Preliminary Validation of the Hypertension Self-Care Activity Level Effects (H-SCALE) and Clinical Blood Pressure Among Patients With Hypertension

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This study establishes preliminary validation of a measure that assesses hypertension self-care activities with clinical blood pressure (BP). The Hypertension Self-Care Activity Level Effects (H-SCALE) was administered to patients with hypertension to assess levels of self-care. Patients (n=154) were predominantly female (68.6%) and black (79.2%). Greater adherence to self-care was associated with lower systolic and diastolic BP for 5 of the 6 self-care behaviors. Medication adherence was correlated with systolic BP ($r=-0.19$, $P<.05$) and weight management adherence was correlated with diastolic BP ($r=-0.22$, $P<.05$) after controlling for other covariates. Increased adherence to recommended dietary practices was strongly correlated with higher systolic ($r=0.29$, $P<.05$) and diastolic BP ($r=0.32$, $P<.05$). The H-SCALE was acceptable for use in clinical settings, and adherence to self-care was generally aligned with lower BP. Assessment of hypertension self-care is important when working with individuals to control their BP. *J Clin Hypertens (Greenwich).* 2013;15:637–643. © 2013 The Authors. *The Journal of Clinical Hypertension* Published by Wiley Periodicals, Inc.

Hypertension is one of the most prevalent chronic diseases among US adults, affecting one third of the adult population older than 20 years[1] and approximately 70% of adults older than 65 years.[2] African Americans experience hypertension at rates of 43.0% for men and 45.7% for women, while rates for white men and women are 33.9% and 31.3%, respectively, and Mexican American men and women have prevalence rates of 27.8% and 28.9%, respectively.[1] Despite some estimates that show modest declines in blood pressure (BP) prevalence,[3] clinicians will be actively engaged in chronic disease management with patients diagnosed with hypertension for the foreseeable future. While trends suggest increased awareness of hypertension among the population and higher treatment rates in the past decade, less than half of hypertensive adults have controlled hypertension regardless of race/ethnicity or sex.[1]

First-line treatment for hypertensive patients is typically antihypertensive medications,[4,5] however, medication is not always effective in achieving BP control. Further, many patients show poor adherence to antihypertensive medications, with reported adherence rates ranging from 59%[6] to 83.6%.[7] While most patients fill an initial prescription for antihypertensive medications, approximately 30% will not refill a prescription.[8] Patients frequently report unpleasant side effects of drug therapies or a dislike of taking medications.[9] Reviews of antihypertensive drug efficacy trials indicate a high risk of study withdrawal because of adverse drug effects, which suggests that published outcomes are highly skewed.[10] Nonadherence can have serious health consequences such as increased rates of hospitalization and emergency department visits.[11]

Therapeutic lifestyle changes are recommended in conjunction with medication therapy for hypertensive patients[12] and are also effective as first-line treatment for patients with prehypertension.[13] Patients who are nonadherent to medications may attempt to control their BP by substituting other self-care activities,[14] including home remedies or complementary therapies.[15] Recent evidence indicates that while population prevalence rates of healthy lifestyle behaviors (nonsmoking, diet, physical activity, and weight control) have improved and are expected to continue, rates are still far from optimal for millions of Americans.[3] Long-term adherence to lifestyle changes at a level sufficient to maintain health benefits is difficult for most individuals.[16,17] For many individuals, even those who are adherent to medications, these additional self-care behaviors are necessary to manage their BP. Thus, assessment of medication adherence and other hypertension self-care activities is essential to gain a comprehensive understanding of what patients are doing and to counsel them appropriately on activities associated with BP control.

