An Update on the Self-Care of Heart Failure Index

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Abstract

Background—The Self-Care of Heart Failure Index (SCHFI) is a measure of self-care defined as a naturalistic decision making process involving the choice of behaviors that maintain physiologic stability (maintenance) and the response to symptoms when they occur (management). In the 5 years since the SCHFI was published, we have added items, refined the response format of the maintenance scale and the SCHFI scoring procedure, and modified our advice about how to use the scores.

Objective—The objective of this article is to update users on these changes.

Methods—In this article we address 8 specific questions about reliability, item difficulty, frequency of administration, learning effects, social desirability, validity, judgments of self-care adequacy, clinically relevant change, and comparability of the various versions.

Results—The addition of items to the self-care maintenance scale did not significantly change the coefficient alpha, providing evidence that the structure of the instrument is more powerful than the individual items. No learning effect is associated with repeated administration. Social desirability is minimal. More evidence is provided of the validity of the SCHFI. A score of ≥70 can be used as the cut-point to judge self-care adequacy, although evidence is provided that benefit occurs at even lower levels of self-care. A change in a scale score more than one half of a standard deviation is considered clinically relevant. Because of the standardized scores, results obtained with prior versions can be compared to those from later versions.

Conclusion—The SCHFI v.6 is ready to be used by investigators. By publication in this format, we are putting the instrument in the public domain; permission is not required to use the SCHFI.

Keywords

Self-management; treatment adherence; decision-making; instrument; psychometric

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An Update on the Self-Care of Heart Failure Index

Since publication in 2004,[1] requests to use the Self-Care of Heart Failure Index (SCHFI) have come from 25 different countries. The instrument has been used in 17 published studies[2–18] and several more studies are currently in process. Questions from users as well as our own experience with the SCHFI in several studies demonstrated some issues that could be addressed with an update regarding the best way to use and interpret SCHFI scores. Since the original publication of version 4 (v.4), we have refined items, added items, and tested the psychometric profile of the SCHFI in various ways. We have assessed the validity using quantitative and qualitative approaches. The purpose of this article is to summarize what we have learned, to update the psychometric profile, and to make the most recent version of the SCHFI (v.6) available to users.

We defined self-care as a naturalistic decision making process involving the choice of behaviors that maintain physiologic stability (maintenance) and the response to symptoms when they occur (management).[7] Those practicing self-care maintenance live a healthy lifestyle, adhere to the treatment regimen, and monitor symptoms. Symptom monitoring is an essential segue into self-care management, which refers to decision-making in response to symptoms. Self-care management is an active, deliberate process that begins with recognizing a change in health (i.e., shortness of breath or edema), evaluating the change, deciding to take action, implementing a treatment strategy (e.g., take an extra diuretic dose), and evaluating the treatment implemented (Figure 1).

Although, we originally believed that self-care was a rational process in which patients used critical thinking to decide what to do about symptoms,[19] naturalistic decision making is a better description of how laypersons make decisions about their symptoms. Naturalistic decision-makers focus on process rather than outcome, use decision rules that match the situation and the action, let the context influence their decision-making process, and base practical decisions on the empirical information available at the moment.[20] The factors that facilitate the development of expertise in mentally simulating situations and anticipating outcomes are knowledge, experience, skill, and compatibility with values.[9]

Revisions since Publication

The SCHFI v.4 was published in 2004 with 5 maintenance items, 6 management items, and 4 confidence items. Through the years we have modified item and stem wording in minor ways and tested those revisions in our own research. Most revisions were made to the maintenance scale to reflect the evolution in knowledge about heart failure (e.g., weight management, exercise). The management scale items have never changed. The confidence scale was published with 4 items but we have routinely used 6 items (2 addressing maintenance and 4 addressing management) in our research. Thus, with significant experience, we are able to say that none of the different versions has changed the psychometric profile to any significant degree. More evidence of this statement is provided below.

In the SCHFI v.6 much remains unchanged. No changes have been made to the underlying definition of self-care, the criterion-referenced measurement approach (level of achievement predetermined) used in the self-care maintenance and management scales or the norm-referenced approach (no level of achievement predetermined) to the confidence scale. The SCHFI still uses a quantitative, ordinal, self-report, performance-rating scale to measure each of the processes described above. Each scale remains standardized to a total possible score of 100 for ease of interpretation.

The major revision since 2004 evolved from concerns about the low coefficient alpha for the 5 item self-care maintenance scale ($\alpha = .56$). We had anticipated a low coefficient alpha because alpha is a measure of internal consistency; items that are internally consistent measure the same concept. The behaviors addressed in the self-care maintenance scale reflect the wide variety of therapeutic and life-style behaviors in which we ask persons with heart failure (HF) to engage. Thus, we expected little relationship between medication adherence and routine exercise, for example. However, users were concerned about the low coefficient alpha, so we added 5 more items to the self-care maintenance scale (Table 1). Added items address monitoring of ankles for swelling, consulting the provider, and adhering to the medication regimen. One item, keep your weight down, was deleted because of recent data demonstrating that weight loss may not been advisable in persons with chronic HF.[21] Three redundant items were purposely included in different forms to increase the coefficient alpha. An important change was made to the response format of the maintenance scale with the addition of "…or daily" to the choice "always". This change allowed us to be consistent in the wording of individual items (e.g., "weigh yourself daily" was changed to "weigh yourself").

The other change seen in the SCHFI v.6 is the addition of 2 additional items to the self-care confidence scale. The original 4 items addressed only confidence in the ability to perform self-care management. In this revision, 2 items measuring confidence in the ability to perform self-care maintenance were added (Table 1). With this addition, the confidence scale can be said to measure confidence in overall self-care, not just self-care management.

A major change was made to the scoring procedure, with users now cautioned not to calculate a total score. Instead, we strongly recommend that the 3 scales (self-care maintenance, management, and confidence) be used separately. Self-care is best represented by maintenance and management. Confidence is an important process that probably moderates the relationship between self-care and outcomes.[7] This change benefits users because now even asymptomatic patients will have self-care maintenance and confidence scores. Self-care management scores remain appropriate only in persons who have been symptomatic.

Finally, a major change was made to the formula used to calculate standardized scores. Our original formula used an index value to convert scores to a possible score of 100, although the lowest score possible was not 0. In the revised formula, discussed below, scores are possible in the full range of 0 to 100.

