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Psychometric Testing of the Self-Care of Heart Failure Index Version 6.2

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Abstract: The Self-Care of Heart Failure Index Version 6.2 (SCHFI v.6.2) is widely used, but its psychometric profile is still questioned. In a sample of 659 heart failure patients from Italy, we performed confirmatory factor analysis (CFA) to test the original construct of the SCHFI v.6.2 scales (Self-Care Maintenance, Self-Care Management, and Self-Care Confidence), with limited success. We then used exploratory factor analysis to determine the presence of separate scale dimensions, followed by CFA in a separate sub-sample. Construct validity of individual scales showed excellent fit indices: CFI = .92, RMSEA = .05 for the Self-Care Maintenance Scale; CFI = .95, RMSEA = .07 for the Self-Care Management Scale; CFI = .99, RMSEA = .02 for the Self-Care Confidence scale. Contrasting groups validity, internal consistency, and test-retest reliability were supported as well. This evidence provides a new understanding of the structure of the SCHFI v.6.2 and supports its use in clinical practice and research. © 2013 Wiley Periodicals, Inc. Res Nurs Health 36:500–511, 2013

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Heart failure (HF) is a major public health problem worldwide, with prevalence rates ranging from 0.4% to 2.4% in European and United States populations (Davis et al., 2002; Goldbeck & Melches, 2005; Mosterd et al., 1999). The prevalence of HF increases with age, reaching the highest levels after age 75 years (O'Flaherty et al., 2009; Setoguchi et al., 2008). Population longevity and better survival rates after acute myocardial infarction have further increased the prevalence of HF (O'Flaherty et al., 2009; Setoguchi et al., 2008). Nonetheless, morbidity and mortality associated with HF are high (Teng et al., 2012). Forty percent of adults with HF die in the first year after the diagnosis; the 4-year mortality is 50% (Dickstein et al., 2008;

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Krum, 2005). A high symptom burden greatly impairs patients' quality of life (QOL) (Iavazzo & Cocchia, 2011; Jurgens et al., 2009; Mulligan et al., 2012; Rete Infermieri GISSI-HF, 2009). HF is associated with frequent emergency department visits and hospital admissions that contribute enormously to health care costs in all countries (Braunschweig, Cowie, & Auricchio, 2011; Jaarsma et al., 2013; Naccarelli, Johnston, Lin, Patel, & Schulman, 2010).

Self-care of HF has been demonstrated to improve QOL and reduce emergency department visits, hospital admissions, and mortality (Buck et al., 2012; Lee, Carlson, & Riegel, 2007; Wang, Lin, Lee, & Wu, 2011; Zambroski, 2008). The American Heart Association and the European Society of Cardiology (Lainscak et al., 2011; Riegel et al., 2009) recommend that self-care be improved by providing educational programs to HF patients. In order to evaluate the effectiveness of these programs, valid and reliable measures of self-care are needed.

Development of the Self-Care of Heart Failure Index

Numerous definitions of self-care can be found in the literature (Leenerts, Teel, & Pendleton, 2002; Orem, 2001). For the purposes of this study, self-care was defined as a naturalistic decision-making process that patients use in the choice of behaviors such as symptom monitoring and treatment adherence that maintain physiological stability (self-care maintenance) and response to symptoms when they occur (self-care management). These self-care behaviors are greatly influenced by self-efficacy, or the confidence that HF patients have in each phase of the self-care process (Riegel et al., 2004, 2011; Riegel & Dickson, 2008). These three dimensions are captured in the situation-specific theory of HF self-care (Riegel & Dickson, 2008).

The Self-Care of Heart Failure Index (SCHFI) captures the three dimensions of self-care—Maintenance, Management, and Confidence—in three separate scales. The SCHFI measures behaviors recommended by the current guidelines on HF treatment (Lainscak et al., 2011; Riegel et al., 2009). The construct validity of the SCHFI has been supported with mixed methods research in which higher SCHFI scores identified patients who were more adherent to treatments, more engaged in body listening or self-monitoring, able to manage the symptoms of a HF exacerbation, and confident in dealing with the illness. People with low SCHFI scores had negative attitudes about HF, were less vigilant over time, and had less skill in managing the illness (Dickson, Deatrick, & Riegel, 2008).

Testing version 4. The SCHFI version 4 (v.4) was developed in the US as a 15-item tool and tested initially on an American sample of 760 HF patients. In this older version of the SCHFI, a summary index score was used, and construct validity of the instrument as a whole was tested by confirmatory factor analysis (CFA), but fit indices were poor: $\chi^2(89, 760) = 329.9$, comparative fit index (CFI) = .73, normed fit index (NFI) = .67, non-normed fit index (NNFI) = .69, average absolute residual = .03. Known-groups technique and scale-to-scale correlations were used to further evaluate construct validity. Reliability, tested by Cronbach alpha, was .76 for the full scale and .56, .70 and .82 for the Self-Care Maintenance, Self-Care Management, and Self-Care Confidence scales respectively (Riegel et al., 2004). Test-retest reliability was not tested.

