Development and Psychometric Properties of the Japanese Heart Failure Knowledge Scale

Japanese Heart Failure Knowledge Scale

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SUMMARY

Knowledge about their own condition is important for patients with heart failure (HF). No valid, reliable, and easily administered instrument is available to measure this knowledge in clinical practice. In this study, a HF knowledge scale was developed, and its psychometric properties were tested. Items related to knowledge about HF were extracted from relevant guidelines. Content validity of the items was confirmed by an expert panel including a cardiologist and nurses specialized in treatment and care of patients with HF. A self-administered questionnaire was then distributed to 187 patients with HF (64.0 ± 12.1 years, males 69%). In 62% patients, a left ventricular ejection fraction of $< 50\%$ was identified. Exploratory factor analysis demonstrated the one-dimensionality of the 15-item HF knowledge scale. Mean score was 10.7 ± 3.0 (range, 0–15). Known-group validity testing revealed a significant difference in HF knowledge score between patients newly diagnosed with HF and patients experienced with HF (9.4 ± 3.2 versus 10.8 ± 2.9 , $P = 0.043$). In addition, HF knowledge scale scores were correlated with HF self-care scores assessed by the European Heart Failure Self-Care Behavior Scale for evaluation of criterion validity ($\rho = -0.304$, $P < 0.001$). Cronbach's alpha was 0.79, and item-total correlation was 0.22–0.51, thereby suggesting that the reliability of the scale was acceptable. Acceptable validity and reliability were demonstrated for the HF knowledge scale developed in this study. This instrument could be useful in evaluation of patient knowledge about HF. (Int Heart J 2013; 54: 228–233)

Key words: Patient compliance, Patient education, Questionnaire, Reliability, Self-care, Validity

With the rapid aging of society in both Japan and Western countries, the number of patients with HF has also increased.¹⁾ Despite improvements in HF therapy, high rates of rehospitalization persist. In Japan, approximately 20% patients with HF were rehospitalized within 1 year of discharge.^{2,3)} HF creates physiological and psychological burdens for patients and their families, and also places an enormous economic burden on the health insurance system. Therefore, preventing deterioration of this disease in patients with chronic HF is extremely important.

In some cases, rehospitalization in patients with HF has been caused by their lack of self-care or inadequate knowledge about diet, medication, and HF symptoms.^{4,7)} A meta-analysis revealed a significant reduction in the rate of hospitalization due to worsening HF because of disease management programs aimed at enhancing self-care.⁸⁾ Although the underlying mechanism of this improved rate of hospitalization was not specified, the increase in knowledge about their own condition in patients with HF may have contributed to these results,

thereby enhancing self-care practice and improving clinical outcome. HF knowledge does not always guarantee good adherence to a therapeutic regimen, but previous studies have indicated that better adherence is often associated with greater knowledge.^{9,12)} Considering the fact that knowledge about HF may have a positive influence on patient prognosis, appropriate evaluation of the extent to which patients understand their condition may aid health care professionals in improving treatment adherence as well as outcome in patients with HF.

A review of the literature revealed that 4 instruments are currently available for measurement of the levels of HF knowledge. Two of these are questionnaires with comprehensive coverage of HF topics such as symptoms and treatment of HF.^{9,13)} However, the validity and reliability of these scales has not been fully demonstrated. Reilly, *et al* developed the Atlanta Heart Failure Knowledge test.¹⁴⁾ Although the content and construct validities and internal consistency of this test have been confirmed, the assessment length constitutes a barrier to its easier application in clinical settings. It contains 30 multiple-

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choice items and requires considerable time to complete. Finally, the psychometric properties of the 15-item Dutch Heart Failure Knowledge Scale have been confirmed.¹⁵⁾ The scale has been developed for research purposes, not for use in clinical practice. As a result, the questions on this instrument may require clinical knowledge that is too advanced for most HF patients.

A valid, reliable, and easily administered scale must be available for the measurement of knowledge in patients with HF; subsequently, test results of such scales may be used to enhance self-care practice and improve clinical outcomes. In this study, a HF knowledge scale was developed, and its validity and reliability were tested.

