable. Item response theory (IRT) analyses led to a revised 13-item version of the scale: MASES-R. EFA, CTT, and IRT results provide a foundation of support for MASES-R reliability and validity for African Americans with hypertension. Research examining MASES-R psychometric properties in other ethnic groups will improve generalizability of findings and utility of the scale across groups. The MASES-R is brief, quick to administer, and can capture useful data on adherence self-efficacy.

**Keywords** Scale validation · African Americans · Self-efficacy · Medication adherence · Hypertension

---

S. Fernandez (✉) · A. M. Schoenthaler  
New York University School of Medicine, VA New York  
Harbor 423 E. 23rd St., 15-167AN, New York, NY 10010, USA  
e-mail: Senaida.Fernandez@nyumc.org

W. Chaplin  
St. John's University, Queens, NY, USA

G. Ogedegbe (✉)  
New York University School of Medicine, VA New York  
Harbor 423 E. 23rd St., 15-168, New York, NY 10010, USA  
e-mail: Olugbenga.Ogedegbe@nyumc.org

## Introduction

Hypertension (HTN) affects over 65 million individuals in the United States and remains one of the major chronic diseases contributing to the racial mortality gap between African Americans and whites (American Heart Association 2006). Compared to whites, African Americans have a higher prevalence of HTN, with approximately 40% compared to 28% in whites (Centers for Disease Control Prevention 2005). However, HTN is controlled in only 30% of African Americans compared to 35% of whites (Hertz et al. 2005). Poor medication adherence is a major contributing factor to poor blood pressure (BP) control with an estimated 50–70% of hypertensive patients reporting poor adherence rates (World Health Organization. 2003). African Americans have poorer rates of medication adherence compared to whites and this may account for the disproportionately higher rates of hypertension-related outcomes in this patient population (Bosworth et al. 2006; Burt et al. 1995; Kirscht and Rosenstock 1977; Monane et al. 1996). Several behavioral models have been proposed to explain adherence behavior, but the one that has received the most attention in the literature is the social cognitive model (Bandura 1977a, 1977b). One component of this model that has been shown to predict initiation and maintenance of recommended health behaviors is Bandura's construct of self-efficacy (Bandura 1977a, 1977b; Strecher et al. 1986).

Self-efficacy refers to an individual's judgment of his or her confidence to carry out a specific task in order to produce a desired outcome (Bandura 1977a, 1977b). The stronger one's self-efficacy beliefs, the more likely a person will initiate and maintain recommended health behaviors (Bandura 1977a, 1977b). In patients with chronic diseases, positive self-efficacy appraisals have been found to consistently predict the adoption of, and adherence to a

variety of health-related behaviors including dietary recommendations, exercise regimens, self-management behaviors, and adherence to antiretroviral therapies (Allegrante and Marks 2003; Catz et al. 2000; Gifford et al. 2000; Johnson et al. 2006; Lorig et al. 1989; Nakahara et al. 2006; Strecher et al. 1986). Nakahara and colleagues used structural equation modeling to examine the relationship between psychosocial factors and glycemic control in a sample of 256 Japanese patients with Type 2 diabetes. Their analysis found that self-efficacy predicted adherence, and adherence in turn predicted future levels of glycemic control. Self-efficacy also served as a mediator for the relationship between psychosocial variables (e.g. social support, emotion focused coping) and glycemic control (Nakahara et al. 2006). In a study of mediational role of adherence self-efficacy on the relationship between positive provider interactions and medication adherence, analyses of self-report data for 2765 HIV infected patients on antiretroviral therapy found that adherence self-efficacy was indeed a significant mediator. Further, this pattern remained in stratified analyses based on race, gender, injection drug use history, and specialty care for HIV (Johnson et al. 2006). Similarly, a recent examination of 174 patients with chronic kidney disease found that higher perceived self-efficacy was associated with greater medication adherence behaviors and self-management behaviors in general, while controlling for confounding demographic variables and health characteristics (Curtain et al. 2008).

However, despite evidence documenting the importance of self-efficacy in influencing health behaviors in patients with chronic diseases, little is known about its role in hypertensive African Americans. To address this issue, we developed and evaluated the reliability of a Medication Adherence Self-Efficacy Scale (MASES) in hypertensive African American patients (Ogedegbe et al. 2003). The MASES is a patient derived, self-report measure designed to assess efficacy beliefs regarding adherence to prescribed anti-hypertensive medications. Preliminary support for the internal consistency and test-retest reliability of the MASES was demonstrated in a sample of 72 hypertensive African Americans (Ogedegbe et al. 2003).

In this study, we conducted further psychometric evaluation and revision of the MASES in a larger independent sample of hypertensive African Americans. This study had five objectives: (1) assessment of the unidimensionality of the MASES; (2) evaluation of internal consistency using classical test theory (CTT) and estimates of item parameters and item information functions using item response theory (IRT); (3) scale refinement; (4) CTT and IRT evaluation of the items on the revised scale; (5) assessment of its criterion validity (predictive and concurrent) with self-report and electronic measures of medication adherence.

## Methods

### Study design and participants

Data for this study were collected as part of a larger trial designed to evaluate the effects of a behavioral intervention on medication adherence in a group of hypertensive African Americans followed in a community-based primary care practice. Detailed information on the study design and methods of the larger study are outlined elsewhere (Ogedegbe et al. 2007). Eligible patients were identified via electronic medical records (EMR) using the following criteria: hypertension diagnosis; self-identification as black or African American; age 18 years or older; fluency in English; and taking at least one antihypertensive medication. All patients were approached during their regular clinic visits and asked to participate in the study. They were required to sign informed consent for participation in the trial, which was approved by the institutional ethics review board of Columbia University Medical Center.