In additional testing of the SCHFI v.4, Yu and colleagues (Yu, Lee, Thompson, Woo, & Leung, 2010; Yu et al., 2011) administered the instrument to 143 Chinese adults with HF after translating, back-translating, and validating the content validity of the SCHFI v.4 in China. Internal consistency of the aggregated scales (Cronbach alpha) was .73. Test-retest reliability was not evaluated. Validity was tested with confirmatory factor analysis using a subset of 86 subjects who had experienced symptoms. All items except two loaded strongly and significantly on the correct factor of the three-factor structure. However, the chi square/degrees of freedom for the overall model was 1.57, the NFI was .60, the NNFI was .59, and the CFI was .64. Exploratory factor analysis (EFA) using principal axis factoring with Varimax rotation revealed that two items were problematic, one of which was revised in version 6.2. The other item, which was retained in version 6.2, is within the Self-Care Management scale and is about seeking guidance from a doctor or nurse when symptoms occur. This item failed to load on Self-Care Management in the Chinese sample. The authors commented that Chinese HF patients regard seeking medical help as a different kind of self-care behavior.

Testing SCHFI version 6.2. The SCHFI was updated as version 6.2 (Riegel, Lee, et al., 2009). The SCHFI v.6.2 is a 22-item instrument with three scales that measure the three theoretically derived components of HF self-care: maintenance, management, and

confidence. The Self-Care Maintenance scale has 10 items that measure symptom monitoring and adherence behaviors performed to prevent a HF exacerbation (e.g., monitoring weight, eating a low-salt diet, and taking medications). The six items of the Self-Care Management scale measure patients' abilities to recognize symptoms when they occur, treatment implementation in response to symptoms (e.g., consult a provider, reduce fluid intake, and take an extra water pill), and treatment evaluation. The Self-Care Confidence scale uses six items to evaluate patients' perceived ability to engage in each phase of the self-care process (e.g., preventing symptom onset and recognizing symptom changes).

Each scale uses a 4-point self-report response format: 1 (*never or rarely*), 2 (*sometimes*), 3 (*frequently*), 4 (*always or daily*). Each scale score is transformed to yield a standardized score from 0 to 100; higher scores indicate better self-care. A cut-point score of $\geq$70 has been suggested as the minimum level of self-care adequacy (Riegel, Lee, et al., 2009).

Construct validity of the SCHFI v.6.2 was tested using CFA, and incremental fit indices were used to determine how well the model fit the data. When all three constructs were tested in a single model, overall model fit was not strong: the χ^2 was 356.92, the CFI was .73, the NNFI was .55, and the root mean square error of approximation (RMSEA) was .07, which is considered adequate but borderline (Riegel, Lee, et al., 2009). Modification indices were not used to improve model fit.

Concurrent validity of the SCHFI v.6.2 was demonstrated by comparing the SCHFI v.6.2 scale scores to scores on the European Heart Failure Self-care Behavior Scale (EHFScBS) (Jaarsma, Stromberg, Martensson, & Dracup, 2003) using data from a small sample of HF patients ($n = 34$) who completed both measures. Self-Care Maintenance on the SCHFI was significantly related to the total EHFScBS score ($r = -.65$, $p < .001$). (The scales are scored in the opposite direction; higher scores on the SCHFI mean better self-care, and higher scores in the EHFScBS mean worse self-care.)

The SCHFI is clearly appealing to investigators worldwide, as it has been translated into a number of languages and tested for content validity in a number of cultural groups (Suwanno, Petpichetchian, Riegel, & Issaramalai, 2009; Tung et al., 2012; Yu et al., 2010). Even after being updated, however, the factorial structure and the reliability of the SCHFI remain poor. Fit indices on CFA were borderline, as noted above, and the alpha coefficients of the Maintenance and Management scales were .55 and .59 respectively (Riegel, Lee, et al., 2009).

It is possible that no prior investigators found a good model fit or strong reliability because the three scales were analyzed in a single confirmatory factor analysis model. The three standardized scale scores were originally used to yield a single self-care score. In the most recent update, however, the instrument authors advocated that the three scales be considered unique and separate dimensions of the overall phenomenon of self-care (Riegel, Lee, et al., 2009). We reasoned that, as the items of the SCHFI measure different aspects of self-care that might not be highly consistent with each other, each scale should be tested individually. Our intention was not to revise the scoring procedures, which work well, but to improve understanding of the dimensions of heart failure self-care measured by the SCHFI.

