Published in final edited form as:
J Cardiovasc Nurs. 2009 ; 24(6): 500–509. doi:10.1097/JCN.0b013e3181aff0b0.

Development, Psychometric Testing, and Revision of the Atlanta Heart Failure Knowledge Test

Carolyn Miller Reilly, RN, PhD,
Assistant Professor, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, Georgia

Melinda Higgins, PhD,
Assistant Research Professor, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, Georgia

Andrew Smith, MD,
Associate Professor of Medicine, School of Medicine, Emory University, Atlanta, Georgia

Rebecca A. Gary, RN, PhD,
Assistant Professor, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, Georgia

Judith Robinson, RN, MSN,
Clinical Research Nurse, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, Georgia

Patricia C. Clark, RN, PhD, FAAN,
Professor, Byrdine F. Lewis School of Nursing, Georgia State University, Atlanta

Frances McCarty, PhD, and
Assistant Professor, Institute of Public Health, Georgia State University, Atlanta

Sandra B. Dunbar, RN, DSN, FAAN
Charles Howard Candler Professor of Cardiovascular Nursing, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, Georgia

Abstract

Background and Research Objective—Several heart failure (HF) knowledge tools have been developed and tested over the past decade; however, they vary in content, format, psychometric properties, and availability. This article details the development, psychometric testing, and revision of the Atlanta Heart Failure Knowledge Test (A-HFKT) as a standardized instrument for both the research and clinical settings.

Participants and Methods—Development and psychometric testing of the A-HFKT were undertaken with 116 New York Heart Association (NYHA) class II and III community-dwelling HF patients and their family members (FMs) participating in a family intervention study. Internal consistency, reliability, and content validity were examined. Construct validity was assessed by correlating education level, literacy, dietary sodium ingestion, medication adherence, and healthcare utilization with knowledge.

Results—Content validity ratings on relevance and clarity ranged from 0.55 to 1.0, with 81% of the items rated from 0.88 to 1.0. Cronbach α values were .84 for patients, .75 for FMs, and .73 for

Corresponding author: Carolyn Miller Reilly, RN, PhD, Nell Hodgson Woodruff School of Nursing, Emory University, 1599 Clifton Rd. NE, Mailstop 1599-001-1AJ, Atlanta, GA 30322 (cmill02@emory.edu).

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.jcnjournal.com).

combined results. Construct validity testing revealed a small but significant correlation between higher patient and FM knowledge on sodium restriction questions and lower ingested sodium, $r = -0.17$, $P = .05$ and $r = -0.19$, $P = .04$, respectively, and between patient knowledge and number of days that medications were taken correctly (diuretics: $r = 0.173$, $P < .05$, and angiotensin-converting enzyme: $r = 0.223$, $P = .01$). Finally, patients seeking emergency care or requiring hospitalization in the 4 months before study entry were found to have significantly lower FM knowledge using both *t* test and logistic regression modeling.

Conclusions—The A-HFKT was revised using the content and construct validity data and is available for use with HF patients and FMs. The construct validity testing indicates that patient knowledge has a significant relationship to aspects of self-care. Furthermore, family knowledge may influence patient adherence with sodium restriction and healthcare utilization behavior.

Keywords

education; heart failure; knowledge

Nearly 6 million people are presently living with heart failure (HF),[1] creating both personal and societal burdens of high health resource utilization and associated costs.[2,3] Frequent hospitalizations are central to this burden and have been directly associated with nonadherence to the prescribed medical regimen and lifestyle modifications (eg, dietary sodium restriction, daily monitoring of weight and symptoms, and medication adherence).[4–6] Although many factors contribute to poor adherence, knowledge has been identified as an essential component for adequate HF self-care management, maintenance, and decision making,[7] and lack thereof as a contributor to rehospitalization.[8]

Efforts to improve HF patient and family member (FM) knowledge, and hence adherence and self-care, are enhanced by clinician understanding of patient's and FM's HF knowledge and reassessment after education or intervention delivery. Thus, a valid and reliable instrument to measure HF knowledge is essential. This article describes the development, pilot, and psychometric testing, as well as the revision, of the Atlanta Heart Failure Knowledge Test (A-HFKT) as a standardized instrument for potential use in both the clinical research and practice settings.

Background and Significance

One contributor to poor adherence and inadequate self-care in persons with HF that has received considerable attention and resulted in the development of several educational interventions and disease management programs is inadequate patient knowledge.[9,10] Although knowledge alone does not guarantee improved adherence, patients who are provided with education concerning their disease and necessary lifestyle modifications demonstrate improved outcomes. Examples of successful outcomes from educational interventions include better adherence to a sodium-restricted diet,[11,12] adherence with daily medications and measurement of weight,[10] and increased physical activity to improve functioning.[13] Fewer readmissions, significantly lower risk for hospitalization, and hospital cost savings of $7,515 per patient were demonstrated with in-depth patient education, teaching booklets, and telephone follow-up.[14] Furthermore, studies of telephone education and counseling in patients with HF have demonstrated a 46% reduced rehospitalization rate at 3 months, followed by 48% at 6 months[15] and a 20% relative risk reduction in combined all-cause mortality and HF admission.[16]

An appraisal of the peer-reviewed literature published in the past decade revealed 16 studies that assessed HF patient knowledge, learning needs, beliefs, and/or related confidence in self-management with an instrument developed expressly for each study.[10,17–31] Of these, 11

specifically tested HF knowledge, providing an analysis of pretest and posttest values to demonstrate improved patient knowledge as one measure of intervention effectiveness.[10,17,19,21,22,25,27–32] Following is a review of 8 published studies that presented psychometric properties of their HF knowledge instruments and described the instrument in sufficient detail.

