# Development and Evaluation of a Hypertension Knowledge Test for Korean Hypertensive Patients

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Patients' knowledge concerning high blood pressure (HBP) is a useful outcome measure in HBP education programs. However, valid and easy-to-use HBP knowledge assessment tools are scarce. The purpose of the study was to validate the HBP Knowledge Test (HKT) in two independent samples of Korean Americans with HBP (N=885). A total of 61% of the sample were women with a mean age of about 61 years (standard deviation=11.0) and 44% reported some college education or greater. Psychometric and item response theory analyses identified 21 items that fit a unidimensional model to form the HKT. Internal consistency was acceptable, with Cronbach's α=0.70. Construct validity testing revealed that patients with controlled BP had significantly higher HKT scores than those with uncontrolled BP (*P*=.012). The HKT is a simple questionnaire for assessing and monitoring HBP knowledge. It is sensitive to differences in blood pressure control status and should provide a valid, reliable, and standardized measure of HBP knowledge with wide relevance. *J Clin Hypertens (Greenwich).* 2011;13:750–757. ©2011 Wiley Periodicals, Inc.

The burden of high blood pressure (HBP) in the United States is tremendous, affecting more than 1 in every 4 adults in the United States.[1] Assessing HBP-related knowledge is an integral part of the overall care of patients with HBP. In particular, HBP knowledge has been used in intervention studies as outcomes of patient education programs.[2,3] Increased HBP knowledge has been associated with lower dropout rates among participants in a behavioral intervention program,[4] greater medication adherence,[5] and better HBP control.[6,7]

To assess individuals' knowledge about HBP, several instruments have been used; however, valid and easy-to-use knowledge assessment tools are scarce. For example, of the 5 HBP knowledge instruments identified (Table I), only one study provided information about the validity of the instrument.[8] Internal consistency reliability (ie, coefficient α) was tested for 4 of the 5 instruments (range=0.70–0.85) in samples as small as 26.[4,6,8,9] While most instruments used a correct/incorrect response format, one instrument included open-ended questions with answers individually recorded verbatim and scored.[6] Only 3 instruments provided specific content areas (eg, definition of HBP, risk factors, treatment, consequences) covered by the instrument.[6,8,10] These knowledge instruments have been used in a limited number of settings, which may be due, in part, to a lack of rigorous validation of the instruments and a lack of clarity in terms of its content or scoring instruction.

Available epidemiologic studies indicate that ethnic minorities, in particular Korean Americans, bear a considerable burden of HBP, as they have been shown to have a higher prevalence and lower rate of treatment and control of HBP when compared with other age-matched ethnic groups.[11–14] In order to address the lack of adequate HBP care and control among Korean Americans, an academic-community partnership was established. Together, the team conducted community-based intervention studies aimed at promoting HBP control in Korean Americans.[3,15,16] While the scope and design of each of those studies differ, information about a few key psychosocial variables such as HBP knowledge has been collected using the same instruments. In particular, data on HBP knowledge has been collected with a hypertension knowledge test (HKT) from two independent samples of nearly 900 Korean Americans with HBP. The HKT is a tool that was designed to assess not only general knowledge about HBP but also Korean cultural practices that could affect HBP care. Cumulatively, the resulting data may provide a unique opportunity to systematically assess the reliability and validity of the HKT in Korean Americans, one of the hardest-to-reach ethnic minority groups.[17] The purpose of this paper is to assess the utility, reliability, and validity of the HKT. Using a rigorous psychometric evaluation approach (item response theory [IRT]), item characteristics including item difficulty and item discrimination were evaluated for each item on the HKT.

