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# Psychometric Testing of the Self-Care of Heart Failure Index

Barbara Riegel

*University of Pennsylvania*, [briegel@nursing.upenn.edu](mailto:briegel@nursing.upenn.edu)

Beverly Carlson


Debra K. Moser

Marge Sebern

Frank D. Hicks

*See next page for additional authors*

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## Abstract

**BACKGROUND:** Self-care is believed to improve outcomes in heart failure (HF) patients. However, research testing this assumption is hampered by difficulties in measuring self-care. The purpose of this study was to evaluate the psychometric properties of a revised instrument measuring self-care in persons with HF, the Self-Care of Heart Failure Index (SCHFI). The SCHFI is a self-report measure comprised of 15 items rated on a 4-point response scale and divided into 3 subscales.

**METHODS AND RESULTS:** Psychometric testing was done using data from 760 HF patients (age 70.36 +/- 12.3 years, 51% male) from 7 sites in the United States. Reliability of the SCHFI (alpha.76) was adequate. Reliability of the Self-Care Maintenance subscale was lower than desired (alpha.56) but the reliability of the other subscales was adequate: Self-Care Management (alpha.70) and Self-Care Self-Confidence (alpha.82). Construct validity was supported with satisfactory model fit on confirmatory factor analysis (NFI=.69, CFI.73). Construct validity was supported further with significant total and subscale (all  $P < .05$ ) differences between patients experienced with HF and those newly diagnosed, consistent with the underlying theory.

**CONCLUSION:** Low reliability of the Self-Care Maintenance subscale was expected because the items reflect behaviors known to vary in individuals. The reliability and validity of the SCHFI are sufficient to support its use in clinical research.

## Keywords

Aged, Aged, 80 and over, Female, Health Knowledge, Attitudes, Practice, Health Status Indicators, Heart Failure, Humans, Male, Middle Aged, Psychometrics, Reproducibility of Results, Self Care, Statistics as Topic, Treatment Outcome, United States

## Disciplines

Analytical, Diagnostic and Therapeutic Techniques and Equipment | Behavioral Medicine | Cardiovascular Diseases | Circulatory and Respiratory Physiology | Health and Medical Administration | Health Services Administration | Health Services Research | Medical Humanities | Medicine and Health Sciences | Nursing | Preventive Medicine | Psychiatry and Psychology

## Author(s)

Barbara Riegel, Beverly Carlson, Debra K. Moser, Marge Sebern, Frank D. Hicks, and Virginia Roland

# Psychometric Testing of the Self-Care of Heart Failure Index

By Barbara Riegel, Beverly Carlson, Debra K. Moser, Marge Sebern, Frank D. Hicks, and Virginia Roland

**Background:** *Self-care is believed to improve outcomes in heart failure (HF) patients. However, research testing this assumption is hampered by difficulties in measuring self-care. The purpose of this study was to evaluate the psychometric properties of a revised instrument measuring self-care in persons with HF, the Self-Care of Heart Failure Index (SCHFI). The SCHFI is a self-report measure comprised of 15 items rated on a 4-point response scale and divided into 3 subscales.*

**Methods and Results:** *Psychometric testing was done using data from 760 HF patients (age 70.36 ± 12.3 years, 51% male) from 7 sites in the United States. Reliability of the SCHFI (alpha .76) was adequate. Reliability of the Self-Care Maintenance subscale was lower than desired (alpha .56) but the reliability of the other subscales was adequate: Self-Care Management (alpha .70) and Self-Care Self-Confidence (alpha .82). Construct validity was supported with satisfactory model fit on confirmatory factor analysis (NFI = .69, CFI .73). Construct validity was supported further with significant total and subscale (all  $P < .05$ ) differences between patients experienced with HF and those newly diagnosed, consistent with the underlying theory.*

**Conclusion:** *Low reliability of the Self-Care Maintenance subscale was expected because the items reflect behaviors known to vary in individuals. The reliability and validity of the SCHFI are sufficient to support its use in clinical research.*

Heart failure (HF) is associated with poor outcomes and self-care is promoted as a way to improve outcomes in this patient population.<sup>1</sup> Education intended to promote self-care has become the cornerstone of HF disease management efforts. However, research testing the effectiveness of these interventions is hampered by difficulties in measuring self-care.

Self-care is defined as a naturalistic decision making process involving the choice of behaviors that maintain physiologic stability (self-care maintenance) and the response to symptoms when they occur (self-care management). Riegel and colleagues published a clinical tool, the Self-Management of HF scale,<sup>2</sup> based on this definition. That tool was lengthy and designed to be used by clinicians to assess self-management decision making. The purpose of this study was to evaluate the reliability (consistency of measurement) and validity (extent to which the instrument measures what it is intended to measure) of a revised version of that instrument, the Self-Care of Heart Failure Index (SCHFI), a self-report measure comprising 15 items divided into 3 subscales. The SCHFI measures self-care maintenance, self-care management, and self-care self-confidence in a short, focused manner that minimizes subject burden.

## Background

HF self-care is difficult to measure, so investigators often assess treatment adherence or knowledge and interpret these as self-care.<sup>3-5</sup> Knowledge is frequently assumed to be adequate for self-care by authors who overlook that knowledge is necessary but not sufficient for self-care.<sup>6</sup> Availability of a valid and reliable measure of HF self-care would allow investigators to measure self-care without having to infer its existence from other indicators.

Three disease-specific HF self-care instruments were located in a thorough search of Medline and the Health and Psychosocial Instruments databases. The European Heart Failure Self-care Behavior Scale by Jaarsma et al,<sup>7</sup> based on Orem's definition of self-care, emphasizes self-care maintenance (eg, "I restrict my sodium intake"). The current version has 12 items rated on a 5-point scale. Reliability was .81 in a sample of 442 elderly, predominately male HF patients.<sup>7</sup> Concurrent validity was established when the scale discriminated between patients with and without extra HF education.