The earliest HF knowledge instrument discussed in the literature[21] was a 3-part tool administered by home health nurses that assessed family and environment, current knowledge, and learning style. The knowledge section focused on what the patient currently knew about the HF disease process, activity, diet, and medications. Content and face validity were established through expert review. Although further description of the tool and psychometric values were not presented, the nurses using the tool evaluated it positively as a means of determining focused, appropriate, and comprehensive teaching to patients with HF and their caregivers.

Artinian et al[17] developed a 13-item multiple-choice test of HF knowledge, with 2 additional items requiring short answers. Items developed for this test were based on clinical experience by the primary author and a review of the literature centering on domains of HF disease state, symptoms, low-sodium food selection, medications including actions and side effects, and self-management activities such as weight monitoring and physical activity. A content validity review for this instrument was done by a nurse practitioner and 2 patient educators, and the authors reported a Cronbach α (CA) reliability of .61 in a sample of 123 participants. In a second study,[31] a slightly revised version of this test composed of 15 multiple-choice questions plus 1 fill-in-the-blank item was administered to 110 participants. The authors acknowledged that the psychometric properties of the test were not firmly established, noting a CA reliability of .62.

The Dutch Heart Failure Knowledge Scale is a 15-item multiple-choice test concerning HF general knowledge, treatment, symptoms, and symptom recognition.[29] Internal consistency was assessed in a sample of 902 Dutch HF patients from 17 hospitals who were hospitalized for HF and participating in the Coordinating study evaluating Outcomes of Advising and Counselling in Heart Failure (COACH) study. In this sample, the internal consistency reliability using CA was .62. Content and face validity were established with a review of the content by 10 experienced HF nurses, 2 cardiologists, and 6 patients who judged the items as relevant, clear, and easy to understand. Construct validity was established by comparing the scores of newly diagnosed patients to the scores of HF patients who have previously received extensive HF education, and an expected statistically significant greater number of correct answers from the latter group was obtained. The authors, using factor analysis as a statistical confirmation of construct validity, were unable to determine factor loadings for 3 possible subscales. Thus, the reliability analysis was reported for the total score.

Caldwell et al[19] developed a 24-item written questionnaire composed of multiple-choice and yes/no or true/false questions that were adapted from the Rapid Early Action for Coronary Treatment (REACT) study[33] of acute myocardial patients. Content validity of this instrument was established with a review by a cardiologist, 2 doctorally prepared nurses, and 2 cardiovascular clinical nurse specialists. Internal consistency reliability (CA = .83) was reported from administering the questionnaire to 36 patients with HF. Mean knowledge score at baseline was low at 64% and, similar with other studies, improved after the educational intervention.

Assessing psychometric properties, Lainscak and Keber[27] validated their self-assessment patient knowledge questionnaire for HF patients. The instrument is less of an assessment of patient knowledge concerning HF, symptoms, and treatments and more of an affirmation of previously received education topics. An example is the question “Do you think your clinical

condition has been clearly explained to you?" In their trial of the instrument in 82 patients with HF, the authors report an adequate internal consistency coefficient of 0.74, no statistical differences in reproducibility testing, and inferred construct validity from better overall scores in persons receiving care from a HF clinic compared with those receiving usual care.

A structured questionnaire was used to assess knowledge about symptoms and self-care in 208 Swedish HF patients[28] after a pilot test with 10 patients. The internal consistency of the questionnaire was demonstrated using the split-half technique, resulting in the correlation coefficient of 0.68 and a reliability of 0.81 using the Spearman-Brown prophecy formula. The questionnaire was originally composed of 33 structured questions or statements about HF, etiology, medication, sodium and fluid restrictions, and symptoms but then was reduced to 19 questions because of redundancy. Responses for questions were open-ended or yes/no although no scoring information was provided. After the intervention, individual item scores improved, but total scores were not significantly improved either over time or between groups. Gender differences in baseline knowledge and knowledge acquisition between groups were noted with women, initially starting with less knowledge but gaining more from the nurse-based management program.

Finally, a study of an HF knowledge test was presented in 2006[25] in which patients (n = 37) from Hong Kong were given a 10-item multiple-choice test with questions covering disease recognition, risk factors, signs and symptoms, medication, diet and exercise. The instrument was developed to measure understanding and recollection of information taught during an intervention program. Content validity was obtained through a Likert rating of relevance of each item by 12 healthcare professionals working in the rehabilitation field. The average rating for individual questions ranged from 4.08 to 4.67, with an overall mean (SD) of 4.42 (0.32). No other psychometric properties or outcomes related to HF knowledge were presented.

In summary, several instruments assessing HF knowledge have been developed and tested for their psychometric properties to varying degrees. The most consistent domains of knowledge were HF disease process, symptom recognition, dietary modifications, and information concerning medications. With a few exceptions, many were from small samples without full reporting of reliability and validity information. No studies of instruments demonstrating construct validity with measurable clinical outcomes or reporting FM or caregiver knowledge were found.