Methods

Design

This cross-sectional study consisted of three phases. First, we tested an Italian translation of the SCHFI with confirmatory factor analysis (CFA) because it is a theory-driven scale. Finding poor fit using CFA, as described below, we hypothesized that dimensions might be specified within each scale to improve model fit. We then performed exploratory factor analysis (EFA) to determine whether such dimensions exist. Finally, we used CFA on a separate sample to validate the EFA results (Barbaranelli, 2007). As little is known about contrasting groups validity and test-retest reliability of the SCHFI v.6.2, we tested the factors for contrasting groups validity, internal consistency (using factor score determinacy) and test-retest reliability (using intraclass correlations).

Instruments

An Italian version of the Self-Care of Heart Failure Index version 6.2 (SCHFI v.6.2) (Riegel, Lee, et al., 2009) was created. First, the tool was translated from English into Italian by two Italian researchers with expertise in English cardiovascular terminology. Second, the Italian version was back-translated into English by a bilingual English teacher with expertise in

English language medical terms who was blinded to the original scale. Then, this version was reviewed by the scale's author to check the accuracy of the translation. Minor revisions to the translation were discussed by e-mail in order to insure correspondence between the English and the Italian versions. The Italian translations of Items 4 (measuring physical activity) and 7 (measuring exercise) were discussed because the wording of these items was quite similar and had potential to generate confusion in responders. The Italian term for exercise (ginnastica) was used for Item 7, and examples were added to item 4 for physical activity (e.g., gardening, housecleaning) in order to make the difference between the two items clear.

Socio-demographic variables including gender, age, education, marital status, and employment were collected by self-report, as done in other studies (Riegel et al., 2010; Vellone, Riegel, Cocchieri, et al., 2013). Data on patients' comorbid conditions, New York Heart Association (NYHA) functional class, ejection fraction, and illness duration were abstracted from the clinical records.

Sample, Setting, and Procedure

A convenience sample of 659 Italian adults with HF was enrolled from ambulatory cardiovascular centers across Italy, in the provinces of Rome, Frosinone, Latina, Olbia, Udine, Benevento, Avellino, Messina, Reggio Calabria, Terni, L'Aquila, Livorno, Milan, Rieti, Bolzano, and Ragusa. Inclusion criteria were a diagnosis of HF, confirmed by echocardiography and clinical evidence of HF; age over 18 years; and medical stability, defined as not having experienced an acute coronary event in the last three months.

Before data collection, the institutional review board of each center approved the study. Data collection took place during routine visits to the cardiovascular centers after participants had signed the informed consent document. Two weeks after the initial data collection, all patients were telephoned for re-administration of the SCHFI v.6.2. The SCHFI previously has been shown to produce comparable results when administered in person or by telephone (Riegel, Lee, et al., 2009). All data collection was performed by trained nurses.

Data Analysis

Descriptive statistics, including means and standard deviation, were used to summarize the characteristics of the participants. Construct validity testing was performed on the classic model of the SCHFI v.6.2 with the traditional three factors: Self-Care Maintenance, Self-Care Management, and Self-Care Confidence. Confirmatory factor analysis was performed with the Satorra–Bentler corrected maximum likelihood estimator due to less than perfectly normal distribution of observed variables. Model fit was determined by combining information from exact fit statistics (e.g., chi-square test), incremental fit indices (e.g., NNFI), and residual-based statistics (e.g., SRMR). When tested as a single model, as done previously, this analysis demonstrated poor model fit, as described in detail below. A poor model fit also was exhibited when a separate CFA was performed for each individual scale.

Because the CFA results demonstrated poor model fit, we performed EFA and then cross-validated the results of the EFA using CFA. First, the entire sample of 659 participants was split into two groups using the following systematic procedure. Using the patient's numeric code in the dataset, we assigned those patients with an even number to subsample A (329 cases) and the patients with an odd number to subsample B (330 cases). These two samples were equivalent in age, $t(643) = -0.147$, $p = .67$, gender, $\chi^2(1, 659) = 0.213$, $p = .64$, education, $\chi^2(1, 659) = 0.644$, $p = .35$, and clinical variables such as NYHA class, $\chi^2(3, 659) = 1.19$, $p = .76$) and ejection fraction, $t(573) = .312$, $p = .78$).

