The Development and Validation of the Hypertension Evaluation of Lifestyle and Management Knowledge Scale

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Hypertension knowledge is an integral component of the chronic care model. A valid scale to assess hypertension knowledge and self-management skills is needed. The hypertension evaluation of lifestyle and management (HELM) scale was developed as part of a community-based study designed to improve self-management of hypertension. Participants included 404 veterans with hypertension. Literature review and an expert panel were used to identify required skills. Items were generated and pilot tested in the target population. Validity was assessed through comparisons of performance with education, health numeracy, print numeracy, patient activation and self-efficacy, and hypertension control. The HELM knowledge scale had 14 items across 3 domains: general hypertension knowledge, lifestyle and medication management, and measurement and treatment goals. Scores were positively associated with education (0.28, $P<.0001$), print health literacy (0.21, $P<.001$), health numeracy (0.17, $P<.001$), and patient activation (0.12, $P=.015$) but no association was found with diastolic or systolic blood pressure. The HELM knowledge scores increased following the educational intervention from baseline (mean, 8.7; standard deviation, 2.2) to 12-month follow-up (mean, 9.2, standard deviation, 2.2; $P<.001$). We conclude that the HELM provides a valid measure of the knowledge required for patients to take an active role in the chronic disease management of hypertension. *J Clin Hypertens (Greenwich).* 2012; 14:461–466. ©2012 Wiley Periodicals, Inc.

Hypertension is a common chronic disease in the United States, with a prevalence of more than 50% of persons 60 to 69 years of age and 75% of persons at least 70 years of age.[1] Although both pharmacologic and lifestyle interventions have proven effective in controlling blood pressure (BP) and decreasing the incidence of cardiovascular outcomes associated with hypertension, BP control on a population-based level has proven difficult to achieve.[2] Studies conducted by the National Health and Nutrition Examination Survey (NHANES) indicate that only 31% of adults with a diagnosis of hypertension in the United States have BP that is controlled at levels of <140 mm Hg systolic and 90 mm Hg diastolic.[2] Risks for uncontrolled BP include limited access to health care, increased comorbidity, and increased age.[2,3] Uncontrolled hypertension is a major public health issue in the United States, as it is an independent predictor of heart disease, stroke, and kidney disease.[4]

The chronic care model provides an organizing framework in which to study the role of a range of system, behavioral, and educational interventions designed to improve the management of chronic diseases such as hypertension.[5,6] A key component of the chronic care model is self-management of chronic disease with patients becoming knowledgeable and active partners in the management of their condition. Interventions designed to modify lifestyle behaviors, improve knowledge about hypertension, and improve self-management of chronic disease have had small to moderate levels of success in the management of hypertension.[7–11] Although many behaviorally oriented interventions include a patient education component, there is a lack of a validated instrument to assess patient knowledge and self-management skills relevant to hypertension. Studies of hypertension knowledge in various populations have used assessments developed for individual studies. These assessments vary in length and use both true/false and multiple choice formats.[12–21] There is a need for a common validated knowledge measure that can be used across studies. The objective of this study was to develop and validate a scale of hypertension knowledge that can be used to assess effectiveness studies of interventions to improve chronic disease management.

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METHODS

We developed, tested in a pilot study, and evaluated in the context of a large randomized controlled trial a hypertension knowledge assessment tool. This study was undertaken as part of a larger study to evaluate educational strategies to improve chronic disease management of hypertension among US veterans active in veteran community organizations. We formulated our initial set of questions based on areas identified by participants in a pilot project that explored chronic disease management in the target population of veter-

ans[22] and through review of existing hypertension knowledge scales.[12–21] We then administered candidate items to participants from the target population and obtained feedback regarding item relevance, clarity, and difficulty. We examined each item to ensure that it addressed an area presented as part of the educational intervention being designed for the study. Revised items were pilot tested among a sample of 100 veterans who were receiving primary care at a Veteran Affairs Medical Center in Southeastern Wisconsin. Items found to be confusing or that did not demonstrate a range in response (too low or too high a level of difficulty to be discriminating) were modified or deleted. A sample of 16 items was finalized to be tested in the target population. The study was approved by the institutional review board of the Clement J. Zablocki Veterans Affairs Medical Center.