METHODS

Study procedure: A new instrument was developed in the form of a self-administered questionnaire for testing knowledge about HF in patients with HF. The content validity of the instrument was assessed before conducting the main study using focus group analysis. Moreover, a pilot study was conducted to determine face validity of the instrument. To test the psychometric properties of the HF knowledge scale, the questionnaire was distributed and scored against a master copy containing correct answers to all the items. Each item of the new scale was assessed for skewed distributions. Thereafter, construct and criterion validity analyses were performed. In addition, the sensitivity and reliability of the new scale were evaluated.

Instrument development: To develop an instrument for measuring knowledge about HF, HF guidelines¹⁶⁻¹⁸⁾ and prior studies^{9,10,12,19-23)} were consulted. The guidelines stated that HF patients should have at least some general knowledge of HF, its signs and symptoms, related treatment, and self-care. Based on these guidelines and the results of earlier studies regarding knowledge about HF and its effects on patient outcome, a new HF knowledge scale was developed initially containing 17 items concerning HF in general (3 items; eg, "HF is a condition in which the heart is not able to pump blood through the body in sufficient amounts"), HF symptoms and signs (5 items; eg, "difficulty in breathing and shortness of breath are symptoms of HF"), and HF-related treatment and self-care (9 items; eg, "diuretics remove fluids from the body" and "HF patients had better take a high-salt diet"). Several self-care-related items such as medication, fluid intake, and exercise were selected based on common misconceptions or concerns identified in HF patients in other studies.^{10,12,19-23)}

The items on the scale were represented by questions to which patients could respond with "yes," "no," or "I do not know." One point was given for each correct answer; an incorrect answer or an answer of "I do not know" received no points. The total knowledge score was determined by the sum of these points, and a higher score indicated greater knowledge about HF.

Pilot study: To ensure that the instrument was comprehensible to patients with HF, several patients were asked to complete the questionnaire and provide feedback about difficulty interpreting the questions. In addition, the time required to answer the questions was recorded.

Study patients: All consecutive patients with HF hospitalized

between March 2009 and March 2010 and consecutive outpatients with HF who had a history of hospitalization due to worsening HF between October 2010 and October 2011 were enrolled from two independent hospitals. The exclusion criteria were: age > 20 years, physical inability to complete the questionnaire, serious psychological distress (as determined by the primary physician), or unwillingness to provide informed consent. Three research nurses selected the patients who met these criteria, and asked them to complete the questionnaire.

All patients provided informed consent after the purpose of the study was thoroughly explained. The institutional review boards of the University of Tokyo (No. 2145, July, 2008) and Sakakibara Heart Institute (September, 2010) approved this study.

Content validity: The content validity of the new HF knowledge scale was discussed in a focus group including a cardiologist, 3 expert nurses, and a nursing researcher; all focus group participants were specialists in the area of HF. To assess its content validity, the following questions were asked: (1) was the new HF knowledge scale easy to understand and complete? (2) was the new HF knowledge scale applicable to patients with HF?

Construct validity: One approach to construct validation is the known-group technique, which tests the ability of an instrument to distinguish between two groups of patients, who are assumed to have different scores on an instrument. We hypothesized that patients newly diagnosed with HF would have lower knowledge scores than those experienced with HF on the basis of results of prior studies.^{20,23)} In the participating institutions, when patients are hospitalized and diagnosed with HF, they receive an educational intervention about HF during hospitalization. In this study, if patients were newly diagnosed with HF, they were asked to complete the HF knowledge scale before the intervention. Thereafter, the known-group technique was utilized to compare the scores of newly diagnosed patients with those of more experienced HF patients to determine the construct validity of the scale.

Criterion validity: Because no scale has been available to measure patient knowledge about HF in Japan for comparison with the scale developed here, the relationship between HF knowledge and HF-related self-care, a concept theoretically linked with HF knowledge, was examined in this study.^{9-12,24)}

We assumed an association between greater HF knowledge and better self-care. Self-care behavior was assessed using the Japanese version of the European Heart Failure Self-Care Behavior Scale (EHFScBS).^{25,26)} This is a 12-item self-administered questionnaire that obtains information on the self-care behavior of patients with HF, including daily weighing, fluid restriction, and medication. For each item, patients rate their self-care behavior on a 5-point scale from 1 ("I completely agree") to 5 ("I do not agree at all"). The total score ranges from 12 to 60, and a higher score indicates poorer self-care behavior. The validity and reliability of the EHFScBS have been confirmed in a previous study.²⁵⁾

Sensitivity: The sensitivity of an instrument reflects its ability to detect small variations in knowledge. In this study, differences in knowledge score before and after the HF educational intervention were investigated. Ten patients were included in a subgroup analysis of sensitivity. Subjects were patients hospitalized due to worsening HF, who received comprehensive education about HF, including published material about the con-

dition,²²⁾ from nurses and pharmacists during hospitalization. One month after discharge, the questionnaire was administered to these patients in order to evaluate the levels of HF knowledge.