Second, exploratory factor analysis (EFA) was performed on subsample A with principal axis factoring and promax oblique rotation. The number of factors was fixed to reflect the theoretical underpinnings of the SCHFI v.6.2 (Riegel et al., 2004; Riegel & Dickson, 2008; Vellone, Riegel, D'Agostino, et al., 2013) and tested against descriptive indices of goodness of fit. This decision was supported by literature on exploratory factor analysis (Fabrigar, Wegener, MacCallum, & Strahan, 1999) suggesting this approach as the more stringent criterion for establishing the number of factors in EFA. Other criteria such as the well-known Kaiser–Guttman rule-of-thumb (the so-called "eigenvalue greater than 1") approach suffer from problems including being highly dependent on the number of variables that are factored (Fabrigar et al., 1999). As noted by Tabachnick and Fidell (2013), the number of factors presenting an eigenvalue greater than 1 will range from 1/3 to 1/5 of the number of variables, thus

producing an excessive number of factors in an instrument with many variables, and an insufficient number of factors when few variables are factored. In addition, using an eigenvalue greater than 1 is more appropriate for principal component analysis than for true factor analysis, which we used in this study (Barbaranelli, 2007). To accommodate missing data, the full information maximum likelihood (FIML) approach in Mplus (Muthén & Muthén, 1998–2010) was used.

Third, CFA was computed on subsample B, based on the EFA results from subsample A. When factors were highly correlated, a second-order CFA was performed on the separate scales in order to have broader dimension options (Barbaranelli, 2007).

Contrasting groups validity of the SCHFI v.6.2 was examined by comparing the scale scores in a subset of HF patients from a specialty HF clinic and a subset from a general ambulatory cardiology practice using Student's *t*-tests. We expected the patients receiving education in self-care to score significantly higher on the SCHFI v.6.2 than patients cared for in a general ambulatory practice.

Reliabilities for first and second order factors were estimated using factor score determinacy coefficients, which represent an estimate of the internal consistency of the solution, or the certainty with which factor axes are fixed in the variable space (Tabachnick & Fidell, 2013), because coefficient alpha may not be the best measure of reliability for scales with few items in narrow dimensions (Brown, 2006). Coefficients reflect the squared multiple correlations of factor scores predicted from item scores. As with Cronbach alpha, the determinancy coefficient should be $\geq$.70 (Tabachnick & Fidell, 2013). Test-retest reliability of the SCHFI v.6.2 also was tested with the Intraclass Correlation Coefficient (ICC) using a 15-day interval. This test provides an estimate of the stability of the scale scores.

The level of significance (α) was fixed at $p = .05$ for all analyses. These analyses were performed using IBM SPSS v.19 and Mplus 6.1.

Results

Sample Description

A total of 659 Italian HF patients participated in the study. Table 1 shows sociodemographic and clinical characteristics of the sample. Males constituted more than half of the participants. Educational level was quite low in the sample. Most patients were married and retired. Functional class was good, with few patients in NYHA Class IV.

Table 1. Sociodemographic and Clinical Charac-teristics of the Sample ($n = 659$)

Characteristics	*n*	%
Gender		
Male	376	57.10
Female	283	42.90
Education		
Less than high school	511	77.54
High school	97	14.70
University degree	51	7.70
Marital status		
Married	351	53.30
Single	49	7.40
Widowed	204	31.00
Divorced or separated	55	8.30
Profession		
Employed	119	18.10
Unemployed or retired	540	81.90
NYHA class		
I	135	20.50
II	253	38.40
III	213	32.30
IV	58	8.80
	M	*SD*
Age (years)	72.63	11.70
Ejection fraction (%)	44.21	10.53
	Median	Interquartile Range
Time since diagnosis (years)	3.42	2.00–5.50

Confirmatory Factor Analysis

When tested as a single model, as done previously, a poor model fit was found: $\chi^2(206, 359) = 1028.95$, $p < .001$, CFI = .65, NNFI = .62, RMSEA = .11, 90% CI [.09, .11], SRMR = .10. A poor model fit also was exhibited when separate CFAs were performed for each individual scale: Self-Care Maintenance scale: $\chi^2(35, 658) = 374.87$, $p < .001$, CFI = .54, NNFI = .40, RMSEA = .12, 90% CI [.11, .13], SRMR = .10; Self-Care Management scale: $\chi^2(9, 359) = 34.83$, $p < .001$, CFI = 92., NNFI = .87, RMSEA = .09, 90% CI [.06, .12], SRMR = .06; Self-Care Confidence scale: $\chi^2(9, 658) = 68.56$, $p < .001$, CFI = .89, NNFI = .83, RMSEA = .10, 90% CI [.08, .12], SRMR = .06.

Exploratory Factor Analysis

When EFA was computed on the Self-Care Maintenance scale in subsample A (Table 2), the eigenvalues were 2.37, 1.77, 1.11, 1.01, 0.92, 0.74, 0.63, 0.57, 0.45, and 0.43. A two-factor solution was preferred, with the factors named Autonomous Maintenance and Provider-Directed Maintenance. These factors, after rotation, explained respectively 12.63% and 11.76% of the common variance or 24.39% overall.