In the sections below we address 8 specific questions: 1) Have revisions increased the reliability of the self-care maintenance scale? 2) Have the revisions changed the item difficulty? 3) How often can the SCHFI be administered; is there a learning effect associated with multiple administration? 4) Is social desirability a problem with any of the scales? 5) How valid is the SCHFI as a measure of self-care maintenance and management as defined above? 6) What score can be thought of as adequate? 7) How much change is clinically relevant? 8) Are scores on prior versions of the SCHFI comparable to those obtained with the new version?

Methods and Analysis

Have revisions increased the reliability of the self-care maintenance scale?

Coefficient alpha was calculated using data from community-dwelling out-patients with HF enrolled in a prospective cohort study examining the impact of daytime sleepiness on HF self-care. The sample (n=154) was 66.5% male with average age of 63.87 ± 12.22 years. Most (54.4%) were married and they averaged 13.89 ± 2.65 years of formal education. The

sample was primarily Caucasian (64.3%) and African-American (33.8%), although 1.9% was Hispanic. At enrollment, 3.2% were New York Heart Association (NYHA) class I, 22.6% were NYHA class II, 56.1% were NYHA class III, and 18.1% were NYHA class IV. The average left ventricular ejection fraction was $32.73\% \pm 17.22\%$ with 65.6% having systolic HF and half (50.0%) having HF of ischemic origin. See Table 2 for a brief description of the methods used in this study and the others cited here. Although the SCHFI is being administered at monthly intervals throughout the course of this study, coefficient alpha and 95% confidence interval (CI) of intraclass correlation were calculated on data from the first administration of the SCHFI.

Coefficient alpha on the 10-item self-care maintenance scale (n=154) was .553 (95% CI .439–.651; .542 standardized). This alpha coefficient was not statistically different from the alpha on the original SCHFI v.4 self-care maintenance scale. No particular item was problematic and deletion of a single item would not have raised the coefficient alpha.

Coefficient alpha on the 6-item self-care management scale was .597 (95% CI = .434–.725; .590 standardized). Coefficient alpha of the self-care management scale in the original SCHFI was .70, a score within the current confidence interval. Note that the current data were available only on 73 participants who were symptomatic in the month prior to enrollment. No particular item was problematic and deletion of a single item would not have raised the coefficient alpha.

Coefficient alpha on the 6-item self-care confidence scale (n=154) was .827 (.781–.866; .836 standardized). Coefficient alpha of the confidence scale in the original SCHFI was .82, essentially unchanged. No single item was targeted for deletion.

There was significant variance in mean values of items on the self-care maintenance scale (F = 122.45, p < .001), self-care management scale (F = 3.71, p < .001), and self-care confidence scale (F = 20.58, p < .001). This variance indicates significant differences in responses to scale items within individuals, particularly in the self-care maintenance scale. That is, in a single respondent, scores may differ widely among the items in a particular scale. The three scales were not highly intercorrelated (none >.43), indicating that they do not measure the same construct. In the original publication the highest intercorrelation was between confidence and management (r=.42).

Have the revisions changed the item difficulty?

Each SCHFI item was analyzed to assess difficulty based on the proportion of participants who gave the best response (Table 3). Items with a difficulty score below .3 are considered difficult while items with a difficulty score above .7 are considered relatively easier; scores between .3 and .7 are considered best.[22]

Several SCHFI items were scored as being easy. That is, the vast majority of patients reported weighing themselves daily, trying to avoid getting sick, forgetting to take their medications only infrequently, and using systems to remember to take medications. Many items address behaviors that are difficult for patients. These difficult items included exercising for 30 minutes, asking for low salt foods when out of the home, as well as confidence in keeping free from HF symptoms, confidence in evaluating the importance of symptoms, confidence in doing something that will alleviate symptoms, and confidence in evaluating how well remedies work. Moreover, some items were more difficult on the SCHFI v.6 than v.4 and vice-versa (Table 3).

Is there a learning effect associated with multiple administrations?

In our observational cohort study examining the relationship between daytime sleepiness and HF self-care we administer the SCHFI repeatedly at monthly intervals. We did not consider this an assessment of instrument stability or test-retest reliability because the duration was too long to assume that self-care would not change. Instead, we used these data to assess for a learning effect from taking the instrument repeatedly.

To assess a learning effect, we compared baseline values of the SCHFI scales scores to those obtained one and two months later to assess for learning or trends in improved scores that could be attributed to familiarity with taking the SCHFI. Considering only patients with data available at all three time points (baseline, one month, two months), mean changes in scale scores over time were minimal; no difference in score was statistically different over time, suggesting that learning did not occur (Table 4). If a significant learning effect were at play, greater improvements in self-care would be expected over time. Thus, when SCHFI scale scores change over time in intervention studies, the change likely reflects changes in self-care not attributable to learning how to respond to the SCHFI questions.

Is social desirability a problem with any of the scales?

Social desirability was assessed to determine if something about the manner in which the questions are worded encourages users to respond in a manner they perceive we want them to respond. In 2007, a small sample of 34 HF patients (44.1% female, mean age 80.15 ± 7.9) was enrolled from hospital and community settings in Southern California (Table 2). Patients provided data on the SCHFI, the European Heart Failure Self-care Behavior Scale, [23] and the Crowne Marlow social desirability scale,[24] a measure of social desirability. The Crowne Marlow social desirability scale is scored to provide a sum of 20 true/false items such as "I sometimes try to get even rather than forgive and forget" and "I am sometimes irritated by people who ask favors of me". People who deny ever experiencing these feelings are responding in a socially desirable manner.

Social desirability was assessed by correlating individual SCHFI scale scores with the social desirability scale score. None of the scale scores were significantly correlated with the social desirability scale score. The highest correlation was with the self-care confidence scale ($r = .32$, p=.07, n=33). These results indicate that social desirability is not responsible for the responses obtained on the SCHFI, although the confidence scale may have some element of social desirability in certain populations.

How valid is the SCHFI as a measure of self-care maintenance and management?

Quantitative Assessment of Validity—Concurrent validity was tested by comparing summary scores on the SCHFI to scores on the European Heart Failure Self-care Behavior Scale[23] using data from the sample of 34 HF patients described above. The 12 item European HF Self-Care Behavior Scale uses a 5-point Likert-type scale with 1 equaling 'I completely agree' and 5 equaling 'I don't agree at all'. Thus, lower scores indicate better self-care. Self-care maintenance was hypothesized to be moderately and negatively (because the scales are reversed) related to the European HF Self-Care Behavior Scale and this hypothesis was supported ($r = -.65$, p<.001). As the European HF Self-Care Behavior Scale captures self-care maintenance items only, it was not surprising that it was poorly correlated with self-care management ($r = -.18$, p = .43). Self-care confidence also was poorly correlated with the European HF Self-Care Behavior Scale ($r = -.05$, p = .76).