Demographic and clinical parameters: The following characteristics of the subjects were investigated: gender, age, marital status, employment, etiology of HF, prior hospitalization with HF, B-type natriuretic peptide (BNP) levels, left ventricular ejection fraction, New York Heart Association functional class, systolic blood pressure, heart rate, comorbidity such as diabetes mellitus and chronic kidney disease (defined as estimated glomerular filtration rate < 60 mL/minute/1.73 m²) calculated using the Japanese formula,²⁷⁾ and medication. These data were collected from patient medical records.

Statistical analysis: Categorical data are presented as frequencies and percentages. For continuous variables with a normal distribution, the mean and standard deviation are reported. For BNP, logarithmic transformation was performed and data were analyzed using parametric methods. Values of BNP levels are presented as antilogarithms. To assess factor validity, exploratory factor analysis was performed using the principal component analysis extraction method. The number of factors was determined using a scree plot based on an eigenvalue threshold of 1.0 or higher, and total variance explained was determined. For identifying variables associated with a given factor, 0.35 was used as a cutoff point for defining variables associated with a given factor. Known-group validity was examined with Student's *t*-test to compare the scores of two groups. To examine criterion validity, Spearman's correlation coefficient was calculated to determine correlations between HF knowledge scale scores and EHFSBS scores. Internal consistency and item-total correlation were assessed with Cronbach's alpha coefficient and Pearson product-moment correlation, respectively.

All statistical tests were two-tailed, and *P*-values < 0.05 were considered statistically significant. Statistical analysis was performed using SAS version 9.3 for Windows (SAS Institute, Cary, NC, USA).

RESULTS

Face validity: A pilot test was performed involving 6 patients (3 males and 3 females) with HF. Their mean age was 61.5 ± 20.0 years (range, 35–82 years). None of the patients reported any difficulty in answering or interpreting the questions on the HF knowledge questionnaire. None of the items were missing in the responses to the scale. The time taken to answer all questions on the HF knowledge questionnaire was about 5 minutes. On the basis of these results, the HF knowledge scale was used for the subsequent validation study.

Characteristics of study patients: Of 190 patients who had agreed to participate in the survey, 187 were included in the study. Three patients were excluded due to missing items on their questionnaires (> 40% of all questions). Patient characteristics are presented in Table I. The mean age of the participants was 64.0 ± 12.1 years, with 69% male respondents. In 26% of the patients, the disease was of ischemic etiology, whereas in 62% of the patients, a left ventricular ejection fraction of < 50% was identified. The mean value of BNP levels was 194.4 pg/mL. With regard to medication, beta-blockers and angiotensin-converting enzyme inhibitors and/or angiotensin re-

Table I. Characteristics of Study Patients (*n* = 187)

Age, years	64 ± 12.1
Gender, male	129 (69%)
Married status	
Unmarried	22 (12%)
Married	136 (74%)
Divorced/widowed	24 (13%)
Other	3 (1.6%)
Employment, employed	83 (44%)
Etiology of HF	
Ischemic	48 (26%)
Cardiomyopathy	55 (29%)
Valvular heart disease	38 (20%)
Hypertension	9 (4.8%)
Other	37 (20%)
Prior hospitalization for HF	165 (88%)
BNP, pg/mL	194.4 ± 3.3
LVEF, %	43.3 ± 14.8
LVEF < 50%	116 (62%)
NYHA class, I or II	165 (88%)
Systolic BP, mmHg	117.9 ± 23.0
Heart rate, beats/minute	70.6 ± 12.5
Diabetes mellitus	52 (28%)
Atrial fibrillation	84 (45%)
Chronic kidney disease	102 (55%)
Medication	
β-Blocker	161 (86%)
ACEI and/or ARB	131 (70%)
Diuretics	127 (68%)
Aldosterone blocker	90 (48%)
HF knowledge scale score*	10.7 ± 3.0
European Heart Failure Self-care Behavior Scale score†	31.7 ± 9.9