## METHODS

### Sample

Data from two samples of Korean American immigrant patient populations were the basis for the current analysis (Table II). The first data set (study 1) was

**TABLE I.** High Blood Pressure Knowledge Instruments

| Instrument Name | Items, No. | Content Areas | Response Format | Validity | Reliability | Sample | Studies |
|---|---|---|---|---|---|---|---|
| Hypertension knowledge scale | 27 | Unspecified | Correct/incorrect | | Coefficient α ≥0.75 | 158 Hypertensive patients enrolled in a behavioral intervention program (≥40 y=68%, 51% female, 90% white) | Given and colleagues[4] |
| Hypertension knowledge test | 18 | Risk factors, aggravating conditions, treatment regimen (medication/diet) | Open-ended (answers recorded verbatim and scored as totally correct, partially correct, or incorrect/no answer) | | Coefficient α=0.81 | 450 Hypertensive patients (mean age=59 y, 46% female, 61% white) | Powers and Jalowiec[6] |
| Hypertension knowledge test | 10 | Unspecified | Unspecified | | Coefficient α=0.85 | 26 African American seniors (≥60 y) with HBP (81% female) | Freeman-McGuire[9] |
| Hypertension knowledge interview schedule | 20 | Definition of HBP, etiology, diagnosis, risk factors, treatment, prognosis, sequelae | Correct/incorrect | Content validity, discriminant validity | Coefficient α=0.70 | 330 Spanish-speaking Hispanics living in census areas (mean age=40 y, 59% female) | Ailinger[8] |
| Hypertension knowledge survey | 6 | Main factors contributing to HBP, definition of HBP, symptoms and consequences of HBP | Correct/incorrect | | | 1483 Seniors ≥50 y (≥70 y=32%, 56% female, 59% white) | Okonofua and colleagues[10] |

obtained from 445 middle-aged (range, 40–64 years; mean, 51.9±5.7 years), first-generation Korean immigrants in the Baltimore-Washington metropolitan area. They completed the HKT as part of an intervention trial for HBP control designed to test the effects of a culturally tailored education program combined with bilingual nurse telephone counseling (see[3,12,16] for details about study design and methods). Eligibility criteria for entry into the trial were age 40 to 64 years, systolic blood pressure (SBP) >140 mm Hg and/or diastolic blood pressure (DBP) >90 mm Hg on two separate occasions or taking antihypertensive medication, and self-identification as a Korean American. At baseline, more than half of participants were women (52.3%), had resided in the United States for 16.2 (standard deviation [SD]=8.9) years, and had at least some college education (54.6%). The majority of participants was married (93.0%) and reported working full- or part-time (81.8%), with only 40.4% covered by any form of health insurance at the time of the study. Nearly three quarters (72.9%) reported a family history of HBP, with a mean of HBP 4.3 (SD= 6.3) years. While 26.3% had a comorbid condition (eg, diabetes), 54.6% were taking antihypertensive medication, with less than one third (29.7%) having BP control.[1]

The second data set (study 2) was obtained from 440 elderly, first-generation hypertensive Korean American immigrants (range, 60–89 years; mean, 70.9±5.5 years) in a prospective trial for HBP control designed to test the effects of a health literacy–focused behavioral intervention. The ongoing trial is being conducted in the Baltimore-Washington metropolitan Korean community. Since the majority of Korean Americans attend ethnic churches, churches were used as the randomization unit, after considering several key factors such as denomination, geographic location, and the size of membership of each church. This group also completed the HKT at baseline. Eligibility criteria were the same except for age, which was 60 years or older. Slightly more than two thirds of the sample included women (69.5%), with those living in the United States for a mean of 24.2 (SD=11.3) years, and 58.9% reported living with a spouse at the time of the study. About one third completed some college or more education (33.9%). About 73% had worked full- or part-time before retirement, with 80.2% having health insurance. Additionally, 46.6% reported having