The Revised Heart Failure Self-Care Behavior Scale by Artinian et al<sup>8</sup> is a 29-item measure of HF self-care derived from Orem's self-care model. Self-care maintenance items such as "I weigh myself every day of the week" are answered using a 5-point scale. This instrument goes beyond self-care maintenance to assess the frequency of self-care management with an "adapting activities" subscale. Cronbach's alpha coefficient, a measure of internal consistency reliability, was .84 in a sample of 110 HF patients. Full psychometric analysis has yet to be conducted, but content validity was demonstrated by a panel of 4 experts.

The Self-Management of Heart Failure scale, previously mentioned, is a 65-item clinical assessment guide. As with the SCHFI, the Self-Management of Heart Failure scale queries patients about decision-making processes in relation to symptoms. Six different symptoms are included but few patients have all 6 symptoms, so a skip-pattern format is used, which confuses patients and complicates scoring. Other limitations include lack of breadth because only self-care management is addressed. Subject burden is significant because the measure requires 20 to 30 minutes to complete. Even after careful formatting missing data is a common problem. Wording choices produce a ceiling effect in some areas.

No measure of HF self-care is available that measures both self-care maintenance, which encompasses treatment adherence, and the decision-making process involved in managing the symptoms of HF (self-care management). The SCHFI is such a measure.

One specific aim of this study was to assess the internal consistency of the SCHFI and its subscales. The hypothesis was that the coefficient alphas would be  $>.70$ . A second specific aim was to assess the construct validity of the SCHFI. We predicted that the evidence would support construct validity of the SCHFI.

## Theoretical Framework

The model on which the SCHFI is based builds on research in naturalistic decision making,<sup>9</sup> which addresses how people make decisions in real-world settings. Four characteristics exemplify naturalistic decision making: (1) focusing on process rather than outcome, (2) using decision rules that match the situation and the action, (3) letting context influence decision-making, and (4) basing practical decisions on the empiric information available at the moment.

Naturalistic decision makers rely more on experience and developed expertise to mentally simulate an action and anticipate how it will play out and less on normative models of rational behavior such as formal critical thinking. In the following examples of how experience influences behavior, the characteristics listed previously can be seen in the mental simulation. People with HF may perceive a situation as typical where certain types of actions are usually appropriate and successful (“This shortness of breath feels like it did the last time that I was admitted to the hospital”). Alternately, they may rely on a story-building strategy to mentally simulate events (“If I take my diuretic now I will need the bathroom by 1 PM but I’ll be at lunch then”). Another approach involves mentally comparing a planned action with other options to determine if it will work and to identify unintended consequences (“If I take my diuretic now, I’ll need the bathroom during lunch, but if I take it during lunch, I can make it home before I need the bathroom”).

In HF, the key to naturalistic decision-making is symptom recognition.<sup>10</sup> When recognition fails, as it does frequently in HF when symptoms are initially subtle, naturalistic decision makers often revert to assumption-based reasoning. When decisions are made this way (eg, “my weight will be stable today because I didn’t eat much salt yesterday”), errors in judgment are common. In HF, these errors can lead to hospital admission.

Exploring errors in decision-making can assist clinicians to identify how to improve decision-making performance. Errors are most likely the result of insufficient attention and inadequate problem detection, which are aggravated by inexperience or inadequate training. The SCHFI was designed to allow researchers and clinicians to assess patient behavior, explore the decisions that HF patients make regarding self-care, and evaluate self-care self-confidence in decision making.

A 5-stage model of naturalistic decision making was developed and used to build the SCHFI (Fig. 1). An underlying assumption of the model is that if persons with HF are to be successful at self-care, they must embrace healthy behaviors that help them to stay physiologically stable— self-care maintenance. They also must use problem-solving skill, make decisions, and address new signs and symptoms quickly—self-care management. Content validity of this model is described elsewhere.<sup>2</sup> As self-care maintenance and management improve, confidence in the ability to exert control over the diagnosis and the

treatment regimen builds. Patients high in self-care self-confidence are relatively better in self-care.<sup>11</sup>

Self-care maintenance involves symptom monitoring and treatment adherence. The selective attention that occurs with symptom monitoring is crucial for recognizing and interpreting symptoms.<sup>12</sup> Treatment adherence—a component of self-care<sup>13</sup>—involves following the advice of providers to follow the treatment plan and live a healthy lifestyle.

Self-care management is an active, deliberate decision-making process undertaken in response to symptoms. Self-care management is essential to control what may be a precarious balance between relative health and symptomatic HF. The process, which involves symptom recognition, symptom evaluation, treatment implementation, and treatment evaluation is influenced by self-efficacy.<sup>11</sup> After changes in signs and symptoms are recognized, a response must be decisive, timely, and sometimes adventuresome. We predict that patients trained to recognize and make decisions about their symptoms will be relatively better at HF self-care and will have the best outcomes.

## **Instrument Development**

The SCHFI was developed as a criterion-referenced measure or performance test to measure a level of achievement in self-care maintenance and management, although it can be used to compare self-care abilities in groups of people (norm-referenced).<sup>14</sup> A sound criterion-referenced measure discriminates among those who have and have not mastered the target behaviors of interest. The self-care self-confidence items are norm-referenced because no level of achievement was predetermined.

A quantitative, ordinal, self-report, performance-rating scale was developed by specifying objectives for each stage and devising items based on those objectives. Item stems were constructed to reflect the self-care process. All of the items within each stage of the process are evaluated using the same response format, but the stems vary across stages (see [Fig. 2](#)).

In constructing self-care maintenance items, 9 behaviors advocated in HF clinical guidelines<sup>15</sup> were tested. These behaviors differ significantly from each other, but all are important for people with HF to incorporate into their lives.

In self-care management, symptom recognition involves detecting a change in signs or symptoms and knowing that it is related to HF. The most common symptoms—shortness of breath and ankle swelling—are addressed in the SCHFI. This emphasis excludes asymptomatic patients and those who experienced other symptoms but it simplifies the measure.