Construct validity was tested using confirmatory factor analysis to determine if the individual SCHFI items loaded on the self-care maintenance, management, and confidence scales as expected. Data collected on the first 154 patients who completed the SCHFI in the

prospective cohort study described above were used for this analysis, which was done in AMOS 7.0 (SPSS Inc., Chicago, Illinois). The model was specified with self-care management and confidence correlated and with self-care maintenance and confidence correlated, now that two items in the confidence scale speak directly to self-care maintenance.

Overall model fit of the SCHFI was adequate and similar to that found in the previous version of the SCHFI (SCHFI v.4: $\chi^2 = 329.9$, SCHFI v.6: $\chi^2 = 356.92$) (Figure 2). Two items in the maintenance scale had negative values: item #5 - see your doctor or nurse and item #8 - forget to take one of your medicines. Item #5 is clarified in the instrument example shown in the Appendix as "Keep your doctor or nurse appointments". The other item is the one reverse scored item, which suggests that patients may have trouble reversing the scale in their minds to give the appropriate response to this item. We will continue to monitor this item in future studies.

Absolute fit indices test how far apart the covariance matrices of the model and the sample data are while incremental fit indices test the hypothesized model against an independent model. We were most interested in the incremental fit indices to validate the data against our existing model. In the SCHFI v.4 model, incremental non-centrality measures (comparative fit index = .73) and independence model comparisons (normed fit index = .67 and nonnormed fit index = .69) were adequate. When tested with the SCHFI v.6 items, these measures were similar to those obtained with v.4 data (comparative fit index = .726; normed fit index = .554; root mean square error of approximation =.07).

Qualitative Assessment of Validity—Data from three mixed methods studies[8, 9, 14] were used to assess the convergent validity of the SCHFI. The mixed methods technique of data triangulation was used to confirm, cross-validate, and corroborate findings within each individual study.[25] Convergence of quantitative and qualitative results, or congruence, strengthened our assessment of validity.

In each study interview sessions were audiotaped, transcribed verbatim, analyzed using Atlas.T_i software, and augmented with field notes. Prior to data triangulation, the qualitative data were analyzed using content analysis. Then the qualitative data were compared to the quantitative data obtained with the SCHFI to evaluate congruence on a case by case basis. The qualitative (VVD) and quantitative (BR) researchers were blinded to the other's results until each analysis was completed or the analysis was done sequentially in order to reduce bias and maintain objectivity.

When a discrepancy between a behavior and a SCHFI score was found, we returned to the qualitative data to find an explanation. This process entailed reviewing all accounts of self-care for a specific individual to identify reports of adequacy and consistency in maintenance or management. For example, was there evidence that the individual routinely adhered to medication, diet and weight monitoring practices but had lapses in exercise? Did s/he provide a specific example of how HF symptoms were managed and the effectiveness of that management approach? This process was iterative; the qualitative and quantitative researchers discussed the data until consensus was reached.

In the first study,[8] a longitudinal intervention trial pilot study, after three months there was quantitative evidence of improvement in HF self-care in 12 of 15 participants (80%) and qualitative evidence of self-care behavior change in 12 of 14 (86%) participants (one tape malfunctioned). Congruence in our assessments of self-care at the end of the study was found in 71.4% (10 of 14). Three with evidence of significant improvement in their SCHFI scale scores failed to verbalize behavioral change or the intention to change. One participant

who demonstrated self-care behavior change during discussions had no change in his SCHFI scores over time. Congruence of the qualitative and quantitative data was lower in this study than the subsequent studies presumably because accounts of self-care were extracted from the dialogue between the intervention nurse and the patients.

In the second study,[9] a cross-sectional study, we sought to identify the factors associated with expertise in HF self-care. A semi-structured interview guide was used to structure interviews. Each interview began with a general question: "Tell me about your heart failure…" followed by "Tell me what you do on a daily basis to manage your heart failure…" Participants were encouraged to fully describe their experiences of daily self-care practices and to describe what they did the last time they experienced HF symptoms.

Participants were classified as *poor*, *good*, or *expert* in HF self-care. Those poor in HF self-care (10/29; 34.5%) did not routinely perform daily self-care maintenance and lacked evidence of the ability to manage symptoms. Sixteen (55.2%) were identified as good in HF self-care based upon evidence of their ability to adequately manage symptoms and perform most—but not all—maintenance behaviors. Experts (3; 10.3%) in HF self-care were adept at managing HF symptoms or described how they kept themselves symptom-free. These participants were consistent in their self-care maintenance behaviors (e.g., following a low sodium diet, using a system to assure that medications were taken). Scores on the SCHFI rose in a linear fashion as expertise increased (self-care maintenance, poor/good/expert: 70.0 ± 16.9, 80.0 ± 12.2, 85.0 ± 5.0; self-care management: 62.0 ± 12.9, 73.2 ± 11.6, 87.6 ± 5.9), except for confidence, which was highest in patients judged to be good but not expert in self-care 62.1 ± 10.3, 77.7 ± 12.9, 72.3 ± 12.0).

Our third study,[14] which used methods similar to the last one, produced a HF self-care typology with participants categorized as *Inconsistent, Novice,* or *Experts*. Self-care themes differed significantly (p=0.001) among these types, with important differences in consistency of medication and diet adherence, symptom monitoring, exercise, symptom recognition, symptom evaluation, treatment implementation and treatment evaluation. Congruence between the quantitative and qualitative data was 90% for self-care management. There were statistically significant differences (p=0.001) in the adequacy of self-care management and maintenance across the typology groups.

What score can be thought of as adequate?

We have consistently used a cut-point of ≥70 on each SCHFI scale to judge self-care adequacy. In the three mixed methods studies described above,[8, 9, 14] adequacy of self-care maintenance and management practices was judged for each individual based upon the narrative accounts. After identifying individuals with adequate self-care based on the qualitative data, the range of SCHFI scores was used to identify the cut-point that best reflected the behavior.