**TABLE II.** Source of Data and Sample Characteristics

| Variable | Study 1 (n=445) | Study 2 (n=440) | Total (N=885) |
|---|---|---|---|
| | Source of Data[a] | | |
| Age, mean (SD), y | 51.9 (5.7) | 70.9 (5.5) | 61.3 (11.0) |
| Sex, % female | 52.3 | 69.5 | 60.9 |
| Married, % | 93.0 | 58.9[b] | 76.0 |
| Education, ≥some college, % | 54.6 | 33.9 | 44.3 |
| Work status, full- or part-time, % | 81.8 | 73.2[c] | 77.5 |
| Health insurance, % | 40.4 | 80.2 | 60.2 |
| Medical history | | | |
| Family history of HBP, % | 72.9 | 52.2 | 62.4 |
| HBP, mean (SD), y | 4.4 (6.4) | 9.6 (8.9) | 7.0 (8.2) |
| Comorbidity, eg, diabetes, % | 26.3 | 47.0 | 36.6 |
| Taking HBP medication | 54.6 | 84.3 | 69.4 |
| SBP, mean (SD), mm Hg | 143.0 (17.9) | 141.0 (18.7) | 142.0 (18.4) |
| DBP, mean (SD), mm Hg | 91.0 (11.1) | 79.5 (11.2) | 85.3 (12.6) |
| Controlled BP, %[d] | 29.7 | 38.6 | 34.1 |

Abbreviations: DBP, diastolic blood pressure; SBP, systolic blood pressure; SD, standard deviation. [a]Study 1=high blood pressure (HBP) care for middle-aged Korean Americans; study 2=Health literacy-focused HBP care for Korean American seniors. Recruitment period was 2003–2004 for study 1 and 2007–2009 for study 2. [b]Percentage of patients living with a spouse. [c]Percentage of patients with previous full- or part-time employment . [d]Defined as blood pressure (BP) <140/90 mm Hg (130/85 mm Hg for patients with diabetes according the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure 2003).

a comorbid condition. In the sample, 52.2% had a family history of HBP, with a mean of 9.6 years of having HBP (SD=8.9). The majority of participants reported taking an HBP medication regimen (84.3%), but only 38.6% had their BP controlled.

For the purposes of this study, the two Korean samples were combined to create a new sample pool. The rationale for the data aggregation was 3-fold: (1) the primary purpose of this analysis was a psychometric assessment of the HKT using IRT methods, which required a large sample size; (2) the Korean American participants were all first-generation immigrants who were born, educated, and socialized in Korea and therefore assumed to share the same language and cultural backgrounds; and (3) each sample was recruited independently, each representing different age ranges, and hence fulfilling the independent observations assumption in IRT-based analysis.[18] As a result, we were able to achieve a sample of Korean American participants that was diverse in age, sex, education, and medical history (Table II).

## Procedures

All study procedures were approved by the Johns Hopkins Hospital institutional review board, and every participant provided written informed consent.

Massive outreach efforts, in collaboration with our community partners (eg, the Korean Resource Center, a community-based non-profit organization), were made during each enrollment period of October 2003 to December 2004 for study 1 and December 2007 to June 2009 for study 2, respectively. Detailed outreach effort and recruitment success have been published elsewhere.[12,17] In brief, program brochures and fliers were distributed at ethnic churches, grocery stores, and social clubs in the target community. Additionally, intensive media campaigns announcing the project were made in ethnic newspapers, weekly magazines, and several ethnic radio stations. During the baseline evaluation for each study, trained bilingual research staff collected physiologic data, including BP and body weight, while demographic and psychological data, height, and antihypertensive medication use were all obtained via self-report. Furthermore, trained bilingual research staff and nurses were available at every recruitment event held in the community to help with the explanation and completion of the baseline survey.