Symptom evaluation, the next phase of self-care management, occurs as patients attempt to distinguish between important and unimportant symptom changes,<sup>16</sup> assuming that symptoms judged to be important will command the most attention. In the most recent version, the item stem asks “how worrisome or troubling” the most common symptoms of HF would be if they occurred. In an earlier version the stem

asked about “importance.” Both stems were examined in item analysis.

Writing items for treatment implementation, a component of self-care management, was challenging because shortness of breath and ankle swelling are precipitated by fluid overload and are treated most rapidly by pharmacologic means. However, not all physicians encourage self-dosing diuretics and not all patients are capable of deciding when to take an extra dose. Thus other methods of maintaining fluid balance are included (eg, limiting dietary sodium). Consulting the physician or nurse is included because consultation is essential if independent decisions about diuretic dosing were not previously authorized. Actions that are intuitive and require little thought (eg, rest) are not included because they do not reflect true decision making.

Treatment effectiveness, another component of self-care management, involves evaluation of the helpfulness of selected treatments, assuming that if a treatment is effective it will be attempted again. The stem, written to assess evaluation certainty rather than true treatment effectiveness, asks “how sure were you that the remedy helped or not.” A limitation of the instrument is that if no remedy was tried, patients are unable to evaluate treatment effectiveness.

Items assessing self-care self-confidence were included based on prior content validity testing<sup>2</sup> and the vast body of literature showing that self-efficacy is predictive of performance.<sup>11</sup> Confidence in self-care ability is evaluated in terms of each stage of the self-care management process: recognize and evaluate symptoms; implement and evaluate treatments.

A set of 4 response alternatives follows each item. Items contain a best answer but a graded forced-choice 4-point response scale allows assessment of progress, with higher numbers indicating better self-care. Correct responses are derived from published literature, but incorrect response alternatives are included. All items are scored in the same direction to avoid confusion. The SCHFI addresses self-care during the prior 3 months, but the time interval can be adjusted. Our rationale was that a shorter duration may not be adequate to see progress but a longer interval may be difficult to remember. One item (“Have you had trouble breathing or ankle swelling in the prior 3 months?”) is used only as a filter in analysis and not in scoring.

### **Scoring and Administration**

Two issues complicated efforts to devise a scoring algorithm for the SCHFI. The first is the uneven number of items in each stage. Ideally, the number of items in each stage would be equal but item construction was limited by the illness (eg, there were fewer self-care treatments than symptoms available for item construction). To simply add responses would weight scores differentially toward those areas in which there are relatively more items (eg, symptom treatment > symptom recognition). To deal with the uneven number of items, responses in self-care maintenance, self-care management, and self-care

self-confidence are each transformed to 100 points. The maximum score in each set is 100 for a total possible score of 300 points on the SCHFI.

The second problem is that persons who have been asymptomatic for the prior 3 months and those with other symptoms are not able to respond to the questions about self-care management. In this situation, investigators are encouraged to compare scores on the self-care maintenance and self-care self-confidence subscales, which can be completed without having been symptomatic. No total SCHFI score can be computed for asymptomatic patients.

The SCHFI takes about 5 minutes to complete. It can be completed directly by patients or indirectly by interview. It is available free of charge in English and Spanish. The Spanish version was translated and back-translated by fluently bilingual research staff. Although back-translation is essential, it is not sufficient to produce a culturally relevant instrument because back-translation assumes that concepts are universal.<sup>17</sup> Therefore, during pilot testing, fluently bilingual nurses suggested refined word choices to the investigators when patients seemed confused by terms. This process resulted in an instrument that reflects the Mexican-American dialect of Southern California and includes concepts clear to the Hispanic population in whom it was tested.



## Methods

### Sample

The SCHFI was tested in a pooled convenience sample of 760 persons with HF drawn from 7 sites across the United States (community hospitals in Southern California and Michigan, Veterans Affairs hospitals in Southern California and Michigan, and 4 university hospitals and clinics in Wisconsin, Kentucky, Michigan, and Ohio). Institutional Review Board approval was obtained by each investigator and for the aggregate analysis reported here. The majority of patients were drawn from community hospitals in Southern California.

### Procedure

Rigid rules for test administration were not specified, so some patients completed the SCHFI themselves, others were interviewed, and some responded by telephone interview. Data were submitted to the principal investigator electronically in an Excel (Microsoft, Redmond, WA) file format and translated into SPSS version 11.0 (Chicago, IL) for analysis.

Analyses of the self-care maintenance and self-care self-confidence items included both symptomatic and asymptomatic patients. Analyses of the self-care management items used only symptomatic patients. A total of 760 people completed 1 of the 4 versions of the SCHFI used in this analysis. The version shown in Fig. 2 is the last version tested in this analysis. Of these 760 participants, 758 completed the self-care self-confidence items and 517 completed a version with the self-care maintenance items. There were 606 symptomatic patients (79.7% of the sample) and most completed selected self-care management items, but only 98 completed all of them due to the addition of a self-care treatment added late in testing.

Scores could not be summed if any missing data were present so when possible, missing data were interpolated using series means. In the vast majority of cases ( $n = 243$ ), missing data reflected revisions in the instrument itself (items added after a cohort had completed the instrument); these data were not interpolated. Items with the most missing data because of patient omission were frequency of eating a low-sodium diet ( $n = 10$ ), keeping weight down ( $n = 7$ ), and the importance of just not feeling well ( $n = 23$ ); these data were interpolated. Because the subscales are score separately, all participants with full subscale data were used in the analyses (self-care maintenance  $n = 517$ , self-care management  $n = 98$ , self-care self-confidence  $n = 758$ ).

### Analysis and Results

The sample was elderly ( $70.36 \pm 12.3$  years) and 51% male. Most (51%) were married but many (27.9%) were widowed. A significant number (20.4%) had less than a high school education. Most were

retired (64.1%) and earned an income equal to or less than \$30,000 annually (62.5%) (Table 1).

Most (69%) respondents had been diagnosed with HF 2 or more months prior. Those diagnosed >2 months prior were significantly more likely to perform self-care maintenance, recognize their symptoms, and evaluate the interventions they used to treat their symptoms ( $P < .05$ ). Only treatment implementation was equivalent regardless of length of experience with the HF diagnosis.