Instrument Development

The A-HFKT was initially developed to measure patient and family knowledge about HF, treatment, and self-care. In addition, the 27-item instrument was designed to measure change in knowledge after exposure to a specific education and self-management intervention for HF patients and their FMs. Items were generated to measure domains of patient education related to the HF disease process, diet and nutrition (including sodium and fluid restriction), medications, symptoms, and behaviors (such as daily weighing and physical activity). The concepts were drawn from clinical recommendations for patient and family teaching, with emphasis on self-care.[34,35]

Multiple-choice questions were generated with emphasis on knowledge related to key pathophysiology (2 items), nutrition (11 items), behavior (5 items), symptom assessment/management (4 items), and medication (5 items) components of HF self-care, which tend to take place in the family context. Permission was obtained to adapt and include 4 items from the instrument developed by Artinian and colleagues.[17] The reading level was determined to be at a fifth grade level using the Flesch-Kincaid formula and the Fry Readability statistics.[36]

Scoring of the test attributes 1 point for each correct answer with no additional weighting of items, followed by summing the correct responses. Incorrect or skipped questions were awarded 0 points. For purposes of this analysis, total scores ranged from 0 to 27 but could also be converted to a 0% to 100% scale for standardization. Although there are more than 2 choices, nominal scaling (right/wrong) was used because the instrument was developed for discrete knowledge measurement. This is in contrast to several other knowledge tools that used Likert scaling, usually reserved for measuring variables such as viewpoints, attitudes, or opinions that can be measured on a continuum.

Content validity of the test was assessed by distributing the new instrument to a panel of 9 nationally known nurse experts in HF patient education and self-management. The national nurse experts were selected based on their HF clinical and research activities related to patient education and self-management and their prior publications in the field.

The experts were asked to rate each item for clarity and relevance using a structured process. Clarity was defined as understandability; relevance was defined as appropriateness for the population of HF patients. Ratings were requested on a 4-point scale, with 1 being the least clear/relevant and 4 representing the highest clarity/relevance. Expert raters were also asked to identify missing areas and to make comments and suggestions for use in revising each item. Mean item level content validity (I-CVI) scores for clarity and relevance were separately calculated by determining the proportion of ratings greater than 3.[37] In addition, scale level content validity index (S-CVI/Ave) was calculated by the mean of the I-CVIs.[37]

The clarity item level scores ranged from 0.55 to 1.0, with 81% of the items rated as 0.88 to 1.0. For relevance, the aspect most important to content validity, I-CVI ranged from 0.55 to 1.0, with 92% rated between 0.88 and 1.0. Thus, at the item level, the clarity (0.81) and relevance (0.92) CVI ratings were acceptable, and the overall S-CVI/Ave (0.96) was excellent.[37]

Comments provided by the experts were examined, and revisions were made accordingly. Specific attention was given to the items with the lowest I-CVI on clarity. Four raters identified missing areas including vaccine recommendations and action to be taken when medications were not taken as prescribed. These suggestions were useful in revising the final questions.

Reliability and Validity Testing

Setting and Sample

Data were collected from NYHA class II and III HF community-dwelling patients and their FMs who participated in a family intervention study (N = 116 dyads). The study was approved by the Institutional Review Board of Emory University, and both members of the dyad gave written informed consent. Inclusion criteria for the patient were ability to read, write, and speak English; telephone access; medication regimens that include angiotensin-converting enzyme inhibitors (ACE-Is) or angiotensin receptor blockers (ARBs) and diuretics or documented contraindications to these; a low-sodium diet; ambulatory, glomerular filtration rate of more than 30; and participation by an eligible FM defined as a spouse, partner, or other adult (18 years or older) FM living in the same house or in contact with the HF patient in a caregiver relationship at least 2 times per week.

Variables and Measures

Patient demographic and clinical data were obtained from patient history and the medical record. Family demographics were obtained from self-report of FMs. Both the patient and FM separately completed the A-HFKT before intervention. Both members of the dyad also completed the Rapid Estimate of Adult Literacy in Medicine (REALM), a psychometrically

reliable and valid word recognition test of 66 items arranged in order of complexity and pronunciation difficulty used to assess health literacy.[38]

Variables used in the assessment of construct validity included education level, REALM score, dietary sodium ingestion, medication adherence, and patient reported number of hospitalizations. Dietary sodium ingestion was measured by urinary sodium values obtained from a 24-hour urine sample collected by the patient in the outpatient setting. More than 95% of ingested sodium is excreted in the urine.[39] Urine collections occurred with patients in "steady state" (on stable medication regimen for at least 14 days) and were assessed for total volume, urinary sodium, urea, and creatinine to determine completeness of collections based on standard formulas correcting for sex and age.

Medication adherence was measured using the Medication Event Monitoring System (MEMS), a microelectronic monitoring device applied as a cap to medication containers. The MEMS system records each time a cap is removed from a medication bottle, allowing adherence data to be transferred to a computer database for analysis and display. Available information included a calendar with doses per day, a chronology of times per day that each dose was taken, missing doses, and drug holidays. For this analysis, the percentage of days that doses of ACE-Is/ARBs and diuretics were taken correctly was used.