### Data collection

Upon enrollment into the trial, trained research assistants conducted baseline assessments on all patients. All baseline and three month data were collected prior to randomization and delivery of the behavioral intervention, as an effective behavioral intervention focusing on adherence would have confounded responses to questions regarding self-efficacy for adherence. Study participants completed the MASES questionnaire and a self-report measure of medication adherence at baseline and 3 months. In addition, they were given an electronic pill bottle cap fitted on a pill bottle in order to monitor their adherence to prescribed antihypertensive medications for the study duration. Patients were taught to use the electronic pill bottles and asked to put their antihypertensive medications in them. Additional data collected included demographics; insurance status; socioeconomic status.

### Measures

*Self Efficacy* was assessed with the MASES (Ogedegbe et al. 2003). This is a 26-item scale that is used to assess patients' confidence in their ability to take their antihypertensive medications in a variety of situations. Some examples of situations include "when busy at home," "while at work," "when they cause some side effects." Items are scored from 1 (*not at all sure*) to 4 (*extremely sure*) and a total score on the measure is computed by averaging across responses to all items. Higher scores

indicate a greater level of self-efficacy. Cronbach's alpha for the measure was 0.95.

*Self-report medication adherence* was assessed with the well-validated four-item scale developed by Morisky et al. in a primarily African American sample of 400 hypertensive patients with uncontrolled blood pressure (Morisky et al. 1986). It asks patients to respond "yes" or "no" to the following questions: "Do you ever forget to take your medicine?" "Are you careless at times about taking your medicine?" "When you feel better do you sometimes stop taking your medicine?" and "Sometimes if you feel worse when you take the medicine, do you stop taking it?" Respondents were categorized into a dichotomous "adherent" category if they responded "no" to all items, and into the "non-adherent" category if they responded "yes" to one or more items.

*Electronic measure of medication adherence* was assessed with the Medication Event Monitoring System (MEMS; Aprex, a division of Aardex Corporation, Union City, CA). This consists of a pill bottle and an electronic cap which utilizes microchip technology to record each time that the pill bottle is opened and closed. Data are downloaded to a computer directly from the cap using Powerview software (Aprex, a division of Aardex Corporation, Union City, CA; [www.aardexgroup.com](http://www.aardexgroup.com)). Medication adherence was defined as the ratio of number of doses taken to number prescribed for the study duration. MEMS caps have been used in multiple studies, and evidence of the validity of the system comes through findings of good to high concordance with self-report measures, pill counts, and nurse reports of medication adherence in multiple samples (Choo et al. 1999; Hugen et al. 2002; Liu et al. 2001). The MEMS is currently considered the gold standard for adherence measurement (Choo et al. 1999; Hugen et al. 2002; Liu et al. 2001).

#### Analytic overview

We first evaluated the unidimensionality of the MASES using both confirmatory (CFA) and exploratory factor (EFA) models. The MASES was hypothesized to have a single factor structure. Thus, the model outlined for the CFA analysis included 25 MASES items that were administered as observed variables, which load on a single latent variable of "Medication Adherence Self-Efficacy". Goodness-of-fit statistics were calculated as part of the CFA, and as is conventional, several of these were used to evaluate model fit, including the chi-square statistic, Comparative Fit Index (CFI), Tucker Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA) (Bollen 1989; Cudeck and Browne 1992; Hu and Bentler 1999). A well-fitting model is suggested by a chi-square with a  $p$ -value  $>0.05$  (Bollen 1989); CFI or TLI

values  $>0.90$  (Hu and Bentler 1999); and an RMSEA values  $<0.05$  (Cudeck and Browne 1992; Hu and Bentler 1999). Structural equation modeling (SEM) software was used to evaluate the one-factor CFA model.

The EFA analyses included oblique rotation, and produced eigenvalues, item factor loadings, and significance of factor loadings in order to evaluate the unidimensionality of the measure. An eigenvalue of greater than 1.0 indicates a factor that explains a moderate amount of variance; a minimum acceptable factor loading is defined as .32 or higher, with .50 and above indicating strong loading; and  $p$ -value of  $<0.05$  indicates a significant factor loading for an item (Tabachnik and Fidell 2001). In order to produce a stable factor structure, guidelines suggest that a minimum subject-to-item ratio of between 5:1 (Gorsuch 1983) and 10:1 (Nunnally 1978), and minimum sample sizes of 100–200 (Guaagnoli and Velicer 1988) are utilized in EFA analysis. We hypothesized that a valid measure would have similarity in factor structure over time, and utilized the MASES data from baseline and 3-months in order to test this hypothesis.

We then evaluated the corrected item total correlations, item means and coefficient alpha in a classical test theory (CTT) analysis and finally, we estimated the 2 parameter item characteristic curves and item information functions using Samejima's graded response model (Samejima 1969). The assumption of unidimensionality is critical for both CTT and item response theory (IRT) based scale evaluations. Based on these analyses we revised and shortened the MASES by removing items that were found to provide little information about a patients' adherence self-efficacy. We examined items at both baseline and 3-month time points, and allowed retention of items that performed well in at least one time point. As this study provides an initial examination of item characteristic curves for MASES, an approach such as this allows for future replication of these analyses in independent samples and further evidence-based scale refinement.

Predictive and concurrent validity of the revised MASES (MASES-R) was subsequently evaluated in three ways: (1) differences in mean MASES-R scores among self-reported adherent and non-adherent groups at baseline, (2) correlation between 3-month MASES-R and 3-month MEMS, (3) correlation between baseline MASES-R scores and 3-month MEMS.