In the first study,[8] we found 64% congruency between a scale cut-point score of ≥70 and the narrative accounts of self-care using content analysis and data triangulation. In the second study,[9] using the SCHFI cut-point score of ≥70 we found congruency in 77% of cases based upon the categorization of individuals as poor or good/expert combined. In the third study,[14] using the ≥70 cut-point, there was 90% congruence between the qualitative analysis of self-care management practices and the SCHFI self-care management scores. Congruence between the qualitative self-care maintenance behaviors and the SCHFI self-care maintenance scores was 85%.

We have also observed that different levels of engagement in HF self-care are necessary to influence specific clinical health outcomes. For example, we start to see improvements in

perceived health status with SCHFI scores above the 15th percentile. There are marked reductions in the odds of having episodes of hemodynamic congestion and the risk of death or hospitalization with scores above the 50th percentile. At the 75th percentile, direct inpatient cost-savings are seen. And, patients with scores in the 90th percentile are not likely to accrue inpatient costs at all; these patients also view their health better than does the general non-HF population.[26] Thus, while using the ≥ 70 cut-point has been useful in judging HF self-care adequacy, the minimal effectiveness threshold, or point at which self-care is effective in improving health outcomes, depends on the outcome of interest.

How much change is clinically relevant?

Minimally important differences are calculated to estimate responsiveness to change. Responsiveness refers to the ability of an instrument to reflect underlying clinical benefit, not just statistically significant change.[27, 28] Hays and Farivar[29] note that benefit can be defined by evaluating a variety of parameters such as a change in clinical status, health events, or provider reports. Others have recommended distribution-based indices such as a half standard deviation.[28] Hays and Farivar[29] argue that such approaches provide no direct information about minimally important differences. However, until we have more research that directly tests clinical benefit of self-care, we advocate using a half standard deviation approach to estimate the minimally important change in scores.[28] Use of this approach is consistent with the 8 point difference in standardized scale scores that we have used empirically in interpreting the results obtained in various studies.

Are scores on prior versions of the SCHFI comparable to those obtained with the SCHFI v. 6?

The benefit of using standardized scores is that results obtained from different version of the SCHFI can be compared. In the original 2004 publication we reported a mean self-care maintenance score of 67.8 ± 17.2, a mean self-care management score of 60.9 ± 21.3, and a mean self-care confidence score of 65.0 ± 17.2. These scores are similar to those in a recent U.S. sample (mean self-care maintenance 67.5 ± 16.9, mean self-care management 68.2 ± 17.7, mean self-care confidence 69.9 ± 15.7), although these scores were obtained with a different and more recent version of the SCHFI.[18] In the current study using the SCHFI v.6, we found mean self-care maintenance score of 70.5 ± 14.3, a mean self-care management score of 65.4 ± 22.4, and a mean self-care confidence score of 70.2 ± 16.6. The most important factor that must be considered when comparing scores obtained in research with published scores is the change in the scoring algorithm, as discussed below.

Directions for Use

The time interval used in the directions can be adjusted to reflect your study design. For example, if your follow-up is 3 months, you can ask patients to "think about how you have been feeling in the last 3 months". If you contact patients every month, ask them to "think about how you have been feeling in the last month or since we last spoke as you complete these items." We recommend that no longer than 3 months be used, though, because of issues with recall.[30]

Scoring

We strongly discourage users from calculating a total, combined SCHFI score. Instead, the data will be far more useful if the scales (maintenance, management, confidence) are used individually. Each scale is standardized to a score of 100 to make them comparable across scales, across studies, and across versions.

Maintenance—To calculate the scale scores, each scale score is standardized to a 0 to 100 range. Note that the SCHFI has a reverse scored item in the maintenance scale (# 8). First reverse code that item. After reverse coding, the lowest possible raw scale score is 10. The raw score indicating the best self-care maintenance is 40. Thus, for raw scores of 10 to 40, use the following formula to compute a standardized self-care maintenance scale score: (sum of Section A items - 10) * 3.333.

If you are using a prior version of the SCHFI, you can still score it using the new scoring algorithm. With prior versions, the lowest possible raw scale score is the number of items (usually 5). The raw score indicating the best self-care maintenance is a multiple of the number of items * 4. Thus, for raw scores of 5 to 20, use the following formula to compute a standardized self-care maintenance scale score: (sum of Section A items - 5)*6.667.

Note that more than half of the items in this section A should be answered for the scale to be an adequate measure of self-care maintenance. If not all items are answered, you will need to adjust the math using the following general formula: raw score sum minus lowest possible raw scale score, then divided by the possible range of scores, and finally multiplied by 100 or ((raw score sum – lowest possible raw score)/possible range of scores) * 100. The phrase "range of scores" refers to the difference between the lowest possible raw score and the highest possible raw score.

Management—Score the management scale only if the patient acknowledged having trouble breathing or ankle swelling in the past interval. Otherwise, ignore responses, even if the patient answers the items. Note that the first item (In the past month, have you had trouble breathing or ankle swelling?) is used only for this purpose and not in the scale score.

Code the responses to the rest of the items in Section B as 1 to 4 except for the first (How quickly did you recognize it as a symptom of heart failure?) and last (How sure were you that the remedy helped or did not help?) items in the section. These items have a true 0 possible and are coded from 0 to 4. The self-care management score should also be standardized. The highest possible raw score is 24, and the lowest possible raw scale score is 4. Thus, use the following formula: (sum of Section B items - 4) * 5.

Note that a commonly skipped item is "Take an extra water pill." If the patient is not taking a diuretic, this item can be skipped and the scoring adjusted using the same general formula given above (raw score sum minus lowest possible raw score, then divided by the possible range of scores, and finally multiplied by 100. Other items are rarely missing. If they are, they can be assumed to reflect the lowest score possible (0 or 1). Note that at least 2 of the 4 possible remedies must be answered for the scale to be an adequate measure of self-care management.

Confidence—Self-care confidence scores (Section C) should be standardized as described above. The highest possible score is 24, and the lowest possible scale score is 6. To compute scores use the following formula: (sum of Section C items - 6) * 5.56. If you are using the earlier, 4 item version, the lowest possible raw scale score is 4 and the highest is 16. Thus, for raw scores of 4 to 16, use the following formula to compute a standardized self-care confidence scale score: (sum of Section C items - 4) * 8.333. Note that more than half of the items in this section should be answered for the scale to be an adequate measure of self-care confidence.