When EFA of the Self-Care Management scale was conducted on subsample A (Table 3), the eigenvalues were 2.43, 1.21, 0.88, 0.69, 0.45, and 0.32. A two-factor solution was preferred, with the factors named Autonomous Management and Provider-Directed Management. These two factors, after rotation, explained respectively 31.27% and 9.89% of the common variance or 41.16% overall.

When EFA was conducted of the Self-Care Confidence scale (Table 4), two factors were identified: Basic Self-Care Confidence and Advanced Self-Care Confidence. The eigenvalues were 2.57, 1.08, 0.87, 0.563, 0.46, and 0.45, so a two-factor solution was preferred. The common variance explained by the first and the second factor, after rotation, was 22.54%, and 23.11% respectively or 45.65% overall.

Cross-Validation

Factors identified by EFA were then cross-validated using CFA conducted on subsample B. The initial CFA of the Self-Care Maintenance scale positing the two factors from EFA did not fit the data well: $\chi^2(34, 330) = 131.48$, $p < .001$, CFI = .71, NNFI = .62, RMSEA = .093, 90% CI [.077–.110], SRMR = .078. However the fit indices of this model were better than the one factor solution. By allowing a correlation between items 4 and 7 (do some physical activity; exercise for 30 minutes) and cross loading of item 6 (eat a low salt diet) on the Autonomous Maintenance factor, the following fit was achieved: $\chi^2(32, 330) = 60.60$, $p = .002$, CFI = .92, NNFI = .88, RMSEA = .052, 90% CI [.031–.072], SRMR = .055 (Fig. 1). All factor loadings were statistically significant. No significant correlation between the Autonomous Maintenance Factor and the Provider-Directed Factor was found on CFA ($r = .05$, $p = .55$), so a second order factor was not specified.

CFA of the Self-Care Management scale using the two factors identified in EFA fit the data well: $\chi^2(8, 179) = 15.64$, $p = .050$, CFI = .95, NNFI = .91, RMSEA = .073, 90% CI [.001–.120], SRMR = .046 (Fig. 2). All factor loadings were statistically significant.

CFA of the Self-Care Confidence scale tested with the two factors identified in EFA demonstrated an excellent fit: $\chi^2(8, 330) = 9.69$, $p = .28$, CFI = .99, NNFI = .99, RMSEA = .025, 90% CI [.000, .072], SRMR = .030. Because the two factors were highly correlated ($r = .67$), a second-order factor model was tested, which showed exactly the same fit indices. Standardized parameter estimates for the second order model are presented in Figure 3.

Table 2. Exploratory Factor Analysis of the Self-Care Maintenance Scale ($n = 329$)

		Factors	
Item		1	2
How routinely do you do the following?			
1	Weigh yourself daily	**.332**	.125
2	Check your ankles for swelling	**.383**	.319
3	Try to avoid getting sick (flu shot. avoid ill people)	.079	**.430**
4	Do some physical activity	**.620**	−.149
5	Keep your doctor or nurse appointments	.014	**.716**
6	Eat a low-salt diet	**.337**	.244
7	Exercise for 30 minutes	**.609**	−.174
8	Forget to take one of your medicines (reverse coded)	−.119	**.659**
9	Ask for a low-salt items when eating out or visiting others	**.553**	.108
10	Use a system (pill-box, reminder) to help you remember medicines	.058	**.067**

Note: Factor 1 = Autonomous Maintenance; Factor 2 = Provider-Directed Maintenance. Boldface identifies the primary factor on which the item loaded regardless of its absolute value.

Table 3. Exploratory Factor Analysis of the Self-Care Management Scale ($n = 180$)

Item		Factors 1	2
11	If you had trouble breathing, or ankle swelling, how quickly did you recognize it as a symptom of HF?	**.393**	.046
If you have trouble breathing or ankle swelling, how likely are you to try one of these remedies?			
12	Reduce the salt in your diet	**.750**	−.037
13	Reduce your fluid intake	**.800**	.011
14	Take an extra water pill	.047	**.570**
15	Call your doctor or nurse for guidance	−.027	**.512**
16	Think of a remedy you tried the last time you had trouble breathing or ankle swelling. How sure were you that the remedy helped or did not help?	**.716**	−.002

Note: Factor 1 = Autonomous Management; Factor 2 = Provider-Directed Management. Boldface identifies the primary factor on which the item loads regardless of its absolute value.