As there were complete data for the MASES in this sample, no imputation methods were utilized. The Statistical Package for the Social Sciences (SPSS) version 13.0 was used for CTT and EFA analyses (SPSS 2004), M-plus was used for the CFA analysis, and the IRT analyses were conducted with MULTILOG (Thissen 2003).

## Results

### Patient characteristics

Characteristics of study participants are shown in Table 1 for the 168 participants that provided complete baseline and 3 month data. Their average age was 54 years (SD = 12.36) with 86% female. More than two-thirds had either high school or college education.

### CFA and EFA analyses

Results of the CFA indicated that the observed correlations among the items were not well-described by a one-factor (unidimensional) model,  $\chi^2_{275, N=190} = 942.27, p < .01$ ; CFI = .72; TLI = .69; RMSEA = .11 (90% CI = .10, .12). Subsequently, model modification indices were examined to determine whether changes to the model would improve fit. The analysis did not reveal any meaningful changes, therefore, EFA was used to further examine factor

**Table 1** Participant characteristics ( $n = 168$ )

| Characteristic                       | Value              |
|--------------------------------------|--------------------|
| Age ( $\pm$ SD)                      | 54 ( $\pm$ 12.36)  |
| Female                               | 86%                |
| Education                            |                    |
| Elementary or Junior High School     | 23%                |
| High School                          | 43%                |
| Some College or more                 | 34%                |
| Income                               |                    |
| Unknown                              | 16%                |
| <20K/year                            | 62%                |
| >20K/year                            | 22%                |
| Employment status                    |                    |
| Not employed                         | 54%                |
| Employed                             | 23%                |
| Retired                              | 11%                |
| Disability                           | 12%                |
| Insurance status                     |                    |
| Medicare                             | 13%                |
| Medicaid                             | 71%                |
| HMO                                  | 8%                 |
| Self                                 | 8%                 |
| Number of comorbid conditions        |                    |
| Unknown                              | 1%                 |
| 0                                    | 19%                |
| 1–2                                  | 32%                |
| 3–4                                  | 17%                |
| $\geq$ 5                             | 31%                |
| Diastolic blood pressure ( $\pm$ SD) | 86 ( $\pm$ 11.18)  |
| Systolic blood pressure ( $\pm$ SD)  | 144 ( $\pm$ 18.11) |

structure of the MASES. The principal components EFA analysis revealed five factors with eigenvalues  $>1.0$  at both baseline and 3 months. At baseline, 19 items loaded on the first factor, which had the highest eigenvalue and explained the most variance (37.93%). There was a considerable drop in eigenvalue from the first factor with a value of 9.48 to 1.83 for the second factor. The percent variance explained by the first factor as well as the large drop in eigenvalues from first to second factor and beyond meets established criteria for the “essential” unidimensionality of the scale (Lord 1980). A similar pattern was noted for the 3-month data. These results supported the essential unidimensionality of the MASES and justified proceeding with both CTT and IRT analyses. See Table 2 for eigenvalues and percent variance explained and Table 3 for individual item factor loadings.

### CTT evaluation

Mean scores on individual MASES items are shown in Table 4. Total MASES score for this sample was 3.50 (SD = .46) at baseline and 3.57 (SD = .46) at 3 months. Reliability of the MASES was assessed through evaluation of internal consistency at baseline and 3 months, and its stability over the same time period. Cronbach’s alpha for the measure was .91 at both time points,  $p < .05$ , suggesting that the MASES is an internally reliable measure. The test-retest coefficient of 0.56 between baseline and 3 months,  $p < .05$ , indicated that there was some instability across a three month period. This instability may be temporally attributed, as test-retest analyses are usually conducted on data collected within a two-week window. See Table 4 for results of additional item level analysis, including item-to-total correlations.

### IRT evaluation

Item information curves were examined for all items at baseline and 3 months. Examination of the curves allowed for elimination of items that provided little information about the underlying construct of adherence self-efficacy (i.e. those items that did not perform well at either time point). An item was retained if item information curves

**Table 2** Results of MASES EFA: baseline and 3 month samples

| Factor | Eigenvalue |         | Variance explained (%) |         |
|--------|------------|---------|------------------------|---------|
|        | Baseline   | 3 Month | Baseline               | 3 Month |
| 1      | 9.48       | 9.44    | 37.93                  | 37.75   |
| 2      | 1.83       | 2.02    | 7.31                   | 8.08    |
| 3      | 1.79       | 1.90    | 7.14                   | 7.61    |
| 4      | 1.45       | 1.46    | 5.80                   | 5.85    |
| 5      | 1.01       | 1.39    | 4.05                   | 5.56    |