## Measurements

**The HKT.** The HKT consisted of 12 items developed by the National High Blood Pressure Education Program, the National Heart, Lung, and Blood Institute (*Check Your High Blood Pressure IQ*),[19] which assessed knowledge of causes of, symptoms and dangers of, and ways to prevent or control HBP. The IQ quiz was used in earlier studies of patients with HBP in the United States and South Africa.[20–22] In addition, 14 items were generated by the bilingual investigative team (HRH, JEL, MTK) based on a literature review and community input (involving lay health workers with several years of working experience in the Korean American community and hypertensive patients), which reflected Korean American health practice related to HBP (eg, common Korean diet based on high-salt food). This resulted in a total of 26 items written at the 4th-grade reading level. The 26-item knowledge test has been used in our previous studies of Korean Americans.[5,12,23,24] For the purpose of validating the knowledge items, expert consensus approach (HRH, MTK, TN, JEL, and HS) was taken to identify red herring items (eg, "Bald people are more likely to have HBP"). Red herring items are those which do not directly relate to HBP knowledge. The resulting 21 items on the HKT measure individuals' level of understanding of HBP, its treatment, and follow-up care. Participants are asked to respond true or false to statements such as "If your mother or father has HBP, your chance of getting it is higher," "Koreans eat 2 or 3 times more sodium than they need," or "Regular exercise can help reduce BP," or several multiple choice items (Table III). HBP knowledge scores are calculated by counting the number of items with correct responses with a possible range from 0 to 21. This knowledge quiz was originally developed in English and back-translated.

**TABLE III.** Proportion of Korean Immigrants With Correct Responses on the HBP Knowledge Test (N=885)

| Item | Response Format | Study 1 Correct, % | Study 2 Correct, % | Total Correct, % |
|---|---|---|---|---|
| | | Source of Data | | |
| Q1. If your mother or father has HBP, your chance of getting it is higher. | T/F | 90.1 | 79.5 | 84.9 |
| Q2. Young adults don't get HBP. | T/F | 85.2 | 83.6 | 84.4 |
| Q3. HBP always has symptoms. | T/F | 46.7 | 34.3 | 40.6 |
| Q4. HBP is not life-threatening. | T/F | 87.2 | 84.5 | 85.9 |
| Q5. BP is high when it is at or over 140/90 mm Hg. | T/F | 90.6 | 91.6 | 91.1 |
| Q6. If you're overweight, you're 2 to 6 times more likely to develop HBP. | T/F | 89 | 93.9 | 91.4 |
| Q7. Regular exercise can help reduce BP. | T/F | 95.7 | 97.3 | 96.5 |
| Q8. Koreans eat 2 to 3 times more salt or sodium than they need. | T/F | 88.3 | 88.6 | 88.5 |
| Q9. Drinking alcohol lowers BP. | T/F | 78 | 84.5 | 81.2 |
| Q10. HBP is a man's problem. | T/F | 93.7 | 96.1 | 94.9 |
| Q11. Pregnancy-related HBP is temporary and doesn't require follow-up after delivery. | T/F | 46.5 | 43.6 | 45.1 |
| Q12. BP gets lower in cold weather. | T/F | 51 | 57.7 | 54.4 |
| Q13. HBP harms your body over time by: | MC | 68.8 | 52.7 | 60.8 |
| Q14. Why is HBP called a "silent killer?" | MC | 82.5 | 78 | 80.2 |
| Q15. A person is diagnosed with HBP if he/she has: | MC | 68.3 | 56.4 | 62.4 |
| Q16. A good BP value is: | MC | 85.6 | 93.6 | 89.6 |
| Q17. Which of the following statements is true about HBP medications? | MC | 62.9 | 68.4 | 65.6 |
| Q18. Which of the following statements is false about HBP medications? | MC | 55.3 | 59.3 | 57.3 |
| Q19. All of the following health problems can result from HBP, except: | MC | 73.9 | 77.7 | 75.8 |
| Q20. All of the following are changes that you can make in your diet to lower your HBP, except: | MC | 63.4 | 82.5 | 72.9 |
| Q21. All of these lifestyle changes might help lower your BP, except: | MC | 71.9 | 73.2 | 72.5 |