This change in computation of the standardized score changes the scores obtained in important ways that will require that users specify the scoring approach used. This can be done most easily by reporting the range of scores possible (v.4, 25–100 vs. v.6, 0–100).

Further, with the new scoring algorithm, the average scores will be lower overall, fewer will meet the ≥70 cut-point discussed above, and the dispersion of scores will be greater. See Figure 3 for an illustration of how scores differ for the two approaches.

Discussion

At this point, the SCHFI v.6 is ready to be used by investigators. The addition of items to the self-care maintenance scale did not significantly change the coefficient alpha, providing evidence that the structure of the instrument is more powerful than the individual items. No learning effect is associated with repeated administration. Social desirability is minimal. The SCHFI appears to be valid as a measure of self-care maintenance and management as defined above. A score of ≥70 can be used as the cut-point to judge self-care adequacy in research. A change in a scale score more than one half of a standard deviation is considered clinically relevant.

Investigators are encouraged to use the three self-care scales—maintenance, management, and confidence—to describe their population of patients with HF and to evaluate the effects of their interventions. Although we originally bemoaned the loss of patients without a self-care management score, we soon realized that including asymptomatic patients provided added benefit. For example, in a study of the relationship between HF self-care management and health outcomes, Lee et al[31] compared the risk of all-cause mortality, hospitalization or emergency department admission in patients who practiced above average self-care management, those who practiced below average self-care management, and those who were symptom-free. Those who engaged in above average self-care management had a lower risk of an event during follow-up (hazard ratio HR = 0.44 (95% CI, 0.22–0.88), $P < .05$) than those engaged in below average self-care management. This low event rate was comparable to that of asymptomatic patients.

The confidence scale should be tested as a moderator of the relationship between self-care and outcomes rather than a core component of self-care itself. Although confidence is believed to be extremely important in the success of self-care, a number of questions about when and how confidence influences the relationship between self-care and outcomes remain unanswered. Using this scale as a moderator in analyses will facilitate our understanding of how confidence influences self-care in relation to outcomes.

This is the first test of social desirability of the SCHFI. Social desirability is a form of bias found in all types of self-report measures. Although some have suggested that concerns about social desirability are overrated,[32] we were concerned about possible social desirability after obtaining unusually high self-care confidence scores in a sample of Hispanic heart failure patients.[18] Here we have demonstrated that social desirability of the SCHFI is minimal overall, although the confidence scale is the one most likely to generate a socially desirable response. This possibility should be considered if unusually high confidence scores are obtained.

The fit of the SCHFI v.6 structural equation model was similar to that of the SCHFI v.4 and adequate considering the relatively small sample size available for confirmatory analysis. Based on our interpretation of the overall model, we made an adjustment to SCHFI v.6 item #5 that may help improve the standardized factor loadings for the self-care maintenance scale, improve overall model fit, and further limit residual error. That change is shown in the version shown here.

Limitations

The study here has a number of limitations that must be considered when interpreting the results. One limitation to the instrument itself is that only two symptoms are used to assess self-care management. The decision was made to assess only two symptoms because the self-care treatments differ for most symptoms. That is, the appropriate response to fatigue differs from that of shortness of breath. Further, in our original Self-Management of Heart Failure (SMHF) tool,[19] from which the SCHFI evolved, we evaluated the response to 6 separate symptoms and the tool was ungainly.

A strength of this study is the mixed methods approach to validity testing. Triangulation of the quantitative and qualitative data supports validity of the SCHFI. However, although effort was made to obtain a diverse sample in each of the three qualitative studies; the samples were predominately Caucasian (63.5%) and male (58.9%). Therefore, further validation studies are needed in ethnically diverse samples and with more women.

Conclusion

The SCHFI v.6 is ready to be used by investigators. Permission is not required to use the SCHFI. Investigators are strongly encouraged to use the three self-care scales— maintenance, management, and confidence—to describe the self-care of their population of patients with HF, and to use standardized scoring of each scale.

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SELF-CARE OF HEART FAILURE INDEX v.6.2

All answers are confidential.

Think about how you have been feeling in the last month or since we last spoke as you complete these items.

SECTION A:

Listed below are common instructions given to persons with heart failure. How routinely do you do the following?

		Never or rarely	Sometimes	Frequently	Always or daily
1.	Weigh yourself?	1	2	3	4
2.	Check your ankles for swelling?	1	2	3	4
3.	Try to avoid getting sick (e.g., flu shot, avoid ill people)?	1	2	3	4
4.	Do some physical activity?	1	2	3	4
5.	Keep your doctor or nurse appointments?	1	2	3	4
6.	Eat a low salt diet?	1	2	3	4
7.	Exercise for 30 minutes?	1	2	3	4
8.	Forget to take one of your medicines?	1	2	3	4
9.	Ask for low salt items when eating out or visiting others?	1	2	3	4
10.	Use a system (pill box, reminders) to help you remember your medicines?	1	2	3	4

SECTION B:

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

In the past month, have you had trouble breathing or ankle swelling? Circle <u>one</u>.

  0)   No

  1)   Yes

11. If you had trouble breathing or ankle swelling in the past month…

			(circle one number)			
	Have not had these	I did not recognize it	Not Quickly	Somewhat Quickly	Quickly	Very Quickly
How quickly did you recognize it as a symptom of heart failure?	N/A	0	1	2	3	4

Listed below are remedies that people with heart failure use. If 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**
12. Reduce the salt in your diet	1	2	3	4
13. Reduce your fluid intake	1	2	3	4
14. Take an extra water pill	1	2	3	4
15. Call your doctor or nurse for guidance	1	2	3	4

16. Think of a remedy you tried 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 did not help?	0	1	2	3	4

SECTION C:

In general, how confident are you that you can:

	Not Confident	**Somewhat Confident**	**Very Confident**	**Extremely Confident**
17. Keep yourself <u>free of heart failure symptoms</u>?	1	2	3	4
18. <u>Follow the treatment advice</u> you have been given?	1	2	3	4
19. <u>Evaluate the importance</u> of your symptoms?	1	2	3	4
20. <u>Recognize changes</u> in your health if they occur?	1	2	3	4
21. <u>Do something</u> that will relieve your symptoms?	1	2	3	4
22. <u>Evaluate</u> how well a remedy works?	1	2	3	4