**Table 3** MASES item loadings and results of IRT analyses

| Items  | EFA analyses    |            | IRT analyses   |
|--|-----------------|------------|----------------|
|  | Factor loadings |            |                |
|  | Baseline        | 3 Month    | Items retained |
| <i>Confidence in taking medications:</i>                           |                 |            |                |
| 1. When you are busy at home                                       | <b>.75</b>      | <b>.66</b> | *              |
| 2. When you are at work  | .44             | <b>.54</b> |                |
| 3. When there is no one to remind you                              | <b>.69</b>      | <b>.68</b> | *              |
| 4. When they cause some side effects                               | .32             | .35        |                |
| 5. When you worry about taking them for the rest of your life      | <b>.63</b>      | <b>.59</b> | *              |
| 6. When they cost a lot of money                                   | <b>.53</b>      | <b>.50</b> |                |
| 7. When you come home late from work                               | .42             | <b>.46</b> |                |
| 8. When you do not have any symptoms                               | <b>.65</b>      | <b>.67</b> | *              |
| 9. When you are with family members                                | <b>.75</b>      | <b>.71</b> | *              |
| 10. When you are in a public place                                 | <b>.73</b>      | <b>.71</b> | *              |
| 11. When you are afraid of becoming dependent on them              | <b>.50</b>      | <b>.66</b> |                |
| 12. When you are afraid they may affect your sexual performance    | <b>.57</b>      | <b>.57</b> |                |
| 13. When the time to take them is between your meals               | <b>.75</b>      | <b>.65</b> | *              |
| 14. When you feel you do not need them                             | <b>.53</b>      | <b>.66</b> |                |
| 15. When you are travelling  | <b>.74</b>      | <b>.69</b> | *              |
| 16. When you take them more than once a day                        | <b>.66</b>      | <b>.82</b> | *              |
| 18. If they sometimes make you tired                               | .43             | <b>.50</b> |                |
| 19. When you have other medications to take                        | <b>.77</b>      | <b>.67</b> | *              |
| 20. When you feel well   | <b>.73</b>      | <b>.75</b> | *              |
| 21. If they make you want to urinate while away from home          | <b>.63</b>      | <b>.58</b> | *              |
| <i>Confidence in ability to carry out the following tasks:</i>     |                 |            |                |
| 22. Get refills for your medications before you run out            | .46             | .30        |                |
| 23. Make taking your medications part of your routine              | <b>.66</b>      | <b>.66</b> | *              |
| 24. Fill your prescriptions whatever they cost                     | .49             | .44        |                |
| 25. Always remember to take your blood pressure medications        | <b>.63</b>      | <b>.66</b> |                |
| 26. Take your blood pressure medications for the rest of your life | <b>.61</b>      | <b>.56</b> |                |

Note: Bolded values indicate significant loadings

suggested that it performed well at one time point, or both time points. Ten items performed well at both time points, while 3 performed well at one time point. This process resulted in retention of 13 items that make up the shortened revised version of the scale, the MASES-R. See Table 3 for item content.

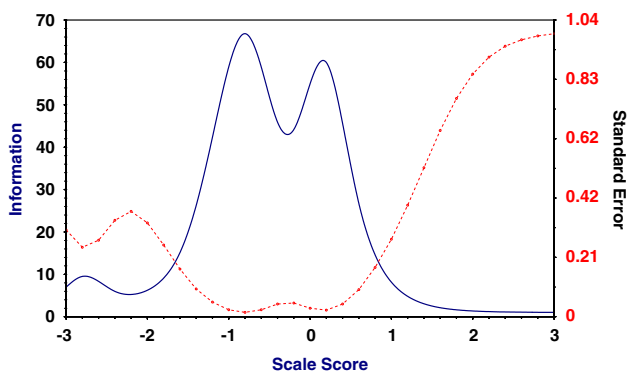
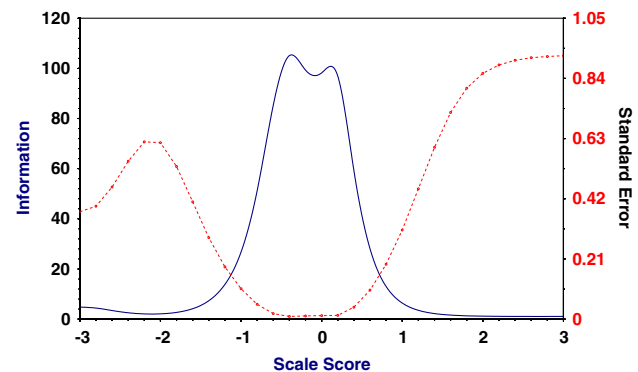
MASES-R CTT and IRT evaluation

The psychometric properties of the shortened revised MASES-R were then examined using previous CTT and IRT methods. Mean total score on the MASES-R was 3.62 (SD = .48) at baseline and 3.72 (SD = .44) at 3 months. Cronbach’s alpha coefficients were .92 and .90 at baseline and 3 months respectively. Test-retest coefficient for MASES-R was 0.51,  $p < .001$ . Results of EFA on the MASES-R were similar to the results of EFA for the 25-item MASES. At baseline, a single factor emerged from the analysis that explained 53.20% of variance and had an eigenvalue of

6.92. All 13 items loaded significantly on this factor with factor loadings of .62 or greater. At 3 months, the solution was similar. Factor 1 explained 49.87% of variance, and had an eigenvalue of 6.48. In contrast, Factor 2 explained 12% of variance and had a much smaller eigenvalue of 1.66. All 13 items loaded highest and significantly on Factor 1, with values of at least .52. These results support the unidimensionality of the MASES-R. Item information curves were examined for the 13 items retained and scale information curve was examined for the total 13-item scale. All items and the total scale performed well at both baseline and 3-month time points. Consistent with the individual item information curves, the scale information curves were most informative about adherence self-efficacy in the moderately low to the middle ranges of the construct. See Figs. 1 and 2 for MASES-R scale information curves at both time points. Of note, a similar pattern was found when examining the item information curves and scale information curves of the 25-item measure (see Figs. 3 and 4).