Abbreviation: T/F=true or false. Response options for multiple choice (MC) items are as follows: For Q13, (1) causing you to have diabetes, (2) causing you to gain weight, (3) damaging your blood vessels, (4) making you nervous; Q14, (1) when you don't have pain or feel ill, you are okay, (2) your risk of dying from HBP is low, (3) when you don't have pain or feel ill, you are okay, (4) you may have no symptoms, and it can be life-threatening; Q15, (1) a lot of headaches that persist over 6 months, (2) family member with high blood pressure (HBP), (3) constant stress and tension, (4) elevated blood pressure (BP) at 3 different times; Q16, (1) <90/50 mm Hg, (2) <140/90 mm Hg, (3) 145/110 mm Hg, (4) 180/100 mm Hg; Q17, (1) there are many different types of medications for HBP, (2) extra medication should be taken when your BP is up, (3) medications should not be taken if drinking alcohol, (4) all BP medications cause a man to lose sex drive; Q18, (1) taking BP medications for a long time can damage your body, (2) once you start taking medication, you have to take it for life, (3) even when you feel good, you have to take your medication as scheduled, (4) when you feel that you need to adjust your dose of medication, you first need to see your doctor; Q19, (1) heart attack, (2) arthritis, (3) stroke, (4) kidney failure; Q20, (1) eat baked chicken instead of fried, (2) stop eating potato chips, (3) avoid adding table salt to food, (4) eat fast food or fried foods; Q21, (1) lifting 100 lb, (2) walking briskly for 30 minutes 3 times a week, (3) drinking <2 alcohol drinks per day, (4) quitting cigarette smoking.

**Blood Pressure.** Measurements of DBP and SBP were obtained by trained research staff using the A&D UA-767 (A&D Company, Ltd, Tokyo, Japan), a fully automatic device based on the oscillometric method. The A&D UA-767 device had been validated against a mercury sphygmomanometer.[25] BP measurements were taken with appropriately sized cuffs after participants were seated for 5 minutes.[26] Baseline BP was measured by averaging the second and third BP readings, recorded in mm Hg.

## Analysis

A multiple analytic approach was employed. First, to evaluate the internal consistency reliability and item homogeneity of the HKT, item-total correlations and Cronbach α were calculated for the HKT total scores. Item-total correlations above 0.15 and α coefficients above 0.70 are considered adequate.[27] Then, IRT analysis of the entire set of HBP knowledge items was conducted to further describe item characteristics. Under IRT, the likelihood that a patient responds correctly to an item, or endorses a response category, depends on

the amount of the underlying construct, being measured by the item, that a respondent possesses.[28] The discrimination (*a*) parameter reflects the ability of an item to discriminate between different levels of underlying trait, with higher *a* values indicating better discrimination. The location or difficulty (*b*) parameter indicates the location of the item on the underlying construct, reflecting where along the measured construct the item is most discriminating. In a simple binary case, such as with correct and incorrect responses to knowledge questions, the location parameter would be defined as the location on the underlying construct (HBP knowledge) where the probability is 50% for answering the item correctly. In this study, higher *b* estimates indicate that greater HBP knowledge is needed to answer the question correctly (ie, harder questions). Using *Multilog*, we tested the model fit of the 2-parameter and 3-parameter logistic models to generate item parameters. Item characteristic curves based on these estimates were created to provide graphic representation of item performance. The 3-parameter model, which adds a guessing parameter to

**TABLE IV.** Means, Standard Deviations, Item-Total Correlations, and Internal Reliability Coefficients of HBP Knowledge Test Scores

| Values | Source of Data | | |
| --- | --- | --- | --- |
| | Study 1 (n=445) | Study 2 (n=440) | Total (N=885) |
| Mean | 15.0 | 15.8 | 15.8 |
| Standard deviation | 3.3 | 2.8 | 3.1 |
| Item-total correlation (range) | 0.18–0.42 | 0.11–0.32 | 0.18–0.34 |
| Cronbach α | 0.74 | 0.62 | 0.70 |

the model, did not improve model fit (2-parameter model: $-2LL=5446.9$; 3-parameter model: $-2LL=5446.3$). Furthermore, the estimated guessing parameter was negligible for 18 of the 21 items ($c \leq 0.03$) and small for the remaining 3 ($c \leq 0.16$). Therefore, we chose to present findings from the more parsimonious 2-parameter model.