HF indicates heart failure; NYHA, New York Heart Association; BNP, B-type natriuretic peptide; LVEF, left ventricular ejection fraction; BP, blood pressure; ACEI, angiotensin-converting-enzyme inhibitor; and ARB, angiotensin II receptor blocker. Values are *n* (%) or mean ± standard deviation. *, A higher score indicates that patients have greater level of knowledge about HF. Score ranges from 0 to 15. †, A higher score indicates poorer self-care behavior. Score ranges from 12 to 60.

ceptor blockers were prescribed in 86% and 70% of the patients, respectively.

Validity and reliability of the HF knowledge scale: Table II presents the pooled items of the first version of the HF knowledge scale. The percentages of correct answers ranged from 16% to 95%. Exploratory factor analysis including 17 items demonstrated one-dimensionality of the scale in terms of the eigenvalue, the scree plot, and the total variance explained. Moderate to strong factor loading (> 0.35) was evident for all items except the following 3: item 1 ("the heart has two chambers," factor loading = 0.291), item 7 ("blood-speckled sputum is characteristic of worsening HF," factor loading = 0.156), and item 12 ("HF patients are discouraged from taking medications without food," factor loading = 0.272). Because of their low factor loadings, items 1 and 7 were eliminated from the scale. With regard to item 12, a previous study indicated strong misconceptions about medication regimens in patients with HF.^{11,19,28)} Therefore, this item was included in view of its clinical importance.^{6,11,29)} After the two items had been eliminated, the contribution of one factor in explaining the variation in the item pool was 71%. Factor loadings of each item ranged from 0.259 (item 12) to 0.594 (item 14). The mean score was 10.7 ± 3.0 (range, 0–15).

Table II. Distributions of the Item Response ($n = 187$)

Item	% of correct answer	Distributions of the item response		
		yes	no	I don't know
<i>HF in general</i>				
1 The heart has two chambers	25%	64%	25%	11%
2 Exchange of oxygen and carbon dioxide occurs in heart	33%	38%	33%	29%
3 HF is a condition in which the heart is not able to pump blood through the body in sufficient amounts	90%	90%	1.6%	8.6%
<i>HF symptoms and signs</i>				
4 Difficulty in breathing and shortness of breath are symptoms of HF	95%	95%	2.1%	2.7%
5 One of the symptoms when the lungs become congested with fluid is shortness of breath	59%	59%	8.0%	33%
6 Some patients with severe HF become breathless when they lie flat and feel much better when they sit up	47%	20%	47%	33%
7 Blood-speckled sputum is characteristic of worsening HF	16%	16%	22%	61%
8 Short-term weight gain is one of the signs of worsening HF	56%	56%	8.6%	36%
<i>HF related treatment and self-care</i>				
9 Overwork and stress sometimes cause HF to get worse	79%	79%	1.1%	19%
10 Sodium causes water retention	63%	63%	4.8%	32%
11 Diuretics remove fluids from the body	85%	85%	3.7%	11%
12 HF patients are discouraged from taking medications without food	52%	21%	52%	27%
13 HF patients had better drink more water than healthy people	67%	11%	67%	22%
14 HF patients had better take a high-salt diet	92%	0.5%	92%	7.5%
15 Smoking is good for patients with HF because it promotes the circulation of blood	91%	3.7%	91%	4.8%
16 HF patients should not perform exercise regardless of their severity of HF	71%	8.6%	71%	20%
17 HF patients had better take a hot bath to promote blood circulation	86%	2.7%	86%	11%

HF indicates heart failure.

Figure 1. Known-group validity (A) and sensitivity for the Japanese heart failure knowledge scale (B). A higher HF knowledge score indicates greater level of knowledge about HF. HF indicates heart failure. * by unpaired t -test, † by paired t -test.

In the analysis of known-group validity, 20 patients had been newly diagnosed with HF. Significantly lower scores were observed for these patients than for those experienced with HF (9.4 ± 3.2 versus 10.8 ± 2.9 , $P = 0.043$; Figure 1A). The mean EHFScBS score for criterion validity was 31.7 ± 9.9 . Spearman's rank correlation coefficient between HF knowledge scores and EHFScBS scores was -0.304 ($P < 0.001$).