Currently, the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC 7) recommends 6 self-care behaviors: (1) adhering to medication regimens; (2) engaging in physical activity; (3) following a

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healthy, low-salt and low-fat diet similar to the Dietary Approaches to Stop Hypertension (DASH) diet; (4) maintaining a healthy weight; (5) reducing alcohol intake; and (6) avoiding tobacco.[18] However, few studies have assessed these behaviors comprehensively among hypertensive individuals, and we do not know the relative importance of these behaviors to BP control.[19] Data from the 2005 Behavioral Risk Factor Surveillance System (BRFSS) indicate that the majority of individuals who have been told they have high BP are engaged in activities to control BP.[20] Adults in 20 states (n=24,447) reported that in response to their hypertension diagnosis, 70.9% had modified their eating habits, 79.5% had limited or eliminated their use of salt, 79.2% had reduced or eliminated alcohol consumption, 68.6% were engaged in physical activity, and 73.4% were taking antihypertensive medications. These data are promising but must be interpreted with caution. Each behavior was assessed using only a single item. Diet changes, exercise, medication adherence, and alcohol assessment are complex activities that typically require multi-item surveys for assessment. Further, while these responses suggest positive actions, they indicate nothing about sustained levels of activity, nor do they indicate whether these efforts are of a sufficient level to effectively influence BP control.

Previous research has led to the development of a self-report measure to assess the six JNC 7 hypertension self-care activities.[6] The Hypertension Self-Care Activity Level Effects, or H-SCALE, is a self-report assessment designed to measure the recommended self-care activities in a way that would facilitate examining the theoretical dose-response relationship between adherence to these behaviors and better control of BP. The H-SCALE is also designed to be a counseling tool to aid primary care physicians with hypertensive patients who are seeking to achieve BP control. Before the tool can be used in primary care settings, such as for panel reviews and focused intervention,[21,22] further examination of the scale and its association with BP is necessary. The pilot investigation reported here examined the individual H-SCALE subscale scores and their associations with systolic and diastolic BP to explore criterion-related validity[23] among hypertensive individuals. H-SCALE scores reflecting better self-care practices should be associated with lower BP readings.

METHODS

Study Design

The study was a cross-sectional survey and medical record abstraction conducted at an outpatient primary care clinic from September 2011 to March 2012 in Charlotte, North Carolina.

Study Inclusion and Exclusion Criteria

Eligible participants self-reported having high BP, having been prescribed hypertensive medications, and were at least 21 years old. The diagnosis of hypertension was validated by medication prescription for ≥1 antihypertensive based on the patient's medical chart. Individuals who were accompanying other patients and not seeing a provider themselves that day were not eligible. Other persons who were ineligible included patients who did not speak English or were at the clinic for some other reason such that their BP would not be taken (eg, picking up forms). We excluded participants who did not have a BP reading recorded for the date of the completed survey from these analyses (n=80). Respondents without a BP reading were older, had a lower body mass index (BMI), and were less likely to have diabetes than the participants available for analysis. They did not differ from study participants on sex, race, or any hypertension self-care activity scores.

Study Recruitment

Study staff recruited patients from the waiting room of the clinic. Eligible respondents were informed about the study and a waiver of consent and a waiver of authorization were used so that research personnel could abstract clinical data from their electronic medical record. No incentive was provided for participation. The consent process was approved by the hospital's institutional review board as well as the UNC Charlotte's Office of Protection for Research Subjects. Patients who took a survey were considered to have given consent.

Response Rate

Study personnel made 85 clinic visits to collect data; they approached 965 individuals. Some individuals indicated that they were not a patient (n=105) or did not speak English (n=19). Twenty percent of those approached who were patients indicated that they were unwilling to take a survey and no further information was available. This group included 40 patients who indicated that they had already been approached or had already completed a survey during the data collection period. Of the 662 remaining, 47.9% had hypertension; 250 patients met the other eligibility criteria and took a survey. Of these, 238 completed surveys and were returned for analysis, with a 95.2% survey response rate.

Measures

Data for this study were collected using an original survey and patient medical records. The JNC 7 prescribed hypertension self-care activities were assessed using the H-SCALE measure; a complete listing of items and scoring procedures has been previously described in detail.[6] Trained research assistants recruited participants and collected data. When a survey was returned, one research assistant abstracted demographic and clinical health measures from the medical record using a standardized abstraction form attached to the back of the survey.

Dependent Variable: BPs

Systolic and diastolic BPs for the survey date were abstracted from respondents' electronic medical charts.

Clinic protocol requires a nurse to take a single BP reading with the patient in a sitting position.