Self-Care Maintenance   **Self-Care Management**

Symptom monitoring and treatment adherence → **Symptom Recognition** → **Symptom Evaluation** → **Treatment Implementation** → **Treatment Evaluation**
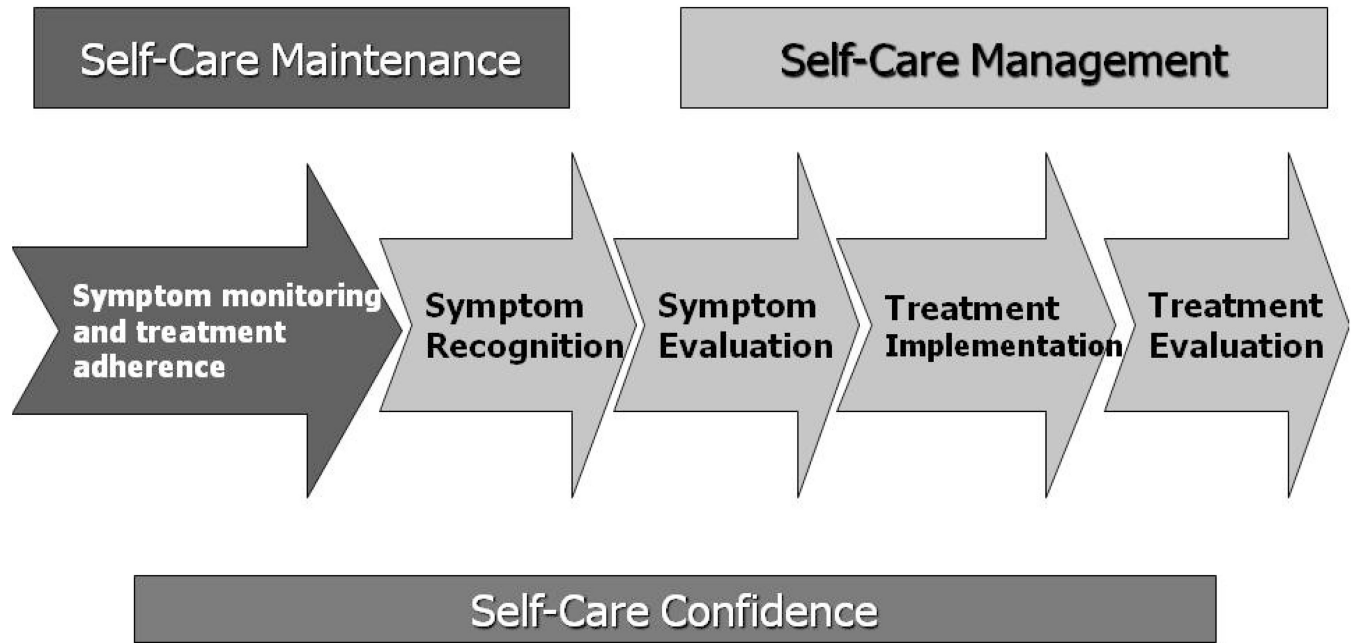
Self-Care Confidence

Figure 1. Model Illustrating the Process of Heart Failure Self-Care
Heart failure self-care is conceptualized as a process involving maintenance and management. Patients perform self-care maintenance behaviors such as medication adherence to keep themselves physiologically stable. Self-care management is performed when a heart failure symptom occurs. The patient must recognize the symptom as related to heart failure, evaluate the importance of the symptom, do something about it, and then evaluate whether or not the treatment was effective. Self-care confidence is not a part of the self-care process per se; it is an extremely important factor influencing the effectiveness of self-care. Thus, it is included in the model.
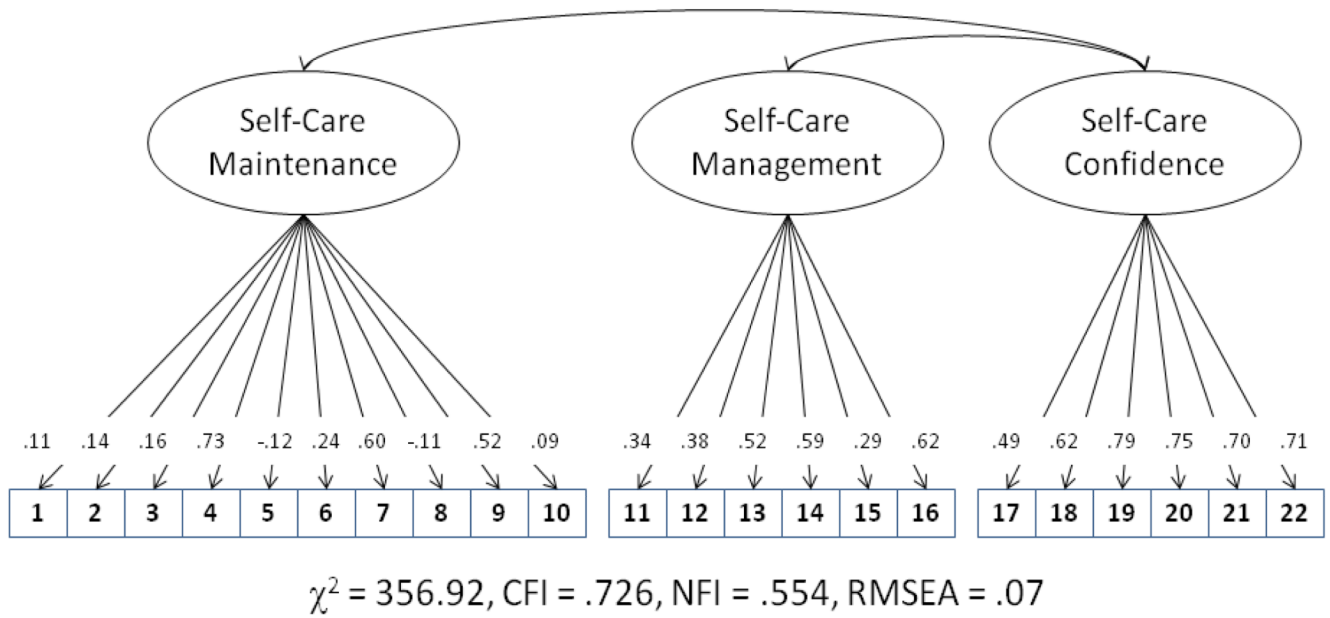
$$\chi^2 = 356.92, CFI = .726, NFI = .554, RMSEA = .07$$