Regarding sensitivity of the knowledge scale, 10 hospitalized patients with HF received comprehensive education about HF during hospitalization. Their mean knowledge score one month after discharge was significantly higher than the baseline scores (10.0 ± 4.0 versus 13.2 ± 1.5 , $P = 0.022$; Figure 1B).

Cronbach's alpha for internal consistency was 0.79. As displayed in Table III, the internal consistency of the instrument could not be improved by deletion of any of the 15 items. Item-total correlation coefficients for all 15 items were be-

tween 0.222 (item 12, "HF patients are discouraged from taking medications without food") and 0.514 (item 14, "HF patients had better take a high-salt diet").

DISCUSSION

Inadequate self-care behavior is one of the main causes of HF deterioration. Knowledge about HF is closely related to treatment adherence, and is key to the success of HF management intervention.¹⁰ For accurate assessment of knowledge about HF, a valid and reliable instrument is needed. To the best of our knowledge, the instrument presented here is the first valid and reliable scale for assessment of HF knowledge in Japan. This instrument might be used not only to assess knowledge about their condition in patients with HF but also to gain insight into the effects of education and counseling on patients with HF.

In this study, items on the HF knowledge scale were based on information from the HF guidelines¹⁶⁻¹⁸ and the results of previous studies,^{9,10,12,19-23} and these were discussed in a focus group including a cardiologist and nurses with extensive HF knowledge. In the pilot study, patients reported no difficulty in answering or interpreting the questions. In addition, the time required to answer the questions was appropriate. From these results, we concluded that the content and face validity of the scale were adequately confirmed.

With regard to the construct validity of the HF knowledge scale, its one-dimensionality was comprehensively evaluated by the eigenvalue, scree plot, factor loading, and item contribution rate analyses. Two of the three items with low factor loadings were eliminated; item 12 regarding medication was retained considering the importance of assessing knowledge about medication. In previous studies, some patients exhibited

Table III. Items Analysis for the HF Knowledge Scale ($n = 187$)

Item	Cronbach's α if item deleted	Corrected item-total correlation
2 Exchange of oxygen and carbon dioxide occurs in heart	0.784	0.293
3 HF is a condition in which the heart is not able to pump blood through the body in sufficient amounts	0.782	0.321
4 Difficulty in breathing and shortness of breath are symptoms of HF	0.776	0.390
5 One of the symptoms when the lungs become congested with fluid is shortness of breath	0.782	0.317
6 Some patients with severe HF become breathless when they lie flat and feel much better when they sit up	0.773	0.422
8 Short-term weight gain is one of the signs of worsening HF	0.773	0.423
9 Overwork and stress sometimes cause HF to get worse	0.769	0.479
10 Sodium causes water retention	0.772	0.437
11 Diuretics remove fluids from the body	0.776	0.395
12 HF patients are discouraged from taking medications without food	0.789	0.222
13 HF patients had better drink more water than healthy people	0.771	0.450
14 HF patients had better take a high-salt diet	0.766	0.514
15 Smoking is good for patients with HF because it promotes the circulation of blood	0.768	0.488
16 HF patients should not perform exercise regardless of their severity of HF	0.779	0.347
17 HF patients had better take a hot bath to promote blood circulation	0.776	0.396

HF indicates heart failure.

misunderstanding or knowledge deficiency on medication.^{11,22)} Such knowledge deficit is likely to lead to poor adherence to medication, which may cause deterioration of HF.^{6,11,29)}

Ni, *et al* reported that greater knowledge was associated with receiving information or advice from health care providers.²⁰⁾ Similarly, lower knowledge scores were observed for newly diagnosed patients, who had not yet received an educational intervention in the current study, which suggests that known-group validity was appropriate. Although we found a statistically significant difference in the knowledge scores between the two groups, the score of newly diagnosed patients was relatively high. This may reflect the fact that the questions are totally easy because we generated the need-to-know questions. Consequently, our knowledge scale may have an advantage for identifying patients who have poor HF knowledge. Instead, it would be difficult to rank patients who have a certain degree of knowledge. Therefore, careful attention should be paid to interpretation of the knowledge score.