Contrasting Groups Validity of the SCHFI v.6.2

Contrasting group validity of the SCHFI v.6.2 was tested by comparing 50 patients from the same sample who were treated in a HF specialty clinic with 50 who were cared for in a general cardiovascular clinic (where education about self-care is not routine). In the specialty HF clinic, a dedicated physician checks patients every three months. During the check-up, the physician also meets with caregivers and provides patients and caregivers with general advice about HF self-care: sodium restriction, physical activity, medications, flu vaccination, and monitoring weight and ankle swelling. Patients from the HF specialty clinic and those from the general cardiovascular clinic were demographically and clinically comparable in term of age, $t(95) = 0.41$, $p = .68$, gender, $\chi^2(1, 100) = 2.60$, $p = .11$, education $\chi^2(3, 100) = 4.81$, $p = .19$, and NYHA class, $\chi^2(3, 100) = 6.25$, $p = .10$. As shown in Table 5, significant differences were found between the groups on each of the SCHFI v.6.2 scales. Patients treated in the HF specialty clinic had statistically and clinically higher scores on each scale.

Reliability of the SCHFI v.6.2

In test-retest reliability testing, moderate to high correlations were found over time in the Self-Care Maintenance, Self-Care Management, and Self-Care Confidence scales (Table 6). The least stable scales were the two factors of the Self-Care Maintenance scale and the overall Self-Care Confidence scale (ICC = .64), the most stable were the two factors of the Self-Care Management scale (both ICC > .80). When internal consistency was tested by factor score determinacy, all coefficients were above .70 (Table 6).

Discussion

The primary aim of this study was to improve our understanding of the dimensions

Table 4. Exploratory Factor Analysis of the Self-Care Confidence Scale ($n = 329$)

Items		Factors 1	2
How confident are you that you can:			
17	Keep yourself free of HF symptoms	−.139	**.711**
18	Follow the treatment advice you have been given	**.301**	.076
19	Evaluate the importance of your symptoms	**.969**	−.114
20	Recognize changes in your health if they occur	**.460**	.127
21	Do something that will relieve your symptoms	.133	**.637**
22	Evaluate how well a remedy works	.189	**.635**

Note: Factor 1 = Basic Self-Care Confidence; Factor 2 = Advanced Self-Care Confidence. Boldface identifies the primary factor on which the item loads regardless of its absolute value.

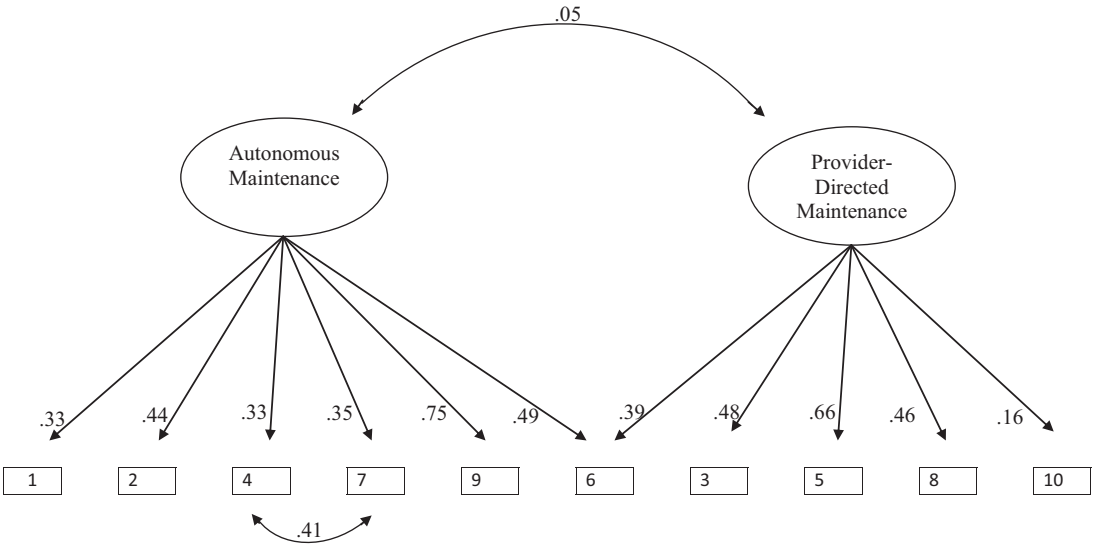

FIGURE 1. Confirmatory factor analysis of the Self-Care Maintenance scale. $\chi^2(32, 330) = 60.60$, $p = .002$, CFI = .92, NNFI = .88, RMSEA = .052,90% CI[.031–.072], SRMR = .055. All relationships between latent variables and items are significant at p level <.001 except for Item 10 where p is 0.02. The relationship between the Autonomous Maintenance factor and Provider-Directed factor is not significant.

measured by the SCHFI v.6.2. The initial CFA testing the three SCHFI dimensions in a single model resulted in poor fit, as did testing of the three scales. But when CFA was performed on factors identified by EFA, excellent fit indices were obtained. The approach used here, which has not previously been applied to data from the SCHFI, allowed us to discover insights into the factorial structure of the SCHFI v.6.2 and identify valid and reliable primary and second-order factors. We acknowledge that EFA with oblique rotation and CFA, which we used in this study, are two different statistical approaches: while EFA allows factor cross-loadings (non-zero partial correlations between items and factors), CFA allows loadings to be fixed or freely estimated. However, cross-loadings in the EFAs were by no means low in our study, with some exceptions in the Self-Care Maintenance scale.