**Table 4** Item analyses for the MASES: baseline and 3-month

| Items   | Mean <sub>B</sub><br>( <i>N</i> = 188) | Mean <sub>3-Mo.</sub><br>( <i>N</i> = 168) | SD <sub>B</sub> | SD <sub>3-Mo.</sub> | <i>r</i> | ITC <sub>B</sub> | ITC <sub>3-Mo.</sub> |
|---|--|--|-----------------|---------------------|----------|------------------|----------------------|
| <i>How confident are you that you can take your blood pressure medications:</i> |  |  |                 |                     |          |                  |                      |
| 1. When you are busy at home  | 3.54                                   | 3.73                                       | .70             | .55                 | .20      | .68              | .59                  |
| 2. When you are at work   | 3.58                                   | 3.80                                       | .84             | .61                 | .15      | .38              | .47                  |
| 3. When there is no one to remind you   | 3.59                                   | 3.74                                       | .69             | .62                 | .45      | .59              | .61                  |
| 4. When they cause some side effects  | 2.60                                   | 2.80                                       | 1.18            | 1.19                | .33      | .34              | .37                  |
| 5. When you worry about taking them for the rest of your life                   | 3.57                                   | 3.60                                       | .71             | .81                 | .28      | .62              | .54                  |
| 6. When they cost a lot of money  | 2.99                                   | 3.04                                       | 1.11            | 1.19                | .45      | .55              | .51                  |
| 7. When you come home late from work  | 3.64                                   | 3.69                                       | .77             | .77                 | .30      | .36              | .38                  |
| 8. When you do not have any symptoms  | 3.62                                   | 3.67                                       | .70             | .75                 | .31      | .60              | .63                  |
| 9. When you are with family members   | 3.70                                   | 3.82                                       | .56             | .49                 | .25      | .68              | .62                  |
| 10. When you are in a public place  | 3.64                                   | 3.79                                       | .71             | .56                 | .37      | .67              | .62                  |
| 11. When you are afraid of becoming dependent on them                           | 3.18                                   | 3.40                                       | 1.08            | 1.00                | .38      | .50              | .66                  |
| 12. When you are afraid they may affect your sexual performance                 | 3.46                                   | 3.42                                       | .88             | .99                 | .28      | .55              | .55                  |
| 13. When the time to take them is between your meals                            | 3.72                                   | 3.76                                       | .49             | .57                 | .19      | .64              | .56                  |
| 14. When you feel you do not need them  | 3.32                                   | 3.42                                       | 1.00            | 1.03                | .22      | .51              | .62                  |
| 15. When you are travelling   | 3.68                                   | 3.81                                       | .63             | .50                 | .25      | .67              | .60                  |
| 16. When you take them more than once a day                                     | 3.60                                   | 3.66                                       | .72             | .73                 | .38      | .59              | .77                  |
| 18. If they sometimes make you tired  | 3.06                                   | 3.12                                       | 1.11            | 1.14                | .28      | .45              | .52                  |
| 19. When you have other medications to take                                     | 3.67                                   | 3.74                                       | .56             | .64                 | .19      | .68              | .58                  |
| 20. When you feel well  | 3.60                                   | 3.75                                       | .72             | .65                 | .27      | .70              | .68                  |
| 21. If they make you want to urinate while away from home                       | 3.46                                   | 3.53                                       | .84             | .92                 | .29      | .64              | .55                  |
| <i>Please rate how sure you are that you can carry out the following tasks:</i> |  |  |                 |                     |          |                  |                      |
| 22. Get refills for your medications before you run out                         | 3.54                                   | 3.60                                       | .74             | .74                 | .35      | .39              | .26                  |
| 23. Make taking your medications part of your routine                           | 3.62                                   | 3.80                                       | .61             | .44                 | .35      | .60              | .60                  |
| 24. Fill your prescriptions whatever they cost                                  | 3.24                                   | 3.30                                       | 1.06            | 1.09                | .48      | .49              | .44                  |
| 25. Always remember to take your blood pressure medications                     | 3.48                                   | 3.67                                       | .78             | .63                 | .36      | .56              | .59                  |
| 26. Take your blood pressure medications for the rest of your life              | 3.56                                   | 3.63                                       | .80             | .78                 | .23      | .59              | .53                  |

**Fig. 1** MASES-R scale information curve at baseline**Fig. 2** MASES-R scale information curve at 3 months

### Concurrent and predictive validity of MASES-R

The scores of MASES-R were examined in relation to self-report adherence and MEMS. We hypothesized that the MASES-R scores would correlate positively with both measures of medication adherence. As expected, at base-

line MASES-R scores were higher for patients whose self-report categorized them as adherent ( $M = 3.81$ ,  $SD = .33$ ) compared to those that were categorized as non-adherent ( $M = 3.51$ ,  $SD = .52$ ;  $t = -4.26$ ,  $p < .001$ ). These data provide preliminary support for the concurrent validity of the MASES-R. Additional support for the scale's concur-