In terms of construct validity evidence, we hypothesized that HF knowledge would be positively associated with education level for both patients and FMs, as well as positively associated with health literacy. We also hypothesized that HF knowledge would be positively associated with medication adherence. Finally, we hypothesized that HF knowledge would be negatively associated with number of hospitalizations and amount of dietary sodium ingestion.

Data Analysis

Sample characteristics were assessed using descriptive statistics. Internal consistency reliability was analyzed using CA for patient, family, and combined data. Item statistics including difficulty and discrimination were also generated. Construct validity was assessed through *t* tests, Pearson *r* correlations, and logistic regression. SPSS version 15.0 (SPSS Inc, Chicago, Illinois) was used to analyze data.

Results

Sample Description

Patients were 28 to 78 years old and primarily male; 57% were African American, and the mean (SD) left ventricular ejection fraction was 27.1% (13.7%). Family members were 19 to 78 years old, primarily female, and 58.8% were African American. Fifty-three percent of the FMs were spouses or long-term partners of the patients. Table 1 provides additional demographic and clinical background of the sample.

Most patients completed a minimum of high school, with about half also completing some college or graduate school. Formal education of FMs was similar to patients. Sixty-six percent of patients and nearly 70% of FMs were determined to read between the ninth and 12th grade levels using the REALM with raw scores not significantly different between patients (mean [SD] = 59.71 [10.75]) and FMs (mean [SD] = 60.26 [9.52]), $t_{111} = 0.583$, $P = .561$.

Heart Failure Knowledge Scores

A survey of the difficulty indexes for each question answered by patients and families revealed a few surprises. All patients and nearly all FMs knew that persons with HF should avoid salty foods, stop smoking, and limit alcohol, but only 50% of patients and 39% of FMs could

correctly identify the daily amount of sodium that persons with HF should eat. Both patients and FMs had difficulty with questions regarding the action of HF medications and identifying the best over-the-counter medication for pain. The only questions that appeared to pose more difficulty for FMs than for patients was a question concerning whether HF could be cured and a second question concerning the recommended frequency of weight monitoring.

Internal consistency of the A-HFKT using the CA standardized item for the total scale was adequate for patients, FMs, and the combined patient and family tests as presented in Table 2. While the CA is equivalent to Kuder-Richardson 20 coefficient for nominal data, split-half computations are also presented displaying reliability coefficients that are similar. As previously described, questions were derived from 5 domains (pathophysiology, nutrition, behavior, symptom assessment/management, and medication), but this test does not lend itself to the identification of multiple subscales due to the limited number of questions per domain.[40]

Although the total instrument CA is within the .70 to .90 recommended for cognitive tests,[41] a review of the item-to-total correlations revealed 3 items that did not meet the minimum .3 criteria[42] in the patient cohort and 4 questions that were problematic for FMs. When analyzed as a combined sample, these same items fell below the acceptable level, indicating their lack of contribution to internal consistency.[42] A cross-tabulation analysis of the percentage of items answered correctly by patient, family, and combined dyads further revealed that 4 of these items were correctly answered less than 40% of the time by respondents, which could indicate global lack of knowledge for these items or poorly worded questions. To discriminate, an analysis of the posttest results (administered after the intervention) revealed that, in all but 2 questions, the percentile of correct responses was greater than 45% for patients and FMs.

Finally, discrimination indexes were calculated to determine how well each question discriminated between and high and low achievers on the test. Eight of the questions scored less than 0.15, indicating poor discrimination for the patient. Of these 8 questions, 7 were also difficult for the FMs. A review of these questions indicated that the questions were either nearly always answered correctly or incorrectly depending upon the question. These data were used in the rewording of the questions. Although space limitations preclude an item-by-item accounting of questions revised, an example of a question changed because it was nearly always answered correctly is item 22 which asked participants to identify the fast food with the lowest amount of sodium. As originally worded, choice C “Garden salad” was correctly chosen by 95% of patients and 88% of FMs indicating poor discrimination. This question was reworded as listed on the Web site so that option C is now “Baked potato with sour cream and chives” and a plausible distracter of “Taco salad” is choice D.

Construct Validity

In addition to establishing content validity, construct validity was assessed to determine if the A-HFKT was related in expected ways with measures of other constructs consistent with theoretically derived hypotheses.[43] The rationale for providing educational interventions to improve knowledge is to ultimately improve ability to enact self-care behavior. To explore this association, a variety of analyses were undertaken evaluating the relationship of the knowledge test to education level, REALM scores, and baseline outcomes of ingested sodium, medication adherence, and healthcare utilizations.

Theoretically, someone with HF should have been exposed to some degree of patient education and know a little more than someone without the illness. This was demonstrated with paired *t* test revealing a significant difference between patients and families on HF knowledge, with patients (mean [SD] = 19.81 [3.30]) scoring slightly better than FMs (mean [SD] = 18.37 [3.66]) on the A-HFKT, $t_{108} = -4.28$, $P < .01$.