Figure 2.
Graphic representation of the confirmatory factor analysis. The figure displays the standardized loadings for the indicators of the SCHFI latent constructs self-care maintenance, self-care management, and self-care confidence. Numbers in the outlined boxes represent the SCHFI item numbers. The standardized numbers reflect the strength of the relationship between each indicator and the construct on which it loads. **Abbreviations:** CFI = comparative fit index, NFI = normed fit index, RMSEA = root mean square error of approximation.
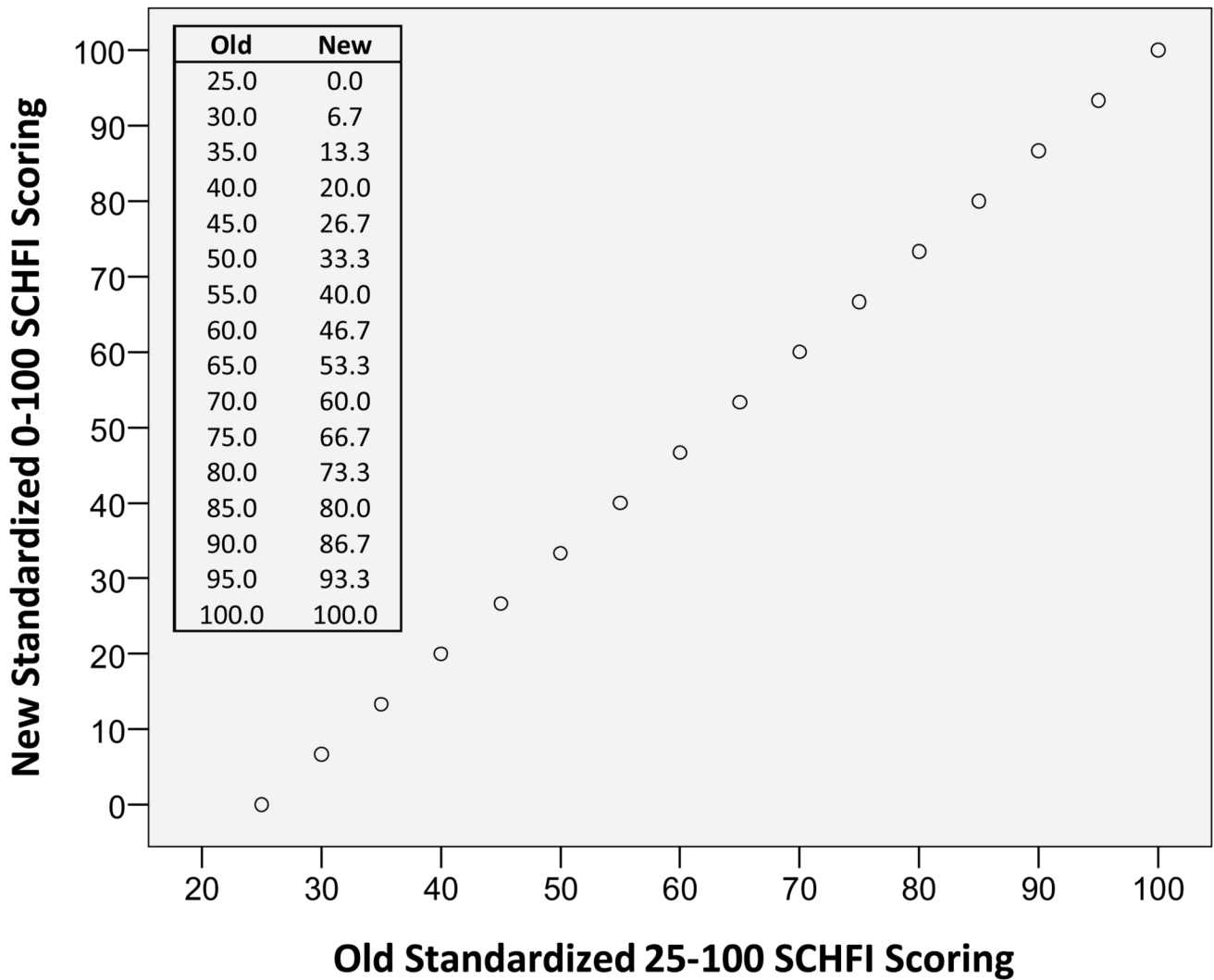
Old	New
25.0	0.0
30.0	6.7
35.0	13.3
40.0	20.0
45.0	26.7
50.0	33.3
55.0	40.0
60.0	46.7
65.0	53.3
70.0	60.0
75.0	66.7
80.0	73.3
85.0	80.0
90.0	86.7
95.0	93.3
100.0	100.0

Figure 3. Comparison of Prior and Current Scoring Algorithms
Comparative self-care maintenance scale scores shown as an example. Although the linear correlation between old standardized 25–100 SCHFI scale scores and new standardized 0–100 SCHFI scale scores is 1 (perfect linear correlation), there are a few key differences. With the new scoring algorithm, the average SCHFI scale scores will be lower overall, a lower proportion of patients will meet the ≥70 (adequate self-care) cut-point, and the dispersion of scores will be greater. For example using the same raw data, old standardized 25–100 scores have a mean and standard deviation of 70.23 ± 17.68, while the new standardized 0–100 scores have a mean of 60.29 ± 23.56. SCHFI = Self-Care of Heart Failure Index

Table 1

Comparison of Original SCHFI Items with SCHFI Items

Original SCHFI Self-Care Maintenance Items	Reworded SCHFI Self-Care Maintenance Items
Weigh yourself daily?	Weigh yourself?
Eat a low salt diet?	Eat a low salt diet? (no change) Ask for low salt items while eating out or visiting others?
Get a flu shot every year?	Try to avoid getting sick (e.g., flu shot, avoid ill people)?
Take part in regular physical activity?	Do some physical activity? Exercise 30 minutes?
Keep your weight down?	
	New SCHFI Items
	Check your ankles for swelling?
	Keep your doctor or nurse appointments?
	Forget to take one of your medicines? (reverse coded) Use a system (pill box, reminders) to help you remember your daily medicines?
Original SCHFI Self-Care Confidence Items	**Reworded SCHFI Self-Care Confidence Items**
How confident are you that you can…	How confident are you that you can…
	Keep yourself free of heart failure symptoms?
	Follow the treatment advice you have been given?
Evaluate the importance of your symptoms?	Evaluate the importance of your symptoms? (no change)
Recognize changes in your health if they occur?	Recognize changes in your health if they occur? (no change)
Do something that will relieve your symptoms?	Do something that will relieve your symptoms? (no change)
Evaluate the effectiveness of whatever you do to relieve your symptoms?	Evaluate how well a remedy works?