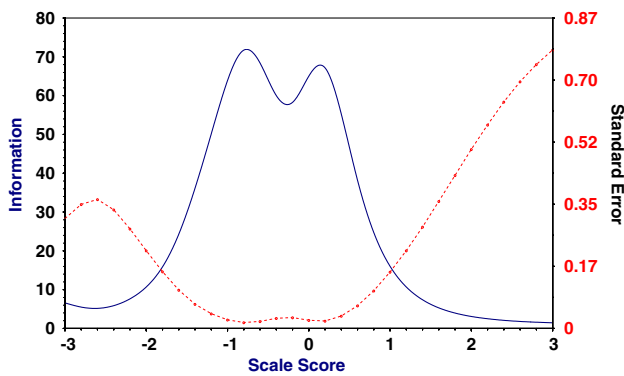


Fig. 3 MASES scale information curve at Baseline

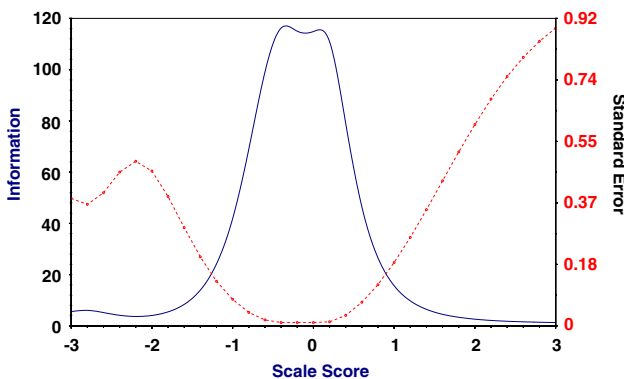


Fig. 4 MASES scale information curve at 3 months

rent validity was provided by significant and positive correlation between 3-month MASES-R and 3-month MEMS ( $r = .20, p = .02$ ). Similarly, correlation between baseline MASES-R scores and 3-month MEMS adherence rates ( $r = .19, p = .02$ ) was significant and positive, indicating support for the predictive validity of the MASES-R. These results suggest initial validity of MASES-R in relation to medication adherence in this patient sample.

## Discussion

The evaluation and revision of the Medication Adherence Self Efficacy Scale was described in this paper. The shortened scale, titled the MASES-R, consists of 13 items that assess an individual's judgment of their ability to adhere to prescribed anti-hypertensive medications under a variety of challenging situations. Twelve of the items ask about confidence in specific situations (e.g. busy at home, no symptoms, traveling), and one item asks about confidence in ability to make medication adherence a part of daily routine. There are no subscales on the measure, but rather the total scale score ranges from 1 to 4 and is the average score of all 13 items. The original MASES was

developed with a sample of 72 African American hypertensive participants with similar demographic characteristics as the current sample (Ogedegbe et al. 2003). Like the original MASES, the MASES-R demonstrates acceptable psychometric properties. This unidimensional scale has good internal consistency and reliability. In addition, the study provides initial evidence for the validity of the revised scale in this population, in this case concurrent and predictive validity. The MASES-R correlated positively and significantly with electronic medication adherence, and a similar pattern emerged with self-report data.

The content and relevance of items dropped from the scale can best be understood in the context of participant demographic characteristics. This sample of African American hypertensive patients included 54% unemployed, and 92% with some form of insurance (Medicaid, Medicare, HMO). The content of the items that were dropped included barriers related to work; cost of medications and ability to refill; perception of side effects and the chronic nature of hypertension. It is likely that in a sample with a high rate of unemployment (54%) items related to self-efficacy for adherence in work situations were less relevant. Additionally, as 92% of the sample reported that they had access to a form of health insurance (and perhaps medications), items related to cost and ability to refill medications may have been less salient. The performance of items related to chronic nature of condition, and perception of side effects may be not only due to gaps in knowledge of hypertension in this sample, but could also be explained by their perceptions of their illness (Boutin-Foster et al. 2007; Ogedegbe et al. 2004; Ravenell et al. 2006).

Of interest, the scale is most informative at distinguishing among those in the middle to lower middle of the scale. This is where both item information curves and scale information curves for the MASES-R provided the most information about adherence self-efficacy. This pattern of findings suggests that clinicians and researchers alike will be able to use the scale to distinguish between those with very low to moderately low self-efficacy. In turn; this information can be useful in the development and implementation of interventions targeting self-efficacy for improved medication adherence. While it is true that the results also suggest that the MASES-R did not distinguish well between those at the higher end of the self-efficacy continuum, this characteristic of the measure is of little practical significance as those with high to very high self-efficacy for adherence are least likely to need intervention.

As noted previously, major strengths of the MASES included use of patient input and feedback for item generation and refinement, and the MASES focuses on a condition-specific list of situations where self-efficacy may vary (Ogedegbe et al. 2003). For example, when patient is

asymptomatic, as may be the case in hypertension but may not be the case with other health conditions. Two strengths of the MASES-R deserve mention. First is the expansion of response options in the measure. In the original MASES, we used a 3-point response option compared to the 4-point used in the MASES-R. While our goal with this change was to provide greater variability and improve predictive power of the revised scale, we previously noted that patients had difficulty discriminating between five response choices in the development phase (Ogedegbe et al. 2003). Thus, the new version of the scale includes four choices to indicate level of self efficacy, including: “Not at all sure,” “A little sure,” “Fairly sure,” and “Extremely sure.” Second, two forms of medication adherence data were used in this study for scale validation: self-report adherence and electronic monitoring, which is currently considered the ‘gold-standard’ of adherence assessment. Thus, a limitation that was previously noted in the introduction of the MASES has been addressed in this study.

One limitation of the study is that the characteristics of this sample (86% women; 62% earning less than \$20,000 per year; 77% with high school education or greater; 54% not employed), limits the ability to generalize findings to a broader population of African American hypertensive patients, as well as hypertensive samples of multiple ethnic groups. Future studies on the MASES-R should address this limitation through utilization of a more representative sample of hypertensive African Americans. Additionally, future studies would do well to collect MASES-R data in multiple ethnic groups, as is currently being done in a separate study of ours (Gerin et al. 2007).

In summary, the data presented in this study provide initial data supporting the reliability and validity of the MASES-R, a shortened version of the MASES, for use in samples of hypertensive African Americans. Additional studies are necessary to further establish the psychometric properties of the measure, most notably construct validity. The MASES-R can provide useful data to both clinicians and researchers who are interested in understanding the role of self-efficacy in medication adherence among a subset of hypertensive African Americans. Ultimately, with appropriate replication and extension of psychometric analyses, it may prove to be a useful tool in research and clinical practice with a wider range of hypertensive adults.