Study Population

Participants were recruited from a sample of female and male veterans who belonged to community veteran's organizations including the Veterans of Foreign Wars (VFW) and the American Legion. All participants had a diagnosis of hypertension as defined by the following criteria: (1) a history of being told by their physician that they had hypertension, (2) currently taking medications to treat hypertension, or (3) documentation of two BP readings >140/90 mm Hg by study staff using standardized methods of BP measurement.[13,19]

Measures

A survey including the hypertension knowledge items was administered at baseline and after a 12-month educational intervention. Surveys were performed at a site convenient to the participant by a research associate who read the questions and response options to the respondents, who also had a copy of the survey. The respondent copy of the survey was collected after administration. The survey also included sociodemographic and health literacy measures. Years of education were assessed and categorized as follows: up to 11th grade, 12 years of education or GED certificate, and college experience. Print health literacy was evaluated with the Rapid Assessment of Adult Health Literacy in Medicine (REALM)[23] and health numeracy was with a 3-item scale developed by Schwartz.[24] Patient activation was assessed using the Patient Activation Measure, a 13-item scale with 4-point Likert scale response options.[25] Self-efficacy was assessed with the self-efficacy scale, a 10-item measure with 4-point Likert scale response options.[26] BP was measured at these encounters using standard methods widely used in epidemiologic and interventions studies for BP measurement.[13,19] After the patient had been seated quietly for 5 minutes, 3 measurements were performed at 1-minute intervals using a calibrated aneroid sphygmomanometer with a cuff size chosen based on arm circumference. The average of the last 2 measures was considered as the overall result of the measurement.

Analysis

Classical test statistics were used to describe the psychometric properties of the measure. The percent answering "do not know" and the percent with the correct response were described for each item. Item-total correlations and the percent correct for each item were determined. Items that had a negative or poor item-total correlation were deleted from the final scale (n=2). One item deleted assessed knowledge regarding how common it was for >1 medication to be required to reach BP goals. The second deleted assessed knowledge regarding the relationship of goal systolic and diastolic BPs to age and comorbidity. The construct validity of the remaining scale (n=14 items) was evaluated through analysis of the Pearson correlation of scores with level of education, health print literacy, health numeracy, self-efficacy, patient activation, and BP control. We also analyzed whether the score

TABLE I. Study Participant Characteristics

Participant Characteristic	No. (%)
Total	404 (100)
Male sex	353 (87)
Age, mean (SD), y	68.2 (10.1)
Education	
<12 y	26 (6)
12th grade or GED	142 (35)
College experience	235 (58)
Health literacy	
3rd grade	3 (1)
4th–6th grade	9 (2)
7th–8th grade	70 (18)
≥9th grade	317 (80)
Schwartz health numeracy (No. correct)	
0	46 (11)
1	169 (42)
2	136 (34)
3	53 (13)
Race	
White	387 (96)
Black or African American	11 (3)
American Indian or Alaskan Native	2 (<1)
Other	4 (1)
Ethnicity	
Non-Hispanic	402 (99%)
Hispanic	2 (<1%)
Income, $	
<25,000	55 (14)
25,000 to <75,000	209 (52)
≥75,000	64 (16)
Prefer not to answer/don't know	73 (18)
Diastolic BP, mean (SD)	72.5 (11.3)
Systolic BP, mean (SD)	134.5 (15.6)
Patient activation measure, mean (SD)	
Range of scale (0–100)	57.8 (13.5)
HELM score, mean (SD)	
Range of scale (0–14)	8.7 (2.2)

Abbreviations: BP, blood pressure; HELM, hypertension evaluation of lifestyle and management, SD, standard deviation.

(number correct) on the remaining 14 items improved in the cohort between baseline and 12-month assessments and whether improvement was greater in the peer-support intervention vs traditional education group.

RESULTS

There were 404 participants enrolled in the study with 100% who completed the baseline survey. At 12 months, 379 (94%) participants completed the survey. The mean age was 68.2 years (standard deviation [SD], 10.1), 87% were men, and 96% were Caucasian. Level of education and health literacy were widely distributed, with 6% having up to 11 years of education, 35% with 12 years or a GED, and 58% with some college. Twenty percent (20%) tested at less than the 9th grade level for print health literacy and only 13% answered 3 health numeracy questions correctly (Table I).

Item Analysis

The psychometric characteristics of items obtained at the baseline survey are presented in Table II. The item analysis revealed a range of difficulty. The easiest item was answered correctly 89% of the time and was a true/false question that asked whether people with hypertension need to take their medicine if they exercise regularly. The hardest item was answered correctly only 25% of the time and was a true/false question that asked whether there were about as many calories in 12 ounces of regular orange juice as 12 ounces of regular cola. A second hard item was answered correctly only 36% of the time and asked about the medical outcomes associated with uncontrolled hypertension. The item-total scale correlations for the 14 items ranged from 0.06 to 0.27, indicating a positive association between knowledge of individual items and knowledge of the full hypertension self-management construct. Overall, the percent correct for the 14 items ranged from 25% to 89%. The mean score on the 14 item scale at baseline was 8.7 (SD, 2.2).