As expected, the level of HF knowledge was positively correlated to self-care in the patients with HF included in this study. This finding agrees with previous findings,^{9-11,20)} and with Orem's theory,²⁴⁾ which proposes that knowledge confers power, which in turn enables self-care. This similarity in results between this study and previous studies and with Orem's theory, suggests that the criterion validity of the scale was acceptable.

In terms of sensitivity, a significant difference was observed in scores before and after educational intervention in a subgroup of patients with HF. Thus, the new HF knowledge scale could be a useful tool to evaluate the effects of educational intervention in patients with HF. However, the sample utilized in this study was very small; thus, the difference between the clinical and statistical significance of this finding remains to be elucidated. Prospective studies are needed to determine a cutoff value of the new knowledge score in order to predict patient outcome.

Cronbach's alpha coefficient of the new HF knowledge scale was 0.79. This value was almost satisfactory when judged against the recommended value of 0.70 or higher for internal consistency.³⁰⁾ Item-total correlations of the scale

ranged from 0.222 to 0.514. Given that coefficients > 0.20 are considered to be acceptable for item-total correlations,³⁰⁾ the values observed here were acceptable.

Clinical and research implications: Poor self-care is well known to be a risk factor for adverse clinical outcomes in patients with HF.^{4,7,11)} Knowledge is one of the important mediators of self-care practice.^{9,10,31)} Although this issue has been studied for decades, poor knowledge about their condition in patients with HF usually prevails; lack of regular assessment of patient knowledge contributes to this problem. The availability of the new HF knowledge scale developed here could benefit health care professionals in clinical practice, allowing them to assess deficiencies in HF knowledge and to identify areas in which patients need support. At the same time, patients who answer all the questions correctly may have a serious knowledge deficit on HF. We recommend use of the HF knowledge scale in combination with a good nursing assessment to assess the real knowledge deficit of HF patients. This new instrument may also allow evaluation of the effects of educational interventions on patient knowledge in future research.

The Dutch HF knowledge scale has been developed for research purposes and was widely utilized in previous studies;¹⁵⁾ meanwhile the scale presented here focuses more on HF management and self-care for use in clinical practice. In particular, the items on self-care were developed with reference to common misconceptions or concerns identified in patients with HF, as observed in other studies.^{10,12,19-23)} For this reason, this scale may have greater power to assess patient knowledge more specifically.

Study limitations: Two limitations were observed in this study. First, the number of patients was relatively small, and enrollment was limited to patients with HF at two hospitals in Tokyo. Nonetheless, the study population was representative of Japanese patients with HF. In the registry study of Japanese HF patients, mean age was 67.8 years, males accounted for 67%, and the ischemic etiology of the HF was in 25%.²⁾ Second, the test-retest reliability of the HF knowledge scale was not evaluated in this study, though the homogeneity of the scale was confirmed.

Conclusions: In this study, a HF knowledge scale was devel-

1	Exchange of oxygen and carbon dioxide occurs in heart	Yes	No	I don't know
2	HF is a condition in which the heart is not able to pump blood through the body in sufficient amounts	Yes	No	I don't know
3	Difficulty in breathing and shortness of breath are symptoms of HF	Yes	No	I don't know
4	One of the symptoms when the lungs become congested with fluid is shortness of breath	Yes	No	I don't know
5	Some patients with severe HF become breathless when they lie flat and feel much better when they sit up	Yes	No	I don't know
6	Short-term weight gain is one of the signs of worsening HF	Yes	No	I don't know
7	Overwork and stress sometimes cause HF to get worse	Yes	No	I don't know
8	Sodium causes water retention	Yes	No	I don't know
9	Diuretics remove fluids from the body	Yes	No	I don't know
10	HF patients are discouraged from taking medications without food	Yes	No	I don't know
11	HF patients had better drink more water than healthy people	Yes	No	I don't know
12	HF patients had better take a high-salt diet	Yes	No	I don't know
13	Smoking is good for patients with HF because it promotes the circulation of blood	Yes	No	I don't know
14	HF patients should not perform exercise regardless of their severity of HF	Yes	No	I don't know
15	HF patients had better take a hot bath to promote blood circulation	Yes	No	I don't know

Figure 2. The Japanese heart failure knowledge scale.

oped, and its psychometric properties were evaluated. The findings suggest that the new scale is useful for measurement of HF knowledge in patients with HF.

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