**Acknowledgments** Preparation of this manuscript was supported by Grants R01 HL 69408, R01 HL078566, to Dr. Ogedegbe, and R24 HL076857 from the National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, MD, USA. Dr. Fernandez was supported by minority supplement to grant R01HL078566-02S1 and the NIH LRP in Health Disparities Research. Dr. Schoenthaler was supported by grant F31HL081926. We are grateful to David Y. Berger and David Statman for their assistance with data cleaning for this project.

## Appendix

### MASES-R

Situations come up that make it difficult for people to take their medications as prescribed by their doctors. Below is a list of such situations. We want to know your opinion about taking your blood pressure medication(s) under each of them. Please indicate your response by checking the box that most closely represents your opinion. There are no right or wrong answers.

For each of the situations listed below, please rate how sure you are that you can take your blood pressure medications all of the time.

| Items | Not at all sure | A little sure | Fairly sure | Extremely sure |
|-------|-----------------|---------------|-------------|----------------|
|-------|-----------------|---------------|-------------|----------------|

*How confident are you that you can take your blood pressure medications:*

1. When you are busy at home
2. When there is no one to remind you
3. When you worry about taking them for the rest of your life
4. When you do not have any symptoms
5. When you are with family members
6. When you are in a public place
7. When the time to take them is between your meals
8. When you are travelling
9. When you take them more than once a day
10. When you have other medications to take
11. When you feel well
12. If they make you want to urinate while away from home

*Please rate how sure you are that you can carry out the following task:*

13. Make taking your medications part of your routine

## References

- Allegrante, J. P., & Marks, R. (2003). Self-efficacy in management of osteoarthritis. *Rheumatic Diseases Clinics of North America*, 29(4), 747–768. doi:10.1016/S0889-857X(03)00060-7. vi-vii.