SCHFI = Self-Care of Heart Failure Index

Table 2

Brief Description of the Methods used in the Studies Referred to in this Article.

Reference	Study Purpose	Study Design	Methods of Measuring Self-Care
Riegel, et al (in process)	1) To describe the transient, reversible factors associated with EDS in persons with HF; 2) To establish the longitudinal relationships among EDS, HF self-care, HRQL, and unplanned hospitalization after adjusting for the severity of HF; 3) To assess cognitive impairment as the mechanism by which EDS influences self-care and outcomes in persons with HF after adjusting for the severity of HF.	Prospective cohort study with a cohort with excessive daytime sleepiness (with and without cognitive impairment) and a control group without excessive daytime sleepiness (with and without cognitive impairment). We are seeking a sample of 280 persons.	Self-care is measured by self-report at monthly intervals for 6 months. 24-hour urine sodium levels are assessed at baseline, 3- and 6-months. Adherence to the medication regimen is assessed over the 6-month period using electronic monitoring technology manufactured by AARDEX (www.aardex).
Carlson, et al (unpublished data)	To assess the social desirability and concurrent validity of the SCHFI items	Descriptive, observational design. A total of 34 persons were enrolled.	Surveys measuring social desirability and an interim version of the SCHFI with many of the items used in the SCHFI were administered in person in the hospital or by telephone after patients had been discharged.
Riegel, et al[8]	To test the effect of a motivational counseling approach on improving self-care in adults with chronic heart failure	Mixed methods longitudinal clinical intervention pilot trial with 15 adults with HF.	An interim version of the SCHFI was used to measure self-care at baseline and 3-months later. Intervention sessions by an advanced practice nurse were audiotaped and transcribed for the qualitative analysis
Riegel, et al[9]	To identify the factors associated with expertise in HF self-care	Mixed methods cross-sectional study of 29 adults with HF. Semi-structured interview guide used to elicit in depth accounts of self-care and the barriers and facilitators to self-care practice. Standardized instruments measured variables known to be related to self-care (e.g., social support, depression, family functioning, physical functioning, cognition and physician communication).	SCHFI was used to measure self-care at two interview sessions about one week apart. Triangulation methods were used to assess concordance of qualitative data (narrative accounts of self-care) and the quantitative SCHFI score.
Dickson, et al[33]	To examine the contribution of biobehavioral variables to HF self-care management.	Mixed methods cross-sectional concurrent nested study (QUAL+quan) with xx adults with HF. Narrative accounts of self-care and attitudes and self-efficacy beliefs about self-care were elicited using a semi-structured interview guide. Cognition, physical functioning and knowledge were measured using standardized instruments.	The SCHFI was used to measure self-care management and maintenance. Triangulation of qualitative and quantitative self-care data were used to anchor the construction of a typology of self-care management.

QUAL = qualitative data takes precedence over quantitative (quan) data; SCHFI=Self-Care of Heart Failure Index

Table 3

SCHFI Item Difficulty Level

SCHFI Scale	Item Difficulty Level	Original SCHFI
Self-Care Maintenance (n = 154)	**Scale average .56**	
1) Weigh yourself?	.82	.55[**]
2) Check your ankles for swelling?	.65	–
3) Try to avoid getting sick?	.73	–
4) Do some physical activity?	.40	.39
5) See your doctor or nurse?	.52	–
6) Eat a low salt diet?	.52	.68[**]
7) Exercise 30 minutes?	.10	–
8) Forget to take one of your medicines?	.83	–
9) Ask for low salt items while eating out or visiting others?	.19	–
10) Use a system to help you remember to take your pills?	.80	–
Self-Care Management (n = 73)	**Scale average .49**	
11) How quickly did you recognize it as a symptom of heart failure?	.64	.34[**]
12) Reduce the salt in your diet	.55	.29[**]
13) Reduce your fluid intake	.40	.29
14) Take an extra water pill	.49	.36[*]
15) Call your doctor or nurse for guidance	.41	.62[**]
16) How sure were you that the remedy helped or did not help?	.43	.58[*]
Self-Care Confidence (n = 154)	**Scale average .28**	
17) Keep yourself free of heart failure symptoms?	.21	–
18) Follow the treatment advice you have been given?	.37	–
19) Evaluate the importance of your symptoms?	.29	.54[**]
20) Recognize changes in your health if they occur?	.36	.63[**]
21) Do something that will relieve your symptoms?	.23	.52[**]
22) Evaluate how well a remedy works?	.24	.46[**]

Item difficulty numbers shown indicate the proportion of patients who selected the best response to each question. Items with a difficulty score below .3 are considered difficult while items with a difficulty score above .7 are considered relatively easier. SCHFI items are compared to the original SCHFI. *P*-values are or two sample tests of proportions comparing data from the original psychometric testing[1] and data collected on the first patients to take the SCHFI. Missing items are those that were not included in the original or the revised version.

Abbreviations: SCHFI = Self-Care of Heart Failure Index, SCHFI = Self-Care of Heart Failure Index Revised.

[**]
 P<0.01,

[*]
 P<0.05

Table 4

SCHFI Learning Effect: Pair-wise comparisons

SCHFI scale	Mean ± SD Scale Score	Correlation with Baseline	Difference from Baseline Mean ± SD
Maintenance			
Baseline (*n= 130*)	70.49 ± 14.32		
Time 2 (*n=130*)	68.40 ± 16.61	.443[**]	1.59 ± 16.08
Time 3 (*n=110*)	69.66 ± 15.06	.470[**]	1.58 ± 15.11
Management			
Baseline (*n=41*)	63.66 ± 22.64		
Time 2 (*n=41*)	66.34 ± 24.06	.663[**]	−2.68 ± 19.21
Time 3 (*n=20*)	57.75 ± 26.33	.383	6.00 ± 26.19
Confidence			
Baseline (*n=130*)	70.00± 16.28		
Time 2 (*n=130*)	67.10 ± 18.88	.296 [**]	2.91 ± 20.96
Time 3 (*n=110*)	70.36 ± 17.96	.200 [*]	−1.41 ± 21.65

[**] $P<0.01$,

[*] $P<0.05$