Finally, construct validity of the HKT was tested by examining the relationship between scores on the HKT and BP level. Based on a theoretical proposition by the Learned Resourcefulness Model,[29] which guided both studies, one of the key objectives was to improve participants' knowledge related to HBP and hence improve HBP control. In accordance with the definition used in the Seventh Report of the Joint National Committee on Prevention, Detection, and Treatment and Control of High Blood Pressure (JNC-7),[1] BP control was defined as BP <140/90 mm Hg (130/80 mm Hg for patients with diabetes). Thus, for the Korean American samples, it was hypothesized that those with BP control would have higher HBP knowledge than those without BP control. This hypothesis was tested using independent samples *t* test. Statistical significance was defined as $P \leq .05$.

## RESULTS

### Descriptive Psychometric Statistics
Table IV summarizes means, standard deviations, item-total correlations, and Cronbach's α reliability coefficients for the HKT for two independent samples. Mean scores for both samples were similar (15.0 for study 1 vs 15.8 for study 2), with a mean score of 15.8 for the combined sample (about 75 based on 100 as a perfect score). All item-total correlations were above the cutoff set a priori at 0.15, ranging from 0.18 to 0.42 for study 1 and 0.18 to 0.34 for the total sample. For study 2, two items (Q3 and Q6) did not meet the cutoff with item-total correlations of 0.11 and 0.14, respectively; item-total correlations for items Q3 and Q6 were 0.30 and 0.40 for study 1 and 0.21 and 0.30 for the total sample. α Coefficients of the 21-item HKT in the Korean samples yielded 0.74 for study 1, 0.62 for study 2, and 0.70 for the combined sample.

### IRT Analysis
Table V shows the estimated parameters from the IRT models. The discrimination (*a*) parameter suggested that all items on the HKT were generally indicative of their corresponding scale, although some items had better discriminability than others. In particular, items such as "HBP is a man's problem" ($a=1.38$), "If you're overweight, you're 2 to 6 times more likely to develop HBP" ($a=1.24$), and "Regular exercise can help reduce blood pressure" ($a=1.10$) had the best discrimination among the items examined. In contrast, items on symptoms of HBP (Q3, $a=0.62$), sodium consumption by Koreans (Q8, $a=0.65$), cold weather effects on BP (Q12, $a=0.65$), and diet changes that lower BP (Q20, $a=0.64$) had lower discriminability.

"Regular exercise can help reduce BP" was identified as an easy item ($b=-3.52$), which most respondents answered correctly. This was consistent with the high percentage (96.5%) of participants who answered the question correctly. On the other hand, the items about pregnancy-related HBP ($b=0.29$), whether HBP always has symptoms ($b=0.67$), or whether BP gets lower in cold weather ($b=-0.29$) were substantially harder questions to answer correctly according to the participants. Those location estimates were also consistent with the lower percentages, 45%, 41%, and 54%, respectively, of participants who responded correctly to those items. A review of the item-characteristic curves for all 21 questions on the HKT revealed a clustering of items at the lower end of the HBP knowledge trait (Figure).

### Construct Validity Testing
Construct validity for the HKT was assessed by testing the hypothesized relationship between HBP knowledge and HBP control. The scores on the HKT were correlated with SBP values for both samples but not with DBP (Table VI). For the combined sample, a statistically significant inverse relationship was obtained between HBP knowledge and SBP ($r=-0.11$, $P=.001$). As hypothesized, patients with controlled BP had significantly higher HBP knowledge scores than those with uncontrolled BP ($t=-2.52$, $P=.012$).