- American Heart Association. (2006). *High blood pressure statistics*. New York.
- Bandura, A. (1977a). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 134–139. doi: [10.1037/0033-295X.84.2.191](https://doi.org/10.1037/0033-295X.84.2.191).
- Bandura, A. (1997b). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.
- Bollen, K. A. (1989). *Structural equations with latent variables*. New York: Wiley.
- Bosworth, H. B., Dudley, T., Olsen, M. K., Voils, C. I., Powers, B., Goldstein, M. K., et al. (2006). Racial differences in blood pressure control: Potential explanatory factors. *American Journal of Medicine*, *119*(1), 70. e9–15.
- Boutin-Foster, C., Ogedegbe, G. O., Ravenell, J. E., Robbins, L., & Charlson, M. E. (2007). Ascribing meaning to hypertension: A qualitative study among African Americans with uncontrolled hypertension. *Ethnicity and Disease*, *17*(1), 29–34.
- Burt, V. L., Cutler, J. A., Higgins, M., Horan, M. J., Labarthe, D., & Whelton, P. (1995). Trends in the prevalence, awareness, treatment, control of hypertension in the adult US population. Data from the health examination surveys, 1960–1991. *Hypertension*, *26*(1), 60–69.
- Catz, S. L., Kelly, J. A., Bogart, L. M., Benotsch, E. G., & McAuliffe, T. L. (2000). Patterns, correlates, and barriers to medication adherence among persons prescribed new treatments for HIV disease. *Health Psychology*, *19*(2), 124–133. doi: [10.1037/0278-6133.19.2.124](https://doi.org/10.1037/0278-6133.19.2.124).
- Centers for Disease Control, Prevention. (2005). Racial/ethnic disparities in prevalence, treatment, and control of hypertension: United States, NHANES 1999–2002. *MMWR. Morbidity and Mortality Weekly Report*, *54*, 7–9.
- Choo, P. W., Rand, C. S., Inui, T. S., Lee, M. L., Cain, E., Cordeiro-Breault, M., et al. (1999). Validation of patient reports, automated pharmacy records, and pill counts with electronic monitoring of adherence to antihypertensive therapy. *Medical Care*, *37*(9), 846–857. doi: [10.1097/00005650-199909000-00002](https://doi.org/10.1097/00005650-199909000-00002).
- Cudeck, R., & Browne, M. W. (1992). Constructing a covariance matrix that yields a specified minimizer and a specified minimum discrepancy function value. *Psychometrika*, *57*, 357–369. doi: [10.1007/BF02295424](https://doi.org/10.1007/BF02295424).
- Curtain, R. B., Walters, B. A. J., Schatell, D., et al. (2008). Self-efficacy and self-management behaviors in patients with chronic kidney disease. *Advances in Chronic Kidney Disease*, *15*(2), 191–205. doi: [10.1053/j.ackd.2008.01.006](https://doi.org/10.1053/j.ackd.2008.01.006).
- Gerin, W., Tobin, J. N., Schwartz, J. E., Chaplin, W., Rieckmann, N., Davidson, K. W., et al. (2007). The medication Adherence and Blood Pressure Control (ABC) trial: A multi-site randomized controlled trial in a hypertensive, multi-cultural, economically disadvantaged population. *Contemporary Clinical Trials*, *28*(4), 459–471. doi: [10.1016/j.cct.2007.01.003](https://doi.org/10.1016/j.cct.2007.01.003).
- Gifford, A. L., Bormann, J. E., Shively, M. J., Wright, B. C., Richman, D. D., & Bozette, S. A. (2000). Predictors of self-reported adherence and plasma HIV concentrations in patients on multidrug antiretroviral regimens. *Journal of Acquired Immune Deficiency Syndromes*, *23*(5), 386–395.
- Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Guadagnoli, E., & Velicer, W. F. (1988). Relation of sample-size to the stability of component patterns. *Psychological Bulletin*, *103*(2), 265–275. doi: [10.1037/0033-2909.103.2.265](https://doi.org/10.1037/0033-2909.103.2.265).
- Hertz, R. P., Unger, A. N., Cornell, J. A., & Saunders, E. (2005). Racial disparities in hypertension prevalence, awareness, and management. *Archives of Internal Medicine*, *165*(18), 2098–2104. doi: [10.1001/archinte.165.18.2098](https://doi.org/10.1001/archinte.165.18.2098).
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55.
- Hugen, P. W. H., Langebeek, N., Burger, D. M., Zomer, B., van Leusen, R., Schuurman, R., et al. (2002). Assessment of adherence to HIV protease inhibitors: Comparison and combination of various methods, including MEMS (electronic monitoring), patient and nurse report, and therapeutic drug monitoring. *Journal of Acquired Immune Deficiency Syndromes*, *30*, 324–334.
- Johnson, M. O., Chesney, M. A., Goldstein, R. B., Remien, R. H., Catz, S., Gore-Felton, C., et al. (2006). Positive provider interactions, adherence self-efficacy, and adherence to antiretroviral medications among HIV-infected adults: A mediation model. *AIDS Patient Care and STDs*, *20*(4), 258–268. doi: [10.1089/apc.2006.20.258](https://doi.org/10.1089/apc.2006.20.258).
- Kirscht, J. P., & Rosenstock, I. M. (1977). Patient adherence to antihypertensive medical regimens. *Journal of Community Health*, *3*(2), 115–124. doi: [10.1007/BF01674233](https://doi.org/10.1007/BF01674233).
- Liu, H., Golin, C. E., Miller, L. G., Hays, R. D., Beck, C. K., Sanandaji, S., et al. (2001). A comparison study of multiple measures of adherence to HIV protease inhibitors. *Annals of Internal Medicine*, *134*(10), 968–977. see comment erratum appears in *Ann Intern Med* 2002 Jan 15;136(2):175.
- Lord, F. M. (1980). *Applications of item response theory to practical testing problems*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Lorig, K., Chastain, R. L., Ung, E., Shoor, S., & Holman, H. R. (1989). Development and evaluation of a scale to measure perceived self-efficacy in people with arthritis. *Arthritis and Rheumatism*, *32*(1), 37–44. doi: [10.1002/anr.1780320107](https://doi.org/10.1002/anr.1780320107).
- Monane, M., Bohn, R. L., Gurwitz, J. H., Glynn, R. J., Levin, R., & Avorn, J. (1996). Compliance with antihypertensive therapy among elderly Medicaid enrollees: The roles of age, gender, and race. *American Journal of Public Health*, *86*(12), 1805–1808.
- Morisky, D. E., Green, L. W., & Levine, D. M. (1986). Concurrent and predictive validity of a self-reported measure of medication adherence. *Medical Care*, *24*(1), 67–74. doi: [10.1097/00005650-198601000-00007](https://doi.org/10.1097/00005650-198601000-00007).
- Nakahara, R., Yoshiuchi, K., Kumano, H., Hara, Y., Suematsu, H., & Kuboki, T. (2006). Prospective study on influence of psychosocial factors on glycemic control in Japanese patients with type 2 diabetes. *Psychosomatics*, *47*(3), 240–246. doi: [10.1176/appi.psy.47.3.240](https://doi.org/10.1176/appi.psy.47.3.240).
- Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.
- Ogedegbe, G., Mancuso, C. A., Allegrante, J. P., & Charlson, M. E. (2003). Development and evaluation of a medication adherence self-efficacy scale in hypertensive African-American patients. *Journal of Clinical Epidemiology*, *56*(6), 520–529. doi: [10.1016/S0895-4356\(03\)00053-2](https://doi.org/10.1016/S0895-4356(03)00053-2).
- Ogedegbe, G., Mancuso, C. A., & Allegrante, J. P. (2004). Expectations of blood pressure management in hypertensive African-American patients: A qualitative study. *Journal of the National Medical Association*, *96*(4), 442–449.
- Ogedegbe, G. O., Schoenthaler, A. M., Richardson, T., Lewis, L., Belue, R., Espinosa, E., et al. (2007). An RCT of the effect of motivational interviewing on medication adherence in hypertensive African Americans: Rationale and design. *Contemporary Clinical Trials*, *28*(2), 169–181. doi: [10.1016/j.cct.2006.04.002](https://doi.org/10.1016/j.cct.2006.04.002).
- Ravenell, J. E., Johnson, W. E., Jr., & Whitaker, E. E. (2006). African-American men's perceptions of health: A focus group study. *Journal of the National Medical Association*, *98*(4), 544–550.
- Samejima F. (1969). Estimation of latent ability using a response pattern of graded scores. *Psychometrika Monographs* 34(4, Pt.2, Whole No. 17).

- SPSS. (2004). Statistical Package for Social Sciences, version 13.0.
- Strecher, V. J., et al. (1986). The role of self-efficacy in achieving health behavior change. *Health Education Quarterly*, 13(1), 73–92.
- Tabachnik, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Needham Heights, MA: Pearson Education Company.
- Thissen, D. (2003). *Multilog User's Guide*. Lincolnwood, IL: Scientific Software International Incorporated.
- World Health Organization. (2003). *Adherence to long-term therapies: Evidence for action*. Geneva: World Health Organization. xv, 198 pp.