This in-depth view of the structure of the three self-care scales allows users to identify narrow and specific dimensions of self-care (e.g., Autonomous Maintenance) as well as

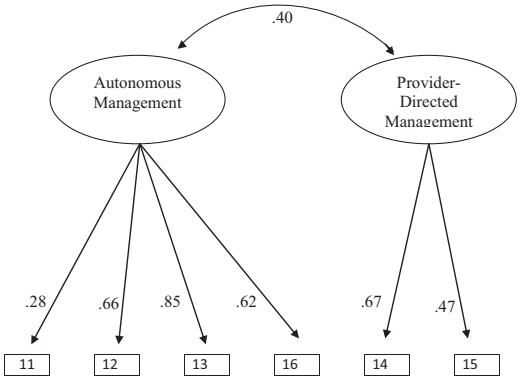

FIGURE 2. Confirmatory factor analysis of the Self-Care Management scale. $\chi^2(8, 179) = 15.64$, $p = .050$, CFI = .95, NNFI = .91, RMSEA = .073, 90% CI [.001–.120], SRMR = .046. All relationships between the latent variables and the indicators are significant at p level <.001.

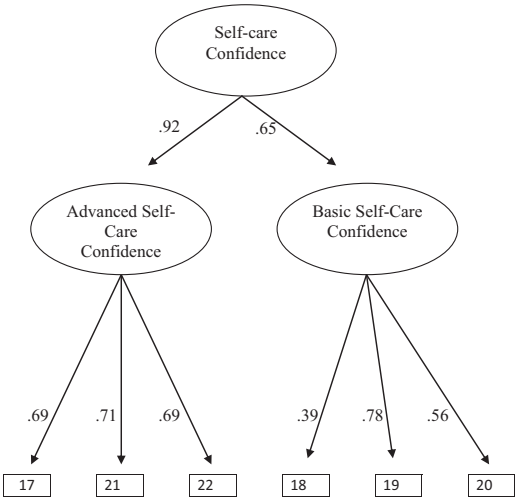

FIGURE 3. Confirmatory factor analysis of the Self-Care Confidence scale. $\chi^2(8, 330) = 9.69$, $p = .28$, CFI = .99, NNFI = .99, RMSEA = .025, 90% CI [.00, .072], SRMR = .030. All relationships between latent variables and the indicators are significant at p level <.001.

Table 5. Comparison of Mean Scale Scores of Patients Cared for in a Heart Failure Clinic and in a General Cardiovascular Clinic ($n = 50$ in Each Group)

Scales	Specialty HF Clinic		Cardiovascular Clinic		Mean Difference	95% CI	*p*
	M	*SD*	*M*	*SD*			
Self-Care Maintenance	69.45	15.25	44.05	13.56	25.40	[19.53, 31.27]	<.001
Self-Care Management	59.20	15.78	43.56	14.24	15.64	[8.77, 22.51]	<.001
Self-Care Confidence	81.76	18.84	51.58	9.29	30.19	[24.16, 36.21]	<.001

Note: CI, confidence interval.

broader dimensions (e.g., Self-Care Confidence), which can have implications for intervention. We also tested contrasting groups validity and test-retest and internal consistency reliability. Overall we found the SCHFI v.6.2 to have evidence of construct validity, contrasting groups validity, internal consistency and test-retest reliability, all of which support its further use in research.

In the Self-Care Maintenance scale, items pertaining to "medical prescription" (e.g., take medicine regularly or keep doctor appointments) loaded separately from the other items. This separation illustrates an essential element described in the situation-specific theory of HF self-care (Riegel & Dickson, 2008): only part of self-care maintenance is captured by adherence to the treatments recommended by providers, but true self-care involves personal endorsement of healthy behaviors. However, the fit indices of the Self-Care Maintenance scale were not all supportive of the proposed structure. Sources of misfit may have been the large sample size ($n = 330$), causal heterogeneity (e.g., possible differences among males and females), and non-normality (although in our model non-normality was adjusted with the Satorra–Bentler correction).

The item measuring adherence to a low-salt diet performed unexpectedly, cross-loading on the Provider-Directed Maintenance and the Autonomous Maintenance factors. This was not an entirely surprising result, however, because in Italy people do not think about following a low-salt diet unless a physician recommends it, so patients see this as a medical prescription (Cancian et al., 2013). Another item that performed in an unexpected fashion was item 10 (use a system such as a pillbox to organize medications); 61.7% of the sample scored 1 (*never or rarely*) on this item, probably because pillboxes or medication reminder systems are used rarely in Italy.