Of the 606 (79.7%) symptomatic patients, many (49.2%) failed to recognize shortness of breath as a symptom of HF or said that it took them awhile to do so. Less than half (45.7%) of the symptomatic patients were likely or very likely to implement 1 of the 4 treatment options in response to symptoms. Those who recognized their symptoms were most likely to do something to treat them ( $\chi^2 = 10.4$ ,  $df = 1$ ,  $P = .001$ ). Of those who did take action to treat their symptoms, most (58%) were able to evaluate the effectiveness of their actions.

Overall, self-care self-confidence was high in much of this sample, with 73.9% reporting confidence or high confidence in their self-care abilities. Specifically, self-care self-confidence was very or extremely high in symptom recognition ability (63.3%), in symptom evaluation (54.1%), in treatment of symptoms (52.5%), and in the ability to evaluate treatment effectiveness (51.2%).

## Item Analysis

Each item was analyzed first to assess its difficulty or the percentage of participants giving the correct answer. Difficulty scores can range from 0 to 1.0 but scores between .3 (harder) and .7 (easier) are considered best.<sup>14</sup> No scores were imputed for this preliminary analysis. Items varied quite a bit in difficulty, with reducing salt and fluid intake in response to symptoms clearly difficult for patients (.29) and avoiding tobacco (.99) quite easy. Four items in the Self-Care Maintenance subscale had an extremely easy difficulty level (>.9) and were removed (Table 2). The scores on one item—get a flu shot every year—were negatively skewed, with 68.6% ( $n = 516$ ) of the patients reporting always getting a flu shot.

After imputing scores, criterion group difference indices (CGDI) were calculated for each item set (eg, self-care maintenance) based on experience with HF, consistent with the underlying theory of naturalistic decision making. Responses to each group of items were summed and divided into 2 groups reflecting correct (top half) and incorrect (lower half) responses. Using chi-square analysis, the percentage of patients scoring in the top half was compared in patients newly diagnosed (<2 months prior) and those diagnosed >2 months prior. For example, 86% of patients diagnosed >2 months prior scored in the top half of self-care maintenance while only 71% of newly diagnosed patients did so. When these percentages were subtracted from each other (.86–.71), the CGDI was .15. The CGDI scores ranged from .15 (self-care maintenance) to .29 (symptom recognition), with higher scores reflecting better discrimination. The CGDI scores differed significantly for self-care maintenance ( $\chi^2 = 9.8$ ,  $P = .002$ ), symptom recognition ( $\chi^2 = 32.4$ ,

$P < .001$ ), treatment evaluation ( $\chi^2 = 13.3, P < .001$ ), and self-care self-confidence ( $\chi^2 = 20.7, P < .001$ ). The CGDI for treatment implementation approached significance ( $\chi^2 = 3.7, P = .055$ ), even with the small sample size ( $n = 93$ ).

One score set, symptom evaluation, a component of self-care management, was a negative discriminator ( $-.04$ ) ( $\chi^2 = .53, P = .47$ ) suggesting that as patients gain experience with HF they become less able to evaluate their symptoms. This counterintuitive result was explored further by analyzing responses to items using the “importance” stem and those using the “worrisome” stem separately. When “importance” was used, all but 1 item was too easy (difficulty  $>.7$ ), yielding a ceiling effect. When “worrisome” was assessed, the items were within the appropriate difficulty range but still unable to discriminate between patients based on experience. Because experience is a key concept in the underlying theory, ability to discriminate based on experience was deemed essential. Further, this set of items had been problematic (eg, ceiling effect) since the inception of the instrument, so all items in the symptom evaluation set were deleted. These revisions left a scale with 15 items and 5 score sets grouped into 3 subscales: self-care maintenance, self-care management, and self-care self-confidence. Scoring is detailed in [Table 3](#).

## **Reliability**

After a final subset of items was chosen, the relationship between individual items and the remaining items and between subscales and total scores were examined. Internal consistency of the SCHFI and its subscales were estimated using coefficient alpha.

### **Self-Care Maintenance Subscale**

Mean of this 5-item subscale was  $67.8 \pm 17.2$  (range 25 to 100 of a possible score of 100) in a sample of 517. Coefficient alpha of the Maintenance subscale was .56. Deletion of 1 item, flu shot, would raise the alpha coefficient to .60, whereas deletion of the others would lower it. The corrected item-total correlation of all items was  $>.2$  except for the flu shot item, which had a corrected item-total correlation of .15. Variance for this item was adequate (1.4). The item was kept at this time because it contributed positively to the CGDI.

### **Self-Care Management Subscale**

Mean of the 6-item subscale was  $60.9 \pm 21.3$  in a sample of 98. The range of scores in this subscale differs from that of the others because symptom recognition and treatment evaluation can have a true 0 (did not recognize symptoms, could not evaluate treatments). The possible range of scores is 16.7 to 100 for the self-care management subscale; the actual range was 16.7 to 100. Coefficient alpha of the Self-Care

Management subscale was .70. The corrected item-total correlations ranged from .25 to .55. No item was predicted to significantly raise the alpha coefficient if deleted.

### **Self-Care Self-Confidence Subscale**

Mean of the 4-item subscale was  $65.0 \pm 17.2$  (range 25 to 100 of a possible score of 100) in a sample of 758. Coefficient alpha of the self-care self-confidence subscale was .82. The corrected item-total correlations ranged from .58 to .67. Deletion of any item would lower the alpha coefficient.

### **Self-Care Heart Failure Index**

The mean SCHFI score was  $192.0 \pm 41.5$  (range 80 to 268 of 300) in a sample of 98. When internal consistency of the SCHFI was calculated with all 15 items, the coefficient alpha of the full SCHFI was .76. No item was predicted to significantly raise the alpha coefficient if deleted.