Independent Variables: H-SCALE

To assess medication adherence, 3 items capture the number of days in the past week (0 through 7) that an individual: (1) takes BP medication, (2) takes it at the same time every day, and (3) takes the recommended dosage. Responses are summed and scores range from 0 to 21.

Practice of weight management activities is assessed with 10 items related to dietary practices such as cutting portion size and making food substitutions as well as exercising specifically to lose weight. Activities are assessed based on recall during the past 30 days. Response options use a 5-point Likert scale from strongly disagree (1) to strongly agree (5), with scores ranging from 10 to 50.

Physical activity was assessed with 2 items. "How many of the past 7 days did you do at least 30 minutes total of physical activity?" and "How many of the past 7 days did you do a specific exercise activity (such as swimming, walking, or biking) other than what you do around the house or as part of your work?" Response options for both items are 0 to 7 days. Responses are summed (range, 0–14).

Smoking exposure is assessed with 2 items, "How many of the past 7 days did you smoke a cigarette or cigar, even just one puff?" and to assess passive smoking exposure "How many of the past 7 days did you stay in a room or ride in an enclosed vehicle while someone was smoking?" Response options for both items are 0 to 7 days. Responses are summed (range 0–14); higher scores indicate greater tobacco exposure.

Alcohol intake is assessed using an existing measure, the 3-item, National Institute on Alcohol Abuse and Alcoholism (NIAAA) Quantity and Frequency Questionnaire.[24] For these analyses, we multiplied the item response to "On average, how many days per week do you drink alcohol?" by the response to "On a typical day that you drink alcohol, how many drinks do you have?" Responses ranged from 0 to 21.

Twelve items assess practices related to eating a healthy, low-fat and low-salt diet, similar to the DASH diet.[25] Items inquire about avoiding salt while cooking and eating, avoiding foods high in salt content, avoiding fatty or fried foods, and eating recommended servings of fruits and vegetables. Response options range from 0 to 7 days. Nine items are negatively phrased and are reverse coded. For these analyses we summed the responses on all items to create a continuous variable, with a possible scoring range of 0 to 84. We further examined these items in 2 subsets: one containing only the salt-related items and the other containing the healthy eating and fatty food items.

Covariates

In addition to BP, information on a number of potential confounders was abstracted from participants' medical charts, including age, sex, race, other chronic conditions (treatment for diabetes, high cholesterol, and/or heart disease based on *International Classification of Diseases, Ninth Revision* codes), and height and weight. Clinical measures were abstracted for the date of the survey or the most recent visit prior to the survey date. BMI was calculated from the most recent weight in pounds and height in inches. We excluded respondents whose race was recorded as something other than black or white because their numbers were too small to be meaningful (n=4).

Statistical Analyses

Descriptive statistics were calculated for demographic characteristics, presence of comorbidities, participants' scores on the H-SCALE, and systolic and diastolic BP. Unadjusted and adjusted partial correlations were performed to examine the relationships between hypertension self-care measure scores and systolic and diastolic BP. All analyses were conducted in 2012 using SPSS version 17 (SPSS Inc, IBM Corporation, Armonk, NY) and statistical significance was set at $P \leq .05$.

RESULTS

Sample characteristics are presented in Table I. Patients were primarily women (68.6%) and black (79.2%), with a mean age of 54.6 years (range, 30–85). More than 70% were being treated for ≥1 chronic condition in addition to hypertension. More than two thirds were obese or morbidly obese (range, 17.4–69.1).

The internal consistency of the subscales, H-SCALE scores, and BPs are presented in Table II. The internal consistency of the subscales was within limits and similar to what has been previously reported.[6] The full range of scores was obtained on each of the various self-care measures.