## DISCUSSION
Accurate assessment of HBP knowledge is an important first step to identify individuals in need of HBP education, since knowledge is often a prerequisite for a patient to perform appropriate HBP self-care as shown in previous research.[5] HBP knowledge may be particularly critical in the management of HBP among non–English-speaking immigrants such as Korean Americans who often have limited resources in health information.[17] Based on the descriptive statistics (Table III), Korean Americans were generally knowledgeable about etiology and common risk factors (eg, drinking, obesity, lack of exercise, salt) of HBP and correctly identified "high" vs "good" BP values. On the contrary, a significant proportion of Korean

**TABLE V.** Parameter Estimates for HBP Knowledge Items

| Item | Estimation | |
|---|---|---|
| | Discrimination (*a*) | Location (*b*) |
| Q1. If your mother or father has HBP, your chance of getting it is higher. | 0.82 | −2.36 |
| Q2. Young adults don't get HBP. | 0.96 | −2.05 |
| Q3. HBP always has symptoms. | 0.62 | 0.67 |
| Q4. HBP is not life-threatening. | 0.87 | −2.35 |
| Q5. BP is high when it is at or over 140/90 mm Hg. | 0.70 | −3.58 |
| Q6. If you're overweight, you are 2 to 6 times more likely to develop HBP. | 1.24 | −2.37 |
| Q7. Regular exercise can help reduce BP. | 1.10 | −3.52 |
| Q8. Koreans eat 2 to 3 times more salt or sodium than they need. | 0.65 | −3.38 |
| Q9. Drinking alcohol lowers BP. | 0.80 | −2.06 |
| Q10. HBP is a man's problem. | 1.38 | −2.70 |
| Q11. Pregnancy-related HBP is temporary and doesn't require follow-up after delivery. | 0.79 | 0.29 |
| Q12. BP gets lower in cold weather. | 0.65 | −0.29 |
| Q13. HBP harms your body over time by: | 0.85 | −0.59 |
| Q14. Why is HBP called a ''silent killer?'' | 0.95 | −1.72 |
| Q15. A person is diagnosed with HBP if he/she has: | 0.68 | −0.82 |
| Q16. A good BP is: | 1.00 | −2.51 |
| Q17. Which of the following statements is true about HBP medications? | 0.91 | −0.83 |
| Q18. Which of the following statements is false about HBP medications? | 0.76 | −0.43 |
| Q19. All of the following health problems can result from HBP, except: | 1.03 | −1.33 |
| Q20. All of the following are changes that you can make in your diet to lower your HBP, except: | 0.64 | −1.67 |
| Q21. All of these lifestyle changes might help lower your BP, except: | 0.75 | −1.44 |

Abbreviations: BP, blood pressure; HBP, high blood pressure.
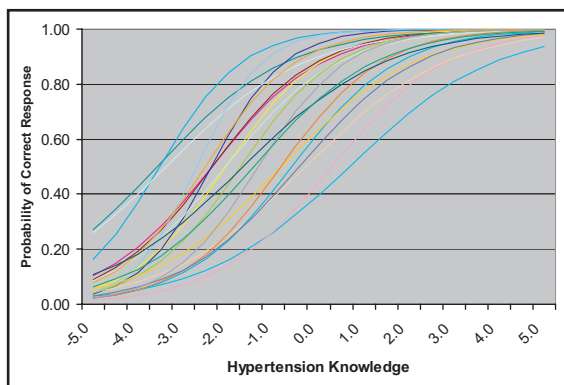


**FIGURE.** Item characteristic curves for 21 high blood pressure knowledge items.

**TABLE VI.** Association Between HBP Knowledge and BP

| | Source of Data | | |
|---|---|---|---|
| | Study 1 HBP Knowledge | Study 2 HBP Knowledge | Total HBP Knowledge |
| SBP | r=−0.13 (P=.005) | r=−0.09 (P=.05) | r=−0.11 (P=.001) |
| DBP | r=−0.08 (P=.107) | r=−0.00 (P=.91) | r=−0.05 (P=.156) |
| BP control | T=−1.89 (P=.06) | T=−1.62 (P=.106) | T=−2.52 (P=.012) |

Abbreviations: BP, blood pressure; DBP, diastolic blood pressure; HBP, high blood pressure; SBP, systolic blood pressure.