Factor analysis of the Self-Care Management scale revealed two factors that we named Autonomous Management and Provider-Directed Management. This structure is consistent with that of the Self-Care Maintenance scale, further emphasizing the division of self-care into dependent (e.g., take an extra water pill) and independent (e.g., reduce fluid intake) behaviors. Factor analysis suggested a process that we confirmed with structural equation modeling: self-care management began with evaluating and interpreting symptoms (measured by Item 11), then reducing salt in the diet (Item 12) and reducing fluid intake

Table 6. Test-Retest Reliability and Factor Determinacy of the Self-Care of Heart Failure Index v.6.2

Scales	ICC	95% CI	Factor Determinacy
Self-Care Maintenance			—
Autonomous Maintenance	.64	[.58, .69]	.83
Provider-Directed Maintenance	.64	[.58, .69]	.78
Self-Care Management			—
Autonomous Management	.89	[.85, .90]	.90
Provider Directed Management	.83	[.79, .87]	.74
Self-Care Confidence	.64	[.58, .69]	.82
Advanced Self-Care Confidence	.70	[.65, .74]	.87
Basic Self-Care Confidence	.70	[.65, .74]	.85

Note: Test-retest reliability was calculated with the intraclass correlation coefficient (ICC), correlating the SCHFI v.6.2 scores collected twice, with a 15-day interval between testing. This analysis was done with the 637 subjects with data at both testing periods. Test-retest for the Self-Care Management scale was computed with the 253 patients who were symptomatic at both intervals. CI, confidence interval. $p < .001$ for each ICC.

(Item 13), and then evaluating treatment effectiveness. Taking an extra diuretic (Item 14) was not part of the process, which may reflect local differences in treatment norms, as self-medication with diuretics is uncommon in Italy.

Factor analysis of the Self-Care Confidence scale revealed two factors that we named Basic Self-Care Confidence and Advanced Self-Care Confidence. The Basic Self-Care Confidence factor included items that are more general and passive actions (e.g., following treatment advice) while the Advanced Self-Care Confidence factor reflects more challenging and active behaviors (e.g., preventing HF symptoms) that require specific education and training. This dichotomy again reflects the premise of the situation-specific theory of HF self-care, in which self-care is more than treatment adherence.

Comparing the model fit indices with those obtained previously illustrates significantly better fit using this refined analytic approach. The improved fit reflects the manner in which the CFA was performed, rather than differences from prior samples. In prior CFA, the three scales were tested in a single model, which yielded poor model fit. Examining each scale individually for its dimensions significantly improved the fit. This approach to analysis supported the revisions made to the SCHFI v.6.2 in 2009 (Riegel, Lee, et al., 2009), when the authors recognized the independence of the scales and discouraged users from summing the scores into a single index score. Using factor score determinacy coefficients instead of coefficient alpha further supported internal consistency.

All the SCHFI v.6.2 scales were able to discriminate between patients educated in self-care and those who were not. Differences between the two groups were statistically and clinically significant. The largest differences were observed for the Self-Care Confidence scale. This finding suggests that the SCHFI v.6.2 is sensitive in detecting changes in self-care behaviors, for example, after the receipt of an intervention aimed at improving self-care.

Test-retest reliability showed moderate to high interclass coefficients. We expected higher values, but the finding was not entirely surprising for three reasons. First, research assistants reported that patients asked them whether they should be engaging in the behaviors listed in the instrument, so it is not surprising that some change occurred simply in response to having completed the instrument. Second, HF is a chronic condition, and patients might find it difficult to adhere constantly to the treatment regimen. Third, self-care maintenance and management are influenced by self-care confidence, which is subject to change (Riegel & Dickson, 2008). A shorter retest period may improve the test-retest reliability of the SCHFI v.6.2.

A limitation of this study was its completion in a country different from where the SCHFI was originally developed. It is possible that the refined structure identified here may not be exactly replicated in another sample. Further research is needed to explore the contribution of cultural beliefs and local customs to HF patient responses on the SCHFI v.6.2. Another limitation was that test-retest reliability might have been influenced by the learning effect caused by the first administration of the SCHFI v.6.2.

Conclusion

Psychometric testing of the three scales of the SCHFI v.6.2 in the Italian population showed supportive psychometric properties of validity and reliability and revealed information regarding specific aspects of the self-care process that had not previously been described. Sub-dimensions of the three original Self-Care Maintenance, Self-Care Management and Self-Care Confidence dimensions improve our understanding of HF self-care. This understanding does not change the scoring, and we advise SCHFI v.6.2 users to continue to compute a standardized 0–100 score for each of the three scales. Further studies are needed to confirm the processes suggested by this analysis in other cultural groups.

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