### **Construct Validity**

Confirmatory factor analysis was used to validate the model of self-care maintenance, self-care management, and self-care self-confidence. Model fit was estimated using the CALIS procedure of SAS (SAS Institute Inc, Cary, NC). The model was specified with self-care management and self-care self-confidence correlated because the self-care self-confidence items measure confidence with each step of the self-care management process. When the model was run with the 120 symptomatic patients with sufficient data, the model fit was adequate (comparative fit index .73, nonnormed index .69), and the average absolute residual was small (.03). Standardized estimates of the manifest variables suggested that certain items were problematic (Fig. 3). Therefore, exploratory factor analysis was done with individual latent constructs to identify problematic areas.

Exploratory factor analysis of the five self-care maintenance items was done with data from 517 patients using Principal Axis Factoring, the preferred method for analyzing correlated data.<sup>18</sup> Oblique rotation with direct oblimin revealed that 4 of the 5 items explained 23.9% of the common variance in scores. All 4 items loaded substantively (ie,  $>.30$ ) (Table 4). The flu shot item failed to load with the others and was poorly correlated with the items measuring physical activity ( $r = .03$ ) and “keep your body weight down” ( $r = .06$ ).

Exploratory factor analysis of the remaining 10 items, which address self-care management and self-care self-confidence was done in one step because the subscales are correlated. Using data from the 98 symptomatic patients, Principal Axis Factoring was used to extract 3 factors with an Eigenvalue  $>1$ . On oblique rotation with direct oblimin, the 3 factors explained 45.9% of the common variance in scores. All 10 items loaded substantively (ie,  $>.30$ ). All of the items intended to load together did so except for the

single item measuring treatment evaluation, which loaded with the treatment items rather than alone. Together, these exploratory factor analysis results support those found with confirmatory factor analysis and help to explain why the model fit was only adequate.

Known-groups technique was used to further evaluate construct validity. Naturalistic decision-making theory specifies that experience is a major contributor to decision making. Others have demonstrated that persons who are experienced with a chronic illness are better at decision making than those newly diagnosed.<sup>19</sup> In persons with HF, Francque-Frontiero et al found that self-care improved after as little as 2 months after initial diagnosis.<sup>20</sup> Therefore, the sample was divided into newly diagnosed (<2 months) and experienced (2 month) patients. Differences between these groups were tested using unpaired *t*-tests. Significant differences based on experience were evident in the Self-Care Maintenance subscale ( $t = 2.0, P = .04$ ), in the Self-Care Management subscale ( $t = 2.4, P = .02$ ), in the Self-Care Self-Confidence subscale ( $t = 3.93, P = <.0001$ ), and in the SCHFI score ( $t = 2.1, P = .04$ ) (Table 5). No group differences in age, gender, marital status, education, work status, income, or functional performance were found in these 2 groups.

The last test of construct validity was to assess the sub-scale-to-subscale correlations. All of the subscales were significantly correlated, which further supported construct validity (Table 6). And, they were not highly intercorrelated (none  $>.42$ ), indicating that they were not measuring the same construct.

## Discussion

The purpose of this study was to evaluate the reliability and validity of a revised measure of HF self-care, the SCHFI. Reliability of the SCHFI and the subscales is adequate to support use of this instrument in research. Although internal consistency of the Self-Care Maintenance scale was lower than desired, this is not surprising because health behaviors are known to be largely independent of each other, controlled by different motivators, and unstable over time.<sup>21</sup> Including behaviors such as activity and weight control almost assures a low internal consistency of this subscale because factors other than HF greatly influence these behaviors. Construct validity of the SCHFI was supported with confirmatory factor analysis. Further evidence was gleaned when the SCHFI was able to discriminate among people based on their experience with the illness, consistent with the underlying theory. These results are promising for both the SCHFI and the theoretical model.

The analyses reported here resulted in significant changes to the instrument, including the deletion of an entire set of items measuring the ability to evaluate symptoms. In spite of these deletions, the model itself was not revised because symptom evaluation is still seen as essential to the process of self-care management. That is, the deletion reflects a problem with measurement, not a rethinking of the self-care process. It may be that concurrent use of a HF knowledge scale will be sufficient to measure patients' abilities to evaluate symptoms.

The 4 items deleted from the Self-Care Maintenance sub-scale had little response variability (alcohol, tobacco, medications, medical appointments), suggesting that patients may have been responding to these items in a socially desirable fashion. Participants completed the instrument for medical personnel, so social desirability is not surprising. Patients also may fail to see that tobacco and alcohol cessation are related to HF, perhaps because HF patients are not routinely instructed to quit smoking or to limit alcohol intake.<sup>22</sup> They may view tobacco and alcohol cessation as general advice rather than recommendations specific to HF. The reason why keeping medical appointments was poorly correlated with the other self-care items may be that people do not view these behaviors as within their scope of self-care. Keeping medical appointments is a behavior that patients are told to do and many people may think they have no choice about whether or not to do it. One item remaining in the self-care maintenance subscale (flu shot) was negatively skewed, poorly correlated with the others, compromised sub-scale internal consistency and factor analysis, and may need to be revised or deleted after further testing.

A benefit to using this instrument is that the information obtained can be used in clinical practice to tailor interventions for people with HF. Although the SCHFI does not address the full range of behaviors reflecting self-care, it does reflect patients' decision-making ability, self-confidence, and adherence to some of the major treatment recommendations. Anecdotally, we have found that use of the SCHFI helps us to identify patients who have difficulty recognizing their symptoms, those who are clearly nonadherent with

recommended therapy, and those lacking self-confidence. Knowing exactly where the problems with self-care occur can be helpful in focusing interventions for individual patients.

Minor changes have been made to the SCHFI since this testing was conducted. One additional self-care maintenance item is being tested: “Check your ankles for swelling?” Also, 2 items addressing self-confidence in relation to self-care maintenance were added: “How confident are you that you can keep yourself healthy and free of heart failure symptoms?” and “How confident are you that you can follow the treatment advice you have been given?” These revisions strengthen the linkages between self-care maintenance, self-care management, and self-care self-confidence. The additions require further testing to assure that they do not change the internal consistency of the instrument but the revisions are not judged to be significant enough to delay publication. These revisions do not change the possible range of subscale and SCHFI scores.