Similarly, it would be expected that higher education levels and REALM scores would predict higher knowledge scores. Analyses of scores by level of education revealed a significant difference in participants who attended college (mean [SD] = 20.43 [3.0]) versus those attending technical or vocational school or completed varying levels of high school (mean [SD] = 19.03 [3.54]), $t_{109} = 2.24$, $P < .05$. This same trend of higher knowledge scores in persons completing more years of formal schooling was observed also in FMs (mean [SD] = 19.36 [3.06] for college vs mean [SD] = 17.31 [4.0] for technical, vocational, or high school), $t_{106} = 3.03$, $P < .01$. This corresponded with a significant difference of knowledge scores when evaluated by reading grade level derived from the REALM in both patients (mean [SD] = 20.18 [3.16] for 12th grade vs mean [SD] = 18.67 [3.50] for eighth grade or less), $t_{107} = -2.23$, $P < .05$, and FMs (mean [SD] = 19.25 [3.09] for 12th grade vs mean [SD] = 16.47 [4.11] for eighth grade or less), $t_{59} = -3.66$, $P < .01$.

Patients with HF (mean [SD] = 19.93 [3.23]) and FMs (mean [SD] = 18.62 [3.5]) who reported trying to reduce dietary sodium had more correct answers on the total A- HFKT than those not trying to reduce dietary sodium (mean [SD] = 17.64 [3.91] for patients and mean [SD] = 16.08 [4.35] for FMs), $t_{111} = 2.19$, $P < .03$. In addition, there was a small but significant relationship between higher scores by patients on sodium knowledge and restriction questions and less ingested sodium as reflected by the 24-hour urine sodium value, $r = -0.17$, $P = .05$. A similar relationship was found when evaluating FM knowledge of sodium restriction questions with patient adherence to a low-sodium diet, $r = -0.19$, $P = .04$.

Relationship between medication knowledge and adherence measures revealed an association between higher scores on the A-HFQT and better adherence on the number of days that the diuretic ($r = 0.17$, $P < .05$) and ACE-Is/ARBs ($r = 0.22$, $P = .01$) were taken correctly. No relationship was demonstrated between family knowledge and patient medication adherence.

Finally, it was hypothesized that HF patients and caregivers who had less knowledge would have more healthcare utilization due to poorer self-management skills. *T* tests were initially used to compare patient and FM knowledge among those patients who had sought emergency treatment or required hospitalization in the immediate 4 months before study entry. Interestingly, FM knowledge, but not that of patients, was significantly lower in dyads where the patient had emergency department (ED) visits for HF (mean [SD] = 17.17 [0 .64]) compared to no ED visit (mean [SD] = 19.10 [0.42]), $t_{102} = 2.586$, $P = .01$. This was also found in analyzing hospitalizations (mean [SD] = 17.51 [0.56]) versus no hospitalizations (mean [SD] = 19.02 [0.44]) for HF ($t_{105} = 2.102$, $P < .05$) in the previous 4 months. Effect sizes were 0.31 for ED visits and 0.20 for hospitalizations.

Further testing with logistic regression produced small but significant results in both unadjusted and adjusted (age and NYHA class) models. Once again, family knowledge predicted patient ED visits ($\chi^2[1, n = 104] = 6.375$, $P = .012$) and hospitalizations ($\chi^2[1, n = 107] = 4.324$, $P = .038$), but patient knowledge did not, as presented in Table 3. Neither family nor patient knowledge was related to the number of visits.

Revision of the A-HFKT

Although the original tool of 27 items had a satisfactory reliability coefficient, individual item analyses and input from the content review panel indicated the need for some revisions.

The revised instrument (A-HFKT, V2) is being piloted with HF patients enrolled in a trial concerning fluid management and in a second study of homebound HF patients and caregiver congruence of symptoms. The revised instrument is available at the journal Web site (see Form, Suppmentental Digital Content 1, Atlanta Heart Failure Knowledge Test Version 2, http://links.lww.com/JCN/A1) with scoring instructions for use in other studies with

appropriate acknowledgement, which will hopefully facilitate broader use and additional psychometric testing.

The revised instrument now contains 30 multiple-choice items, with 2 questions concerning pathophysiology, 12 questions concerning nutrition, 6 questions regarding behaviors, 4 questions regarding symptom management, and 6 questions regarding medications. Revisions included simplification of some wording in stem questions and options, such as changing the wording on one option from “the heart doesn’t beat right” to “the heart skips beats.” Other revisions included standardization of 4 options for most questions and elimination of “not sure” and “no answer” as a possible answer. One question requiring the identification of the food type with most water content was replaced with a more general question related to fluid restriction. Finally, 3 questions regarding ways to control thirst, what to do if medications are accidentally missed, and health behaviors such as obtaining the flu and pneumovax vaccinations were added. These domains remain consistent with guidelines of care for HF patients and designation of patient teaching domains.[34] Although the psychometrics presented in this article relate to the original 27-item HFKT, it is believed that the revisions made will result in similar, if not better, reliability and validity values.

Discussion

Educational interventions and tests of knowledge for persons with HF have previously been reported; however, publication of complete instruments, scoring, and comprehensive psychometric properties vary. The validation and revisions presented for the A-HFKT offer an approach for assessing patient and FM knowledge of HF pathophysiology, diet and nutrition, medications, symptoms, and behaviors for both clinical practice and research.