TABLE III. Association of Participant Characteristics With HELM Score

Participant Characteristic	Pearson Correlation[a]
Level of education	0.28, $P<.001$
Print literacy (REALM)	0.21, $P<.001$
Numeracy	0.17, $P<.001$
Patient activation measure	0.12, $P=.015$
Systolic blood pressure	−0.007, $P=.88$
Diastolic blood pressure	0.039, $P=.44$

Abbreviations: HELM, hypertension evaluation of lifestyle and management; REALM, Rapid Assessment of Adult Health Literacy in Medicine. [a]Construct validity supported by positive Pearson correlation with measures of education, print literacy, numeracy (Schwartz numeracy items), and the Patient Activation Measure score. No significant correlation was found between knowledge and mean systolic or diastolic blood pressure.

Validation of Scale

It was expected that scores on the HELM would be positively associated with level of education, health print literacy, and health numeracy. It was further expected that scores on the HELM would be positively associated with the patient activation measure, general self-efficacy, and blood pressure control. Finally, it was expected that scores on the HELM would increase from baseline assessments to 12-month follow-up assessments following receipt of a hypertension educational intervention as part of the parent study.

A positive Pearson's correlation was found between the HELM and level of education (0.28, $P<.001$), health numeracy (0.17, $P<.001$), and health print literacy (0.21, $P<.001$). Further, a positive correlation

TABLE II. Item Characteristics of Knowledge Items

Domain	Item No.	Item Content	Response	% Correct	Item-Total Correct
General hypertension knowledge	1	Definition of HTN	True/false	88	0.22
	2	Symptoms of HTN	True/false	74	0.27
	3	Complications of HTN	Multiple choice	36	0.17
Lifestyle and medication management	4	Healthy behaviors and blood pressure levels	Multiple choice	50	0.06
	5	Exercise and need for medications	Multiple choice	89	0.20
	6	How to take medication	Multiple choice	44	0.21
	7	Sources of salt intake	True/false	59	0.24
	8	Calories in beverages	True false	25	0.13
	9	Lifestyle and blood pressure control	Multiple choice	50	0.16
	10	DASH diet	Multiple choice	88	0.09
	11	Exercise and blood pressure levels	Multiple choice	52	0.09
Monitoring and setting goals	12	Expected variation in BP readings	Multiple choice	83	0.17
	13	Home monitoring	Multiple choice	63	0.12
	14	Goal systolic/diastolic readings	Multiple choice	69	0.14

Abbreviations: BP, blood pressure; DASH, Dietary Approaches to Stop Hypertension; HTN, hypertension.

TABLE IV. The HELM Knowledge Scale

Item no.	Stem	Response Choices
1	A person is considered to have hypertension if either their systolic blood pressure is 140 or their diastolic is 90 or higher on two separate occasions.	True False
2	Most people can tell when their blood pressure is high because they feel bad.	True False
3	Uncontrolled hypertension can lead to which of the following:	Lung cancer Kidney failure High cholesterol Diabetes
4	Which of the following increases your risk of having hypertension?	Weight lifting Drinking >2 cups of coffee a day Smoking a pack of cigarettes Gaining 15 pounds
5	People with hypertension do not need to take medicine if they exercise regularly	True False
6	Which of the following statements about taking blood pressure medicine is TRUE?	Blood pressure medicine should always be taken with food More than one type of blood pressure medicine can be taken at the same time Blood pressure medicine works best if it is taken at bedtime Blood pressure medicine should not be taken if a person drank alcohol that day
7	Most of the salt Americans eat is added with a salt shaker.	True False
8	There are about as many calories in 12 ounces of regular orange juice as there are in 12 ounces of regular cola.	True False
9	An overweight 60-year-old man has hypertension. He drinks one bottle of beer and 4 cups of regular coffee a day. He adds regular table salt to his food at most meals. Which one of the following changes is the most likely to lower his blood pressure?	Lose 10 pounds Stop drinking alcohol Switch to decaffeinated coffee Switch to sea salt
10	Which one of the following changes to your diet is most likely to lower blood pressure?	Eat more fruits, vegetables, whole grains, and low-fat dairy products Eliminate spicy foods Drink one glass of red wine daily Drink herbal tea instead of coffee
11	Which one of the following statements about exercise and blood pressure is TRUE?	People who are on their feet most of the day will not benefit from more exercise Exercising for 30 minutes every day lowers blood pressure more than exercising for 30 minutes, 3 days a week Weight lifting should be avoided by people with high blood pressure When exercising, you must raise your heart rate to at least 100 beats a minute to improve blood pressure
12	A man reports that his blood pressure is 148/78 mm Hg when he checks it using the blood pressure machine in the pharmacy, 144/66 mm Hg in his family doctor's office, and 132/74 mm Hg when he checks it at home. Which of the following statements is TRUE?	It is common for blood pressure readings to vary like this The highest blood pressure reading is the correct one The lowest blood pressure reading is the correct one He can be reassured that his blood pressure is normal
13	When measuring your blood pressure at home, you should:	Always take your reading before you take your blood pressure medicine Take several readings, a minute or 2 apart, and record the lowest one Tale your blood pressure right after exercising and at least 2 hours after a meal Take two readings, a minute or 2 apart, and write down the average value
14	Blood pressure is measured with two numbers, an upper number and a lower number. It is usually written as upper/lower. If someone is told that their goal blood pressure is 126/76, when have they reached that goal?	When the upper is below 126 and the lower is below 76 When the upper is below 126, even if the lower is over 76 When the lower is below 76 even if the upper is over 126 When the average of the upper and the lower is <100