Limitations of this study include a low coefficient alpha for the self-care maintenance subscale, but this outcome was not unexpected because of the diversity of behaviors queried. Coefficient alpha is a measure of internal consistency and we did not expect people to exhibit consistently good or bad lifestyle behaviors.<sup>23,24</sup> Future research is needed to address acceptable levels of internal consistency reliability estimates when dealing with variables such as this. Another important limitation is the fact that only two of several possible symptoms were measured. This approach limits the number of patients who can be evaluated by the SCHFI. It may be that patients recognize and treat other symptoms better than they manage shortness of breath and ankle swelling. If this is the case, the SCHFI will not adequately represent the level of achievement that these patients achieve in self-care management. However, fluid management is one of the primary causes of hospital readmission,<sup>25</sup> so addressing these 2 symptoms seems adequate to capture the behaviors required to avoid a poor outcome. Further research is needed to determine if self-care, as measured by the SCHFI, is able to predict these outcomes.

Future research should compare Self-Care Maintenance subscale scores and an objective assessment of treatment adherence. Further research also is needed to assess the minimally important differences in subscale and SCHFI total scores. When evaluating a quality best judged by patients (eg, quality of life), the minimally important difference is defined as the smallest difference in scores that patients perceive as important.<sup>26</sup> However, when patients are unable to judge the phenomenon, the minimally important difference is the smallest difference in scores needed to improve patient outcomes. Research is needed to determine what amount of change in SCHFI scores is needed to prevent hospital readmission and improve quality of life. Test-retest reliability needs to be assessed. The scoring algorithm also needs further evaluation. The SCHFI data are technically ordinal but the scoring approach treats responses as interval level data. Although this is common practice in self-report measures, research is needed to determine if expert judgment could be used to improve the current scoring approach.

In summary, the hypotheses of adequate internal consistency were supported for 2 of the 3 subscales and for the SCHFI score; the low alpha coefficient for self-care maintenance can be explained. Construct validity was supported with adequate confirmatory factor analysis model fit, known group differences, and significant subscale intercorrelations.

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**Table 1: Demographic Characteristics of Participants (n = 760)**

	Percentage and Number
Percent diagnosed with HF < 2 months prior	31% (n = 171)
Male	51.3% (n = 388)
Married	51% (n = 385)
Education	
< High school	20.4% (n = 148)
High school or business school	49.7% (n = 361)
At least some college	29.9% (n = 217)
Work status	
Homemaker	10.3% (n = 76)
Employed	18.6% (n = 137)
Retired	64.1% (n = 472)
Other (eg, disability)	6.9% (n = 51)
Functional performance as measured by the Specific Activity Scale	
Class I	15.6% (n = 80)
Class II	19.1% (n = 98)
Class III	50.5% (n = 259)
Class IV	14.8% (n = 76)
Annual income	
\$30,000	62.5% (n = 386)
	Mean and Standard Deviation
Age (y)	70.3 ± 12.3
Specific Activity Scale	2.6 ± .9
Self-care maintenance score	67.8 ± 17.2
Self-care management score	60.9 ± 21.3
Self-care self-confidence score	64.9 ± 17.2
Self-Care of Heart Failure Index score	191.9 ± 41.5

**Table 2: Item Difficulty and Criterion Group Discrimination Indices (CGDI)**

	Item Difficulty Level		Ability to Discriminate Between Patients Based on Their Experience with the Diagnosis ( $\geq 2$ Months vs. $< 2$ Months)
<b>Self-care maintenance</b> (n = 383)			CGDI = .86-.71 = .15 ( $\chi^2 = 9.8$ , $P = .002$ ) (calculated with 5 remaining items)
Weigh yourself daily? (n = 517)	.55		
Eat a low sodium diet? (n = 507)	.68		
Take part in regular physical activity? (n = 515)	.39		
Take medications as directed? (n = 512)	.97	Deleted	
Keep your weight down? (n = 510)	.51		
Get a flu shot every year? (n = 516)	.74		
Avoid drinking alcohol? (n = 118)	.91	Deleted	
Avoid tobacco? (n = 118)	.99	Deleted	
Keep medical appointments? (n = 117)	.92	Deleted	
<b>Self-care management</b>			
<i>Symptom recognition</i> (n = 390)			CGDI = .45-.16 = .29 ( $\chi^2 = 32.4$ , $P < .001$ )
How quickly did you recognize trouble breathing or ankle swelling as a symptom of HF? (n = 490)	.34		
<i>Symptom evaluation</i>		Deleted	CGDI = .77-.81 = -.04 ( $\chi^2 = 32.4$ , $P = .47$ )
	“important”	“worrisome”	CGDI “important” = .96-.94 = .02 ( $\chi^2 = .21$ , $P = .65$ )
Trouble breathing	.97 (n = 104)	.71 (n = 312)	CGDI “worrisome” = .73-.67 = .06 ( $\chi^2 = .52$ , $P = .47$ )
Tired or fatigued	.79 (n = 107)	.54 (n = 312)	
Sudden weight gain	.80 (n = 107)	.60 (n = 308)	
Swelling	.88 (n = 107)	.65 (n = 311)	
Dizziness, loss of balance, or passing out	.88 (n = 106)	.68 (n = 312)	
Sleeping problems because of breathing trouble	.86 (n = 107)	.68 (n = 312)	
Just not feeling well	.62 (n = 88)	.50 (n = 312)	
<i>Treatment implementation</i> (n = 93)			CGDI = .78-.58 = .20 ( $\chi^2 = 3.7$ , $P = .055$ )
Reduce the sale in your diet (n = 378)	.29		
Reduce your fluid intake (n = 377)	.29		
Take an extra water pill (n = 578)	.36		
Call your doctor or nurse for guidance (n = 97)	.62		
<i>Treatment evaluation</i> (n = 391)			CGDI = .54-.34 = .20 ( $\chi^2 = 13.3$ , $P < .001$ )
How sure were you that the remedy helped? (n = 390)	.58		
<i>Self-care self-confidence</i> (n = 549)			CGDI = .79-.60 = .19 ( $\chi^2 = 20.7$ , $P < .001$ )
Confident that you can evaluate the importance of your symptoms? (n = 755)	.54		
Confident that you can recognize changes in your health if they occur? (n = 758)	.63		
Confident that you can do something that will relieve your symptoms? (n = 756)	.52		
Confident that you can evaluate the effectiveness of whatever you do to relieve your symptoms? (n = 688)	.46		