The theoretical direction of the hypothesized relationship and the correlations between H-SCALE scores and systolic and diastolic BP are presented in Table III. In unadjusted correlations, of the 6 subscale scores, only the DASH diet score was significantly associated with systolic BP but notably in the unexpected direction. The crude associations between the other subscale scores and systolic BP were in the expected direction but did

TABLE I. Characteristics of Primary Care Patients With Hypertension (n=154)

	% (No.)
Age, mean (SD)	54.6 (12.19)
Women	68.8 (106)
Black	79.2 (122)
Height, mean (SD), in	66.6 (4.13)
Weight, mean (SD), lb	217.9 (54.46)
BMI, mean (SD)	34.7 (8.75)
Treated for diabetes	39.0 (60)
Treated for high cholesterol	60.4 (93)
Treated for heart disease	14.3 (22)

TABLE II. Characteristics of the H-SCALE Subscales and Systolic and Diastolic BP Among Patients With Hypertension

H-SCALE Subscale	Cronbach's α	Available Range	Observed Range	Mean Score (SD)
Medication	.77	0–21	0–21	17.64 (5.32)
Weight management	.86	10–50	10–50	35.60 (8.32)
Physical activity	.77	0–14	0–14	6.59 (4.88)
Tobacco exposure	.78	0–14	0–14	2.90 (4.70)
Alcohol intake	.88	0–∞	0–21	1.46 (3.44)
DASH diet	.67	0–84	26–83	57.73 (11.98)
Salt items		0–49	0–49	12.47 (8.49)
Non-salt items		0–35	7–35	21.51 (6.01)
Systolic BP, mm Hg	NA	NA	90–208	131.46 (19.61)
Diastolic BP, mm Hg	NA	NA	48–115	80.77 (12.61)

Abbreviations: BP, blood pressure; DASH, Dietary Approaches to Stop Hypertension; H-SCALE, Hypertension Self-Care Activity Level Effects; NA, not applicable; SD, standard deviation.

TABLE III. H-SCALE Subscale Score Partial Correlations With Systolic and Diastolic BP

		Systolic BP, mm Hg		Diastolic BP, mm Hg	
	Theoretical Relationship	Observed Relationship Direction		Observed Relationship Direction	
H-SCALE Subscale	Direction With BP	Unadjusted	Adjusted[a]	Unadjusted	Adjusted[a]
Medication	Negative	−0.11	−0.19[b]	−0.05	−0.07
Weight management	Negative	−0.01	−0.08	−0.13	−0.21[b]
Physical activity	Negative	−0.13	−0.13	−0.10	−0.09
Tobacco exposure	Positive	−0.03	0.05	0.05	0.08
Alcohol intake	Positive	0.04	0.08	0.14	0.13
DASH diet	Negative	0.19*	0.29[b]	0.11	0.32[b]

Abbreviation: DASH, Dietary Approaches to Stop Hypertension. Negative relationship, higher Hypertension Self-Care Activity Level Effects (H-SCALE) score is associated with lower blood pressure (BP). Positive relationship, higher H-SCALE score is associated with a higher BP. [a]Adjusted for age, race, sex; treatment for high cholesterol, heart disease, or diabetes; body mass index, and the other self-care behaviors. [b]$P<.05$.

not achieve statistical significance. After adjusting for other covariates (age, race, sex, BMI, treatment for other comorbidities, and the other self-care activity scores), medication adherence was significantly correlated with systolic BP ($r=-0.19$, $P<.05$). Better DASH diet scores were associated with higher systolic BP ($r=0.19$ and $r=0.29$) in both unadjusted and adjusted analyses.

Results were similar for diastolic BP; 5 of 6 subscale scores had correlations in the expected direction. After adjusting for covariates, better scores on the weight management subscale were significantly correlated with lower diastolic BP ($r=-0.22$, $P<.05$). Here, again, the DASH diet subscale results were not in the expected direction, and the relationship increased in magnitude after adjusting for covariates ($r=0.32$, $P<.05$).

To further explore the relationship between the DASH diet subscale scores and BP we computed partial correlations for each DASH subscale item (Table IV). For non-salt items, the correlations were small and generally nonsignificant. Correlations for 2 items were in the expected direction (eating 5 fruits and vegetables per day and avoiding fatty foods). Eating fried foods was significantly associated with systolic BP in the adjusted model with the correlation in the opposite direction from what is expected ($r=-0.18$, $P<.05$). Items that were within the domain of salt intake showed a consistent negative relationship with increasing BP. Increased consumption of salty foods was related to lower systolic and diastolic BP in both unadjusted and adjusted analyses; 4 items showed significant correlations in adjusted models.