Abbreviation: HELM, hypertension evaluation of lifestyle and management. Correct responses are underlined.

was found between the HELM and the patient activation measure (0.12, P=.015) (Table III). However, there was no significant association of HELM scores with self-efficacy, or diastolic or systolic BP levels. The HELM knowledge scores improved between baseline assessments and 12-month follow-up for the total cohort with a mean score (SD) at baseline of 8.7 (2.2) increasing at 12 months to 9.2 (2.2) ($P<.0001$).

DISCUSSION

We present a 14-item scale for use as an assessment of knowledge relevant to self-management of hypertension (Table IV). The Hypertension Evaluation Lifestyle and Management (HELM) knowledge scale measures the hypertension knowledge in the context of the chronic care model and demonstrates content and construct validity. The domains include general hypertension knowledge, lifestyle and medication management, and measurement and treatment goals. This scale is appropriate for use among patients with a diagnosis of hypertension for whom the goal is to be active participants in the management of their hypertension.

There is a need for development and validation of knowledge scales for hypertension. Knowledge is commonly used as an outcome measure for interventions designed to improve disease management.[14,15] However, scales to assess hypertension knowledge are typically developed for each individual study, limiting the ability to compare knowledge outcomes across studies and populations.[12–21] Further, many patient-centered interventions to improve disease management of hypertension do not include any patient knowledge assessment.[27–32] We propose that the 14-item HELM is a valid measure that can be used across interventions designed to improve chronic disease management of hypertension.

STUDY STRENGTHS

One of the strengths of the HELM knowledge scale is the method used to define the hypertension knowledge construct that we sought to measure. The skills that were identified as comprising this construct were delineated in the context of the chronic care model and further defined through discussions with persons in the target population. The domains assessed include basic aspects of hypertension knowledge, lifestyle and management issues, and monitoring and setting goals in the management of hypertension. These domains reflect the scope of the chronic care model. Patients should have a basic understanding of the definition of hypertension, its symptoms, and its complications if left untreated. Further, there are practical aspects of management related to lifestyle and pharmacologic interventions including the role of exercise, weight, and diet on BP control as well as the relationship of lifestyle and pharmacologic interventions. Finally, the chronic care model supports a patient who is knowledgeable about treatment goals and how to monitor progress towards those goals. The HELM knowledge assessment reflects this full range of skills and thus provides a robust measure of a patient's readiness to participate in self-management of hypertension.

STUDY LIMITATIONS

Our study has some limitations. The scale was developed in a community-based population of veterans, a predominantly white, male, and older population. However, the population was diverse in income, level of education, and level of print and numeric health literacy. More than 20% of participants had less than a 9th-grade print literacy level. Items were read aloud to all study participants, thereby allowing even those with low-reading ability to convey their level of knowledge regarding hypertension and contribute to the psychometric data of the scale. Subsequently, the psychometric properties of the HELM scale reported here reflect how the scale will function in populations across a range of print literacy levels. Second, the scale is moderately long, including 14 items. However, the length of the scale reflects the scope of the construct that it seeks to measure. Further, the range in level of difficulty in items provides the opportunity for discrimination between respondents with different levels of hypertension knowledge and therefore increases the usefulness of the scale for both clinical and research settings.

CONCLUSIONS

We present the psychometric properties of a scale developed to measure knowledge of hypertension in the context of chronic disease management. The HELM knowledge scale provides a feasible assessment the knowledge required to be an active participant in the self-management of hypertension and includes the general content areas of general knowledge, lifestyle and medication management, and monitoring and setting goals. We recommend that the HELM knowledge scale be considered as an outcome measure in studies designed to improve chronic disease management of hypertension.

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