**Table 3: Subscale and Total Self-Care of Heart Failure Index Raw Scores, Transformation Factor, and Mean Transformed Score**

	Items	Scale	Total Point Range	Scale Total Points	Transformation Factor	Mean Transformed Score in this Sample
Self-care maintenance	5	1-4	5-20	20	5	67.8 ± 17.2 (n = 517)
Self-care management	6			24	4.17	60.9 ± 21.3 (n = 98)
Symptom recognition	1	0-4	0-4			
Treatment implementation	4	1-4	4-16			
Treatment evaluation	1	0-4	0-4			
Self-confidence	4	1-4	4-16	16	6.25	65.0 ± 17.2 (n = 758)

**Table 4: Factor Loadings of the Self-Care of Heart Failure Index Derived from the Exploratory Factor Analysis with Principal Axis Factoring with Oblimin Rotation**

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<b>Self-care maintenance</b>			
Weigh yourself daily?	.49		
Eat a low sodium diet?	.34		
Take part in regular physical activity?	.55		
Keep your weight down?	.46		
Get a flu shot every year?		.35	
<b>Self-care management</b>			
<i>Symptom recognition</i>			
How quickly did you recognize trouble breathing or ankle swelling as a symptom of heart failure?		.62	
<i>Treatment implementation</i>			
Reduce the salt in your diet			.68
Reduce your fluid intake			.75
Take an extra water pill			.57
Call your doctor or nurse for guidance			.35
<i>Treatment evaluation</i>			
How sure were you that the remedy helped or not?			.45
<b>Self-care self-confidence</b>			
Confident that you can evaluate the importance of your symptoms?			-.76
Confident that you can recognize changes in your health if they occur?			-.83
Confident that you can do something that will relieve your symptoms?			-.44
Confident that you can evaluate the effectiveness of whatever you do to relieve your symptoms?			-.64

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**Table 5: Differences in Self-Care of Heart Failure Index (SCHFI) Subscales and Total Scores Based on Experience with the Diagnosis**

SCHFI Score	Mean and Standard Deviation	
	Diagnosed <2 Months Prior	Diagnosed >2 Months Prior
Self-care maintenance subscale*	66.1 ± 18.2 (n = 87)	70.3 ± 16.2 (n = 296)
Self-care management subscale*	53.4 ± 20.7 (n = 26)	64.8 ± 20.5 (n = 67)
Self-care self-confidence subscale*	60.6 ± 18.3 (n = 171)	66.9 ± 16.9 (n = 378)
Total SCHFI score*	179.5 ± 39.7 (n = 26)	199.4 ± 40.6 (n = 67)

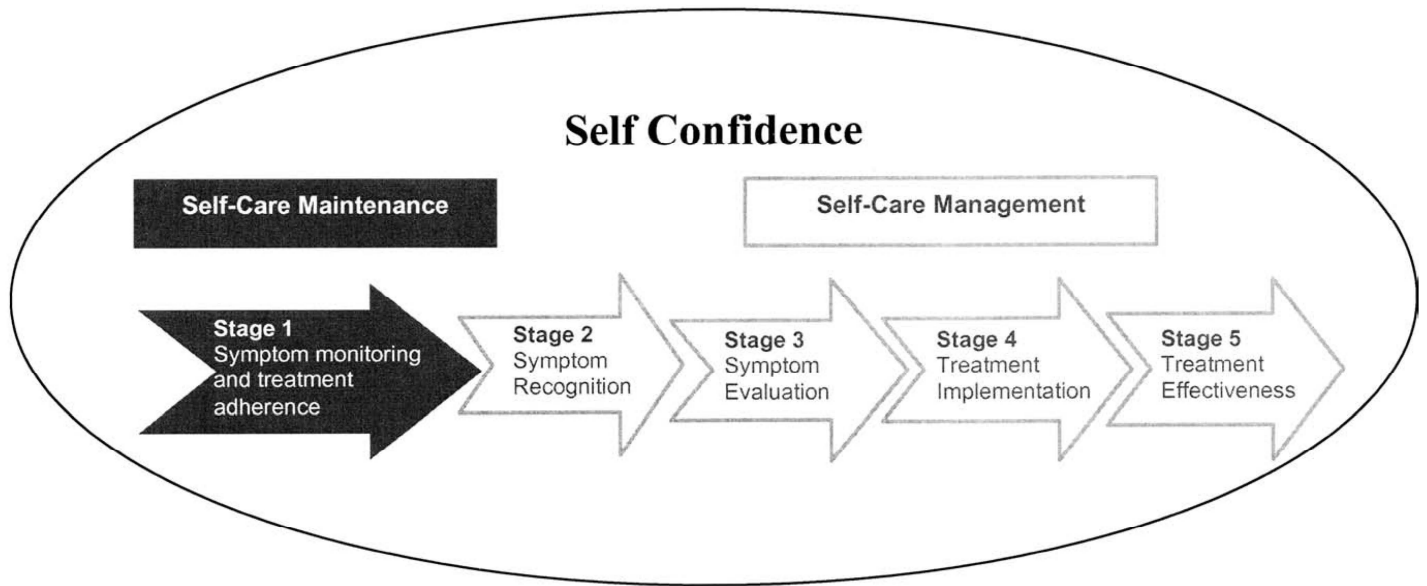
\* $P < .05$ .

**Table 6: Self-Care of Heart Failure Index (SCHFI) Subscales and Total Intercorrelations**

	Self-Care Maintenance Subscale	Self-Care Management Subscale	Self-Care Self-Confidence Subscale
Self-care management subscale	.39*		
Self-care self-confidence subscale	.17*	.42*	
SCHFI	.63*	.85*	.70*

\* $P < .0001$ .