DISCUSSION

Having additional insight into patients' self-care is important for clinicians working with a hypertensive patient population. Health care providers can be more effective lifestyle counselors when they understand specific areas that can help patients achieve optimal BP control. This study examined the relationships between self-report practices reflecting the JNC 7 hypertension self-care activities and clinical BPs among primary care patients with hypertension.

For 5 of the 6 hypertension self-care activities, H-SCALE subscale scores were weakly associated with clinical BPs in the expected direction. Greater adherence

TABLE IV. DASH Subscale Item Partial Correlations With Systolic and Diastolic BP

H-SCALE	Theoretical Relationship Direction With BP	Systolic BP, mm Hg: Observed Relationship Direction		Diastolic BP, mm Hg: Observed Relationship Direction	
		Unadjusted	Adjusted[a]	Unadjusted	Adjusted[a]
Non-salt items					
Follow a healthy eating plan	Negative	0.04	0.06	−0.07	0.07
Eat 5 fruits and vegetables a day	Negative	−0.03	−0.02	−0.01	0.09
Eat packaged bakery goods	Positive	−0.02	0.00	−0.04	−0.06
Eat fried foods such as chicken, French fries, or fish	Positive	−0.14	−0.18[b]	−0.07	−0.18
Avoid eating fatty foods and salt items[c]	Negative	−0.13	−0.06	−0.14	0.03
Eat potato chips, salted nuts, or salted popcorn	Positive	−0.13	−0.16	−0.01	−0.16
Eat processed meats such as ham, bacon, bologna, or sausage	Positive	−0.13	−0.19	−0.12	−0.23
Eat smoked meat or smoked fish	Positive	−0.16*	−0.22[b]	−0.06	−0.16
Eat pickles, olives, or other vegetables in brine	Positive	−0.09	−0.16	−0.09	−0.17[b]
Eat frozen prepared dinners or frozen pizza	Positive	−0.12	−0.11	−0.07	−0.09
Salt food at the table	Positive	−0.23[b]	−0.21[b]	−0.13	−0.16
Add salt when cooking	Positive	−0.21[b]	−0.22[b]	−0.16	−0.16

Negative relationship, higher H-SCALE score is associated with lower blood pressure (BP). Positive relationship, higher H-SCALE score is associated with a higher BP. [a]Adjusted for age, race, sex; treatment for high cholesterol, heart disease, or diabetes; body mass index, and the other self-care behavior scales. [b]$P<.05$. [c]Salt items are reverse coded when included in the full Dietary Approaches to Stop Hypertension (DASH) diet subscale.

to medications, increased physical activity levels, and greater adherence to weight management practices were negatively associated with higher levels of systolic and diastolic BP after adjusting for covariates. Medication adherence was significantly correlated with systolic BP after controlling for covariates, whereas weight management was significantly correlated with diastolic BP after controlling for covariates.

Previous research indicates that medication adherence increases the odds of having controlled BP by 45% (odds ratio, 1.45; 95% confidence interval, 1.04–2.02) among patients receiving monotherapy for hypertension.[26] However, medication adherence among patients with resistant hypertension, who were taking ≥3 antihypertensive medications, was not associated with control of systolic BP.[27] Rather, increasing the drug dosage (treatment intensity) was associated with better systolic BP. These studies assessed medication adherence using a measure consisting of days of pill supply divided by total days in the study period, with a cutpoint of 80%.[28] In contrast, this study used patient self-reports of pill-taking on a continuous scale. Greater adherence was significantly associated with lower systolic pressure.

Weight management practices, but not BMI (data not shown) were also significantly associated with lower diastolic BP. Studies have suggested that even small reductions in weight, without necessarily achieving normal weight status, are beneficial in reducing BP.[29] Thus, weight management behaviors such as reducing portion sizes, modifying recipes, and limiting intake of high-fat or high-sugar foods are as important to maintaining (that is to say not gaining) weight as in losing weight.