Americans answered incorrectly on items about HBP symptoms and diagnosis, HBP medications, harmful effects of HBP over time, and the relationship between BP and cold weather. Korean Americans' lower knowledge about these items, particularly HBP medications is of concern in view of their high prevalence of uncontrolled HBP and less access to medications.[12,14] These results suggest and support continuing need for educational interventions to address their insufficient knowledge in key areas of HBP management.

The reliability and validity of the HKT were supported in the combined sample of Korean American patients with adequate differentiation between those with and without HBP control. Item-total correlations for the 21 items on the HKT were all within the acceptable range of 0.15[27] for the total sample with an internal consistency coefficient of 0.70, meeting the minimum acceptable level of reliability. The result may have to do with the item heterogeneity in that the HKT addresses knowledge of different HBP risk factors (eg, obesity, diet, drinking) or various symptoms and consequences of HBP. Nevertheless, the HKT yielded a reliability estimate that should allow researchers to use it with some confidence. Indeed, the usefulness of the HKT as an outcome measure has been reported in a separate study with significant changes in HKT scores at 3-month follow-up

(*P*=.000) after an educational intervention for Korean Americans.[16]

IRT findings offer insights on the overall and specific performance of the HKT items. In general, the information curves for the HKT items revealed that the 21 items performed in a similar pattern as a cluster at the lower end of the HBP knowledge trait. Location parameters (*b*) of the 21 items were between 0 and −3. The results suggest that the HKT is best at quantifying differences among respondents who are less knowledgeable about HBP, particularly within 3 standard deviations below the group mean. All the items on the HKT were found to be at least moderately discriminating, with the discriminating (*a*) parameters ranging from 0.62 to 1.38, although several items were particularly good at distinguishing between respondents at different levels of HBP knowledge. Taken together, the current set of items on the HKT will perform best among quantifying differences among individuals with lower HBP knowledge and hence can be useful for identifying individuals who are in need of further education about HBP.

## LIMITATIONS

While this study offers great opportunities to measure HBP knowledge among recent Korean American immigrants in the Baltimore-Washington metropolitan area, an understudied and vulnerable population, there are a number of limitations to consider. The two samples included in the analysis were participants in educational intervention trials for HBP control. People who volunteered to be in those trials were likely to be more interested in their health and HBP management than those who did not. Therefore, the level of HBP knowledge reported in this study might have been an overestimate of the HBP knowledge in the larger Korean American population, limiting the generalizability of the findings. In addition, the HKT was administered in the two behavioral intervention trials along with a number of other study questionnaires. Therefore, participant fatigue might have been introduced, influencing participant performance on the measure.

## CONCLUSIONS

While there is no standard to measure the level of HBP knowledge required for adequate management of HBP, we developed the HKT, a measure that was modified from the National Heart Blood and Lung Institute hypertension knowledge questionnaire[19] as well as a literature review and community input, to assess patients' general knowledge of HBP. The reliability and validity of the HKT was supported in this sample of Korean Americans. The HKT was also sensitive in detecting differences among persons with and without adequate HBP control. Furthermore, given that there are 21 items written at the 4th-grade level, the HKT can be easily self-administered and may be particularly helpful in identifying patients with low HBP knowledge. With continued validation, clinicians can use the knowledge gaps demonstrated on the HKT to provide the basis for additional hypertensive management education for Korean Americans with HBP. Future research is warranted to evaluate the HKT in other ethnic samples of hypertensive patient populations.

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