Knowledge gleaned from analyzing the difficulty and discrimination indexes of the questions revealed that patients and FMs knew some basic information about HF, including that persons with HF should avoid salty foods, stop smoking, and limit alcohol. Only 50% of patients and 39% of FMs could correctly identify the amount (ie, around 2000 mg/d) that persons with HF should eat. This may be due to the variation in recommendations provided to patients and families by healthcare providers. Both patients and FMs had difficulty answering questions about the actions of typical HF medications. Lack of knowledge may help explain the low adherence with taking their ACE-Is/ARBs and diuretics as measured with the MEMS caps in this population. The lower knowledge scores demonstrated by persons with lower education levels and lower health literacy point to the need for greater educational interventions and attention to this population to reduce their vulnerability for subsequent poorer adherence and self-care.

The revised A-HFKT is presented for use with HF patients, as well as their FMs as integral members of the caregiving team. As confirmed in previous studies,[10,31] adherence to self-care behaviors was related to knowledge, with greater patient knowledge in this sample associated with lower sodium ingestion and better medication adherence.

Findings from testing the construct validity of this instrument indicate that family knowledge may be important to patient adherence with dietary sodium restriction and use of health resources such as ED visits and hospitalizations. This assessment of family knowledge and influence has been tested and facilitated in other serious and chronic illnesses[44–46] but has only recently been studied in persons with HF.[47] Findings from this analysis support the recommendation of providing education to patients and FMs who may be more supportive of appropriate choices or actually provide care such as shopping and cooking for the patient.[48]

Two limitations were noted for this analysis. First, because of the demographics of the population served in the first trial, testing of this instrument was undertaken in primarily white

and African Americans, but not Hispanics or Asians. We hope to test the revised instrument in a more diverse population in the future.

Second, several of the instruments previously developed for evaluating HF knowledge and beliefs assessed construct validity through factor analysis because they used a Likert scale; however, the A-HFKT is a test of knowledge with items coded as right or wrong. Given the binary nature of the item scoring and the relatively small sample size, we decided not to conduct a factor analysis. We would recommend that a future study use factor analytic techniques that make use of a tetrachoric correlation matrix. This technique requires a somewhat larger sample ($n > 300$) than was available in this study.

In conclusion, assessment of HF knowledge remains a relevant and ongoing area of research. The first version of the A-HFKT demonstrated acceptable psychometric properties, and a revised version is now being used in other studies with HF patients and FMs. Application is also possible in the clinical settings with both patients and FMs. The A-HFKT is unique among the various HF knowledge tests in that it demonstrates acceptable psychometric properties with FMs or care-givers and demonstrates construct validity by directly correlating knowledge with clinical and self-care outcomes including dietary sodium consumption, medication adherence, and healthcare utilization. Results of ongoing and planned randomized trials will continue to add psychometric information about the revised instrument and contribute to a better understanding of the role of knowledge in HF patient outcomes.

What's New and Important

- The A-HFKT is a useful tool to assess both patient and family member heart failure knowledge with demonstrated acceptable psychometric properties.
- Content validity ratings on relevance and clarity ranged from .55 to 1.0 with 81% of the items rated .88–1.0. Reliabiity by Cronbach alpha was 0.84 for patients, 0.75 for family members, and 0.73 for combined results.
- Construct validity was demonstrated by directly correlating knowledge with clinical and self care outcomes including dietary sodium consumption, medication adherence, and healthcare utilization.

Acknowledgments

This study was supported by the National Institute of Health (NIH)/National Institute of Nursing Research (NINR) RO1 NR008800 (S.B. Dunbar, principal investigator), the Emory General Clinical Research Center NIH grant M01-RR00039, and NIH/NINR NRSA 5F32 NR010451-02 (C.M. Reilly, principal investigator).

References

1. American Heart Association. Heart Disease and Stroke Statistics—2009 Update. Dallas, TX: American Heart Association; 2009.
2. DeFrances, CJ.; Podgornik, MN. 2004 National Hospital Discharge Survey. Hyattsville, MD: National Center for Health Statistics; 2006.
3. Bonow RO, Bennett S, Casey DE, et al. ACC/AHA clinical performance measures for adults with chronic heart failure. J Am Coll Cardiol 2005;46(6):1144–1178. [PubMed: 16168305]
4. Tsuyuki RT, McKelvie RS, Arnold JM. Acute precipitants of hospitalization for heart failure exacerbations. Arch Intern Med 2001;161(19):2337–2342. [PubMed: 11606149]
5. Bennet SJ, Huster GA, Baker SL, et al. Characterizations of the precipitants of hospitalization for heart failure decompensation. Am J Crit Care 1998;7(3):168–174. [PubMed: 9579241]