Our findings related to diet and salt intake were puzzling. We found consistent, strong, significant relationships between healthier nutrition habits, including reduced consumption of salt, and higher systolic and diastolic BP. These findings contradict the majority of research on sodium and BP.[30] However, the findings are consistent with a few key studies that indicate a negative association between sodium intake and mortality[31] and sodium intake and risk of hypertension or cardiovascular disease consequences.[32] Also, it appears that associations between sodium and cardiovascular events may be tempered by potassium intake,[33,34] a factor we did not measure. The studies to date all measured salt using urinary sodium excretion. Examining correlations of the DASH subscale scores with sodium intake using a dietary recall survey or urinary sodium excretion would provide a direct test of validity; thus, it is difficult to determine effect without these additional data. However, both of these methods have limitations. They are typically for a 24-hour period, which may reflect patients' average sodium intake.[30] Thus, repeat measures on consecutive days would be needed to correspond to the 7-day recall period we assess in the H-SCALE.

Our finding between diet, sodium consumption, and BP has several possible interpretations. One is that patients with high BP are practicing good DASH habits, but these efforts are not entirely effective. More intense efforts at controlling salt intake may be needed. Another interpretation is that patients with hypertension have received messages to reduce salt consumption but their actions have yet to affect their BPs. For example, a recent study introduced DASH concepts to hypertensive African Americans, whose diet improved, but no

significant changes occurred in BP.[35] The temporal response related to short-term or long-term diet changes is unknown and likely influenced by many other factors beyond the scope of this study. A third hypothesis may be that patients with higher or uncontrolled BP may have provided socially desirable answers because they were concerned that their physician would see their responses. Finally, the relationship between salt consumption and BP may be less robust than has previously been suggested. Salt sensitivity and the degree to which it affects BP differs among individuals with hypertension.[36] African Americans, who are the majority of this sample, are more prone to being salt-sensitive.[37]

Reducing salt intake requires knowledge of sodium levels, which is typically obtained from food labels. In this sample, 65% of participants (data not shown) agreed or strongly agreed that they read food labels, consistent with previous research,[38] but we do not know what their purpose was in doing so. People may read food labels to assess the ingredient list because of food allergies, to ascertain whether a food meets organic standards, to examine calories and portion sizes, or to check fat, sugar, or sodium content. Thus, more specific survey items are needed to determine whether patients with hypertension are reading food labels to make decisions about sodium content.

Limitations and Strengths

Study results should be interpreted with some caveats. We could not control for potassium intake, as noted above, which may moderate the risk of excessive sodium intake.[34] Also, the DASH diet subscale does not assess the quantity of foods consumed or timing, which may affect sodium concentration. Participants may be eating other foods with high sodium content that are not captured by the DASH subscale. A large proportion of our sample (74%) did not drink alcohol, consistent with previous studies conducted in the South; thus, we have limited variance for this self-care behavior. Our sample was small, making these analyses exploratory. The small sample size and limited number of BP readings also limit our ability to detect a significant relationship. Women and African Americans were overrepresented even with respect to the clinic population, which is predominantly female (65%) and African American (65%). Additional studies should examine people both with and without hypertension and those who are treated and untreated for hypertension. Finally, we were unable to control for the number of antihypertensive medications taken, the class of antihypertensive medication, or treatment intensification, which have been shown to influence medication adherence.

The study has several strengths including the use of medical records to obtain clinical BP and to ascertain treatment for other health conditions. We were also able to validate respondents' self-reports of hypertension diagnosis and treatment. Further, the H-SCALE measured the comprehensive set of recommended hypertension self-care behaviors, which allowed us to control for the other self-care activities in which respondents may engage.

CONCLUSIONS

Valid and reliable self-report measures for hypertension self-care are essential to further our understanding of activities related to hypertension and BP control. Our preliminary results suggest that in general the H-SCALE scores are theoretically in the same direction with BP, with the notable exception of the DASH diet scale. Further validity studies on the H-SCALE with larger and more diverse samples will extend the evidence about the utility of the scale. Additional studies comparing the H-SCALE with validated measures of medication adherence; food frequency questionnaires; and clinical tests for urinary sodium, potassium, and cotinine will provide evidence of convergent validity. The goal is to establish validity such that the H-SCALE will have clinical utility in health care settings and epidemiological surveys and as a measure of hypertension-related behavioral outcomes for intervention studies.

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