**Figure 1: Visual Depiction of the Self-Care Process.**



Self-care is defined as a process of maintaining health through treatment adherence and symptom monitoring. When signs and symptoms occur, decision-making of self-care management is required. Self-care is positively influenced by self-confidence in one's abilities.



## Figure 2: Self-Care of Heart Failure Index.

### SELF-CARE OF HEART FAILURE INDEX®

All answers are confidential.

Date Completed \_\_\_\_\_

#### SECTION A:

Listed below are common recommendations for persons with heart failure. How often do you do the following?

	Never or rarely	Sometimes	Frequently	Always
1. Weigh yourself daily?	1	2	3	4
2. Eat a low salt diet?	1	2	3	4
3. Take part in regular physical activity?	1	2	3	4
4. Keep your weight down?	1	2	3	4
5. Get a flu shot every year?	1	2	3	4

#### SECTION B:

Many patients have symptoms due to their heart failure. Trouble breathing and ankle swelling are common symptoms of heart failure.

In the past three months, have you had trouble breathing or ankle swelling? Circle one.

- 1) No
- 2) Yes

6. The **LAST TIME** you had trouble breathing or ankle swelling, (circle **one** number)

	I did not recognize it	Not Quickly	Somewhat Quickly	Quickly	Very Quickly
how quickly did you recognize it as a symptom of heart failure?	0	1	2	3	4

Listed below are remedies that people with heart failure use. When you have trouble breathing or ankle swelling, how likely are you to try one of these remedies?

(circle **one** number for each remedy)

	Not Likely	Somewhat Likely	Likely	Very Likely
7. Reduce the salt in your diet	1	2	3	4
8. Reduce your fluid intake	1	2	3	4
9. Take an extra water pill	1	2	3	4
10. Call your doctor or nurse for guidance	1	2	3	4

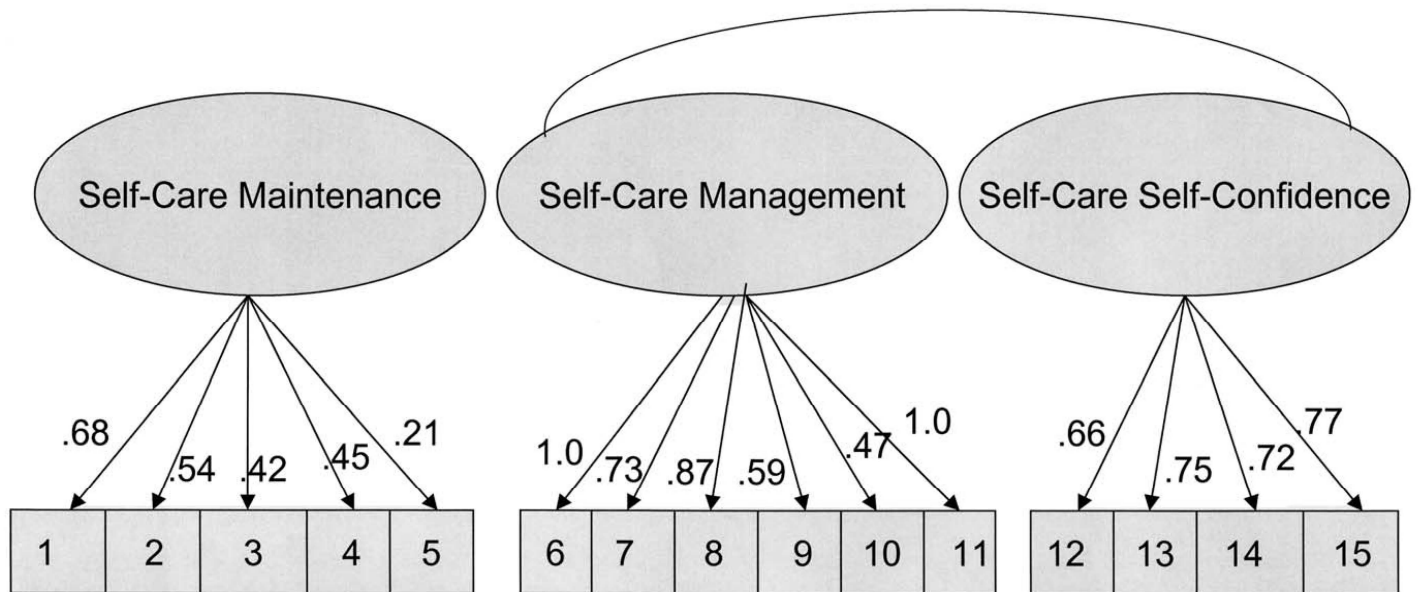
11. If you tried any of these remedies the last time you had trouble breathing or ankle swelling, (circle **one** number)

	I did not try anything	Not Sure	Somewhat Sure	Sure	Very Sure
how <u>sure</u> were you that the remedy helped or not?	N/A	1	2	3	4

#### SECTION C:

	Not Confident	Somewhat Confident	Very Confident	Extremely Confident
12. How confident are you that you can <u>evaluate the importance of your symptoms</u> ?	1	2	3	4
13. Generally, how confident are you that you can <u>recognize changes</u> in your health if they occur?	1	2	3	4
14. Generally, how confident are you that you can <u>do something</u> that will relieve your symptoms?	1	2	3	4
15. How confident are you that you can <u>evaluate the effectiveness</u> of whatever you do to relieve your symptoms?	1	2	3	4

**Figure 3: Graphic Representation of the Confirmatory Factor Analysis**



$\chi^2(89) = 329.9$ , CFI=.73, NFI=.67, NNFI=.69, average absolute residual .03

The figure displays the loadings for the various indicators of the latent constructs self-care maintenance, self-care management, and self-care self-confidence. Numbers in the boxes refer to item numbers. Self-care management and self-care self-confidence were correlated in analysis. The standardized numbers in the figure reflect the strength of the relationship between each indicator and the construct on which it loads. The model fit the data adequately, although the fit was not excellent (>.90).