6. Ghali JK, Kadakia S, Cooper R, Ferlinz J. Precipitating factors leading to decompensation of heart failure. Traits among urban Blacks. Arch Intern Med 1988;148(9):2013–2016. [PubMed: 3046541]
7. Riegel B, Dickson VV. A situation-specific theory of heart failure self-care. J Cardiovasc Nurs 2008;23 (3):190–196. [PubMed: 18437059]
8. Welsh JD, Heiser RM, Schooler MP, et al. Characteristics and treatment of patients with heart failure in the emergency department. J Emerg Nurs 2002;28(2):126–131. [PubMed: 11960124]
9. Stromberg A. The crucial role of patient education in heart failure. Eur J Heart Fail 2005;7:363–369. [PubMed: 15718176]
10. Ni H, Nauman D, Burgess D, Wise K, Crispell K, Hershberger R. Factors influencing knowledge of and adherence to self-care among patients with heart failure. Arch Intern Med 1999;159:161–169. [PubMed: 9927099]
11. Dunbar SB, Clark PC, Deaton C, Smith AL, De AK, O'Brien MC. Family education and support interventions in heart failure: a pilot study. Nurs Res 2005;54(3):158–166. [PubMed: 15897791]
12. Kutzleb J, Reiner D. The impact of nurse-directed patient education on quality of life and functional capacity in people with heart failure. J Am Acad Nurse Pract 2006;18(3):116–123. [PubMed: 16499744]
13. Gary R. Exercise self-efficacy in older women with diastolic heart failure: results of a walking program and education intervention. J Gerontol Nurs 2006;32(7):31–39. [PubMed: 16863044]
14. Krumholz HM, Amatruda J, Smith GL, et al. Randomized trial of an education and support intervention to prevent readmission of patients with heart failure. J Am Coll Cardiol 2002;39(1):83–89. [PubMed: 11755291]
15. Riegel B, Carlson B, Kopp Z, LePetri B, Glaser D, Unger A. Effect of a standardized nurse case-management telephone intervention on resource use in patients with chronic heart failure. Arch Intern Med 2002;162(6):705–712. [PubMed: 11911726]
16. Grancelli H, Varini S, Ferrante D, et al. Randomized Trial of Telephone Intervention in Chronic Heart Failure (DIAL): study design and preliminary observations. J Card Fail 2003;9(3):172–179. [PubMed: 12815566]
17. Artinian NT, Magnan M, Christian W, Lange MP. What do patients know about their heart failure? Appl Nurs Res 2002;15(4):200–208. [PubMed: 12444578]
18. Albert NM, Zeller RA. Developing and testing of the survey of illness beliefs in heart failure tool. Prog Cardiovasc Nurs 2007;22(1):63–71. [PubMed: 17541315]
19. Caldwell MA, Peters KJ, Dracup KA. A simplified education program improves knowledge, self-care behavior, and disease severity in heart failure patients in rural settings. Am Heart J 2005;150 (5):983.e988–983.e912. [PubMed: 16290977]
20. Albert NM, Buchsbaum R, Li J. Randomized study of the effect of video education on heart failure healthcare utilization, symptoms, and self-care behaviors. Patient Educ Couns 2007;69:129–139. [PubMed: 17913440]
21. Lile JB, Buhmann J, Roders S. Development of a learning needs assessment tool for patients with congestive heart failure. Home Health Care Manag Pract 1999;11(6):11–25.
22. Gonzalez B, Lupon J, Herreros J, et al. Patient's education by nurse: what we really do achieve. Eur J Cardiovasc Nurs 2005;4:107–111. [PubMed: 15904880]
23. Gonzalez B, Lupon J, Parajon T, et al. Nurse evaluation of patients in a new multidisciplinary heart failure unit in Spain. Eur J Cardiovasc Nurs 2004;3:61–69. [PubMed: 15053889]
24. Hagenhoff BD, Feutz C, Conn VS, Sagehorn KK, Moranville-Hunziker MB. Patient education needs as reported by congestive heart failure patients and their nurses. J Adv Nurs 1994;19:685–690. [PubMed: 8021389]
25. Hui E, Yang H, Chan LS, et al. A community model of group rehabilitation for older patients with chronic heart failure: a pilot study. Disabil Rehabil 2006;28(23):1491–1497. [PubMed: 17166817]
26. Kline KS, Scott LD, Britton AS. The use of supportive-educative and mutual goal-setting strategies to improve self-management for patients with heart failure. Home Healthc Nurse 2007;25(8):502–510. [PubMed: 17828004]
27. Lainscak M, Keber I. Validation of self assessment patient knowledge questionnaire for heart failure patients. Eur J Cardiovasc Nurs 2005;4:269–272. [PubMed: 15936987]

28. Karlsson MR, Edner M, Henriksson P, et al. A nurse-based management program in heart failure patients affects females and persons with cognitive dysfunction most. Patient Educ Couns 2005;58:146–153. [PubMed: 16009290]
29. van der Wal MHL, Jaarsma T, Moser DK, van Veldhuisen DJ. Development and testing of the Dutch Heart Failure Knowledge Scale. Eur J Cardiovasc Nurs 2005;4:273–277. [PubMed: 16126459]
30. Stromberg A, Dahlstrom U, Fridlund B. Computer-based education for patients with chronic heart failure. A randomised, controlled, multicentre trial of the effects on knowledge, compliance and quality of life. Patient Educ Couns 2006;64:128–135. [PubMed: 16469469]
31. Artinian NT, Megnan M, Sloan M, Lange MP. Self-care behaviors among patients with heart failure. Heart Lung 2002;31(3):161–172. [PubMed: 12011807]
32. Rogers MAM, Small D, Buchan DA, et al. Home monitoring service improves mean arterial pressure in patients with essential hypertension. Ann Intern Med 2001;134(11):1024–1032. [PubMed: 11388815]
33. Simons- Morton DG, Goff DC, Osganian S. Rapid early action for coronary treatment: rationale, design, and baseline characteristics. REACT Research Group. Acad Emerg Med 1998;5:726–738. [PubMed: 9678398]
34. Heart Failure Society of America H. HFSA 2006 comprehensive heart failure practice guideline. J Card Fail 2006;12:e1–e2. [PubMed: 16500560]
35. Konstam, M.; Dracup, K.; Baker, DW.; Bottorff, MB.; Brooks, NH.; Dacey, RA. Heart Failure: Evaluation and Care of Patients With Left-Ventricular Systolic Dysfunction. Rockville, MD: Agency for Health Care Policy and Research; 1994.
36. Fry, E. Elementary Reading Instruction. New York, NY: McGraw Hill; 1977.
37. Polit, DF.; Beck, CT. Nursing Research: Generating and Assessing Evidence for Nursing Practice. 8. Philadelphia, PA: Lippincott Williams & Wilkins; 2008.
38. Davis TC, Long SW, Jackson RH, et al. Rapid estimate of adult literacy in medicine: a shortened screening instrument. Fam Med 1993;25(6):391–395. [PubMed: 8349060]
39. Bates, CJ.; Thurnham, DI.; Bingham, SA. Biochemical markers of nutrient intakes. In: Margetts, BM.; Nelson, M., editors. Design Concepts in Nutritional Epidemiology. New York, NY: Oxford University Press; 1997. p. 170-240.
40. Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika 1951;16:297–334.
41. Kline, P. The Handbook of Psychological Testing. 2. London, England: Routledge; 1999.
42. Field, A. Discovering Statistics Using SPSS. 2. London, England: Sage; 2005.
43. Carmines, EG.; Zeller, RA. Reliability and Validity Assessment. Newbury Park, CA: Sage Publications; 1979.
44. Given B, Sherwood PR. Family care for the older person with cancer. Semin Oncol Nurs 2006;22(1): 43–50. [PubMed: 16458182]
45. Cole I, Chesla CA. Interventions for the family with diabetes. Nurs Clin North Am 2006;41(4):625–639. [PubMed: 17059978]
46. Hudson PL, Aranda S, Hayman-White K. A psychoeducational intervention for family caregivers of patients receiving palliative care: a randomized controlled trial. J Pain Symptom Manage 2005;30 (4):329–341. [PubMed: 16256897]
47. Chung ML, Lennie TA, Moser DK. Impact of gender, marital status, and diabetes on adherence to a low sodium diet. Eur J Cardiovasc Nurs 2005;4:73.
48. Dunbar SB, Clark PC, Quinn C, Gary RA, Kaslow NJ. Family influences on heart failure self-care and outcomes. J Cardiovasc Nurs 2008;23(3):258–265. [PubMed: 18437068]

TABLE 1

Demographic and Clinical Data (N = 116)

	Patient		Family Member	
Age, mean (SD), y	**56.12 (10.45)**		**52.28 (13.29)**	
Variable	**n**	**%**	**n**	**%**
Men	74	63.8	20	17.2
Married/domestic partner	67	57.8	74	63.8
Living alone	27	23.3	19	16.4
Race				
African American	67	57.8	67	58.8
White	49	42.2	46	40.4
Other	0	0	1	0.9
Hispanic	5	4.3	5	4.3
Highest education completed				
Technical/vocational school, high school, or less	60	51.7	59	51.8
College or postgraduate	56	48.3	55	48.2
Work status				
Full time	11	9.9	49	43
Part time or homemaker	11	9.9	21	18.4
Retired	26	23.4	22	19.2
Medical leave/disability	48	43.2	8	7
Not working but not retired	15	13.5	14	12.2
No. of hospitalizations due to heart failure (HF) in past 6 mo				
0	69	63.3		
1–2	29	26.6		
3–4	8	7.3		
>5	3	2.8		
No. of emergency visits due to HF in past 6 mo				
0	70	65.4		
1–2	30	28		
3–4	5	4.7		
>5	2	1.8		
Length of Time with HF				
0–6 mo	8	7		
7 mo to 1.5 y	16	14		
1.5–2 y	9	7.9		
2–4 y	24	21.1		
>5 y	57	50		
Type of HF				
Systolic	54	51.4		
Diastolic	18	17.1		

	Patient		Family Member	
Age, mean (SD), y	**56.12 (10.45)**		**52.28 (13.29)**	
Variable	**n**	**%**	**n**	**%**
Mixed	33	31.4		
New York Heart Association classification				
II	84	72.4		
III	32	27.6		

TABLE 2

Reliability Coefficients for the Atlanta Heart Failure Knowledge Test

	Patient Only	Family Only	Patient and Family
n	114	112	225
Cronbach α	.84	.75	.73
Spearman-Brown	0.85	0.70	0.71
Guttman split half	0.84	0.70	0.71

TABLE 3

Logistic Regression Results for Healthcare Utilization

				95% Confidence Interval for Exp(*B*)	
	B	**Significance**	**Exp (*B*)**	**Lower**	**Upper**
Emergency department visit					
Patient knowledge	−0.091	0.150	0.913	0.807	1.033
Constant	1.123				
	Model χ^2 (1, n = 106) = 2.104				
Family member (FM) knowledge	−0.144	0.014	0.866	0.771	0.971
Constant	1.944				
	Model χ^2 (1, n = 104) = 6.375				
Hospitalization					
Patient knowledge	−0.082	0.171	0.921	0.818	1.036
Constant	1.155				
	Model χ^2 (1, n = 109) = 1.899				
FM knowledge	−0.115	0.042	0.891	0.798	0.996
Constant	1.627				
	Model χ^2 (1, n = 107) = 4.324				