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

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.

Keywords

psychometric testing, instrument validity and reliability, heart failure, self-care

Disciplines

Behavioral Medicine | Cardiology | Cardiovascular Diseases | Circulatory and Respiratory Physiology | Medical Humanities | Medicine and Health Sciences | Nursing | Preventive Medicine

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Construct Validity of the Self-Care of Heart Failure Index Version 6.2

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Key Words: Instrument Validity and Reliability, Heart failure, Self-care

Abstract

CONSTRUCT VALIDITY OF THE SCHFI V.6.2

The Self-Care of Heart Failure Index Version 6.2 (SCHFI v.6.2) is widely used but its psychometric profile is still questionable. In this study we performed confirmatory factor analysis to test the construct of the SCHFI v.6.2 scales (Self-Care Maintenance, Self-Care Management and Self-Care Confidence), and then used exploratory factor analysis to determine if model fit could be improved. In a sample of 659 heart failure patients from Italy, 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 supports use of the SCHFI v.6.2 in Italian population.

Introduction

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).

Morbidity and mortality associated with HF are high (Teng et al., 2011). Forty percent of adults with HF die in the first year after the diagnosis; the four-year mortality is 50% (Dickstein et al., 2008; Krum, 2005). A high symptom burden greatly impairs patients' quality of life (QOL) (Iavazzo & Cocchia, 2011; Jurgens et al., 2009; Mulligan et al., 2011; 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). Guidelines from the American Heart Association and the European Society of Cardiology (Lainscak et al., 2011; Riegel, Moser, 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. One of the instruments available is the Self-Care of Heart Failure Index (SCHFI). The SCHFI is a multidimensional instrument with three separate scales: self-care maintenance, self-care management and self-care confidence. Although the factorial structure of the SCHFI has been tested several times, no prior studies have found a good model fit or strong reliability (Riegel et al., 2004; Riegel, Lee, Dickson, & Carlson, 2009; Yu, Lee, Thompson, Woo, & Leung, 2010), probably

because the three scales have been analyzed in a single confirmatory factor analysis model, which we think is misguided. The three scales were originally added to yield a single self-care score but in the most recent update, the instrument authors advocated that the three scores be considered as unique and separate dimensions of the overall phenomenon of self-care (Riegel, Lee, et al., 2009).

In this study we tested the SCHFI with confirmatory factor analysis (CFA) because it is a theory-driven scale. Finding poor fit with CFA, as described below, we hypothesized that within each individual scale there could be dimensions that, if specified, could improve model fit. We performed exploratory factor analysis (EFA) to identify if such dimensions exist. Then we used CFA on a separate sample to validate the EFA results (Barbaranelli, 2007). Reliability was tested with factor score determinacy because coefficient alpha may not be the best measure of reliability for scales with few items in narrow dimensions (Kottner & Streiner, 2010). Finally, 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). Our intention was to improve understanding of the dimensions measured by the SCHFI rather than to revise the scoring procedures that work well as they stand.

Background

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; Riegel & Dickson, 2008; Riegel et al., 2011). These three dimensions

are captured in the situation-specific theory of HF self-care (Riegel & Dickson, 2008). This theory provides the theoretical underpinnings of the SCHFI.

The Self-care of Heart Failure Index (SCHFI) version 4 (v. 4) was developed in the U.S., published in 2004 (Riegel et al., 2004), and updated as version 6.2 in 2009 (Riegel, Lee, et al., 2009). As described above, the SCHFI (v.4 and v.6.2) captures three dimensions of Self-Care—Maintenance, Management, and Confidence in three separate scales. The SCHFI fully represents the theoretical construct of HF self-care as defined above and measures behaviors recommended by the current guidelines on HF treatment (Lainscak et al., 2011; Riegel, Moser, et al., 2009). In addition, the contruct validity of the SCHFI has been supported with mixed methods research where 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 a negative attitude about HF, were less vigilant over time, and had less skill in managing the illness (Dickson, Deatrick, & Riegel, 2008).

Testing Version 4. SCHFI v.4 was tested initially on an American sample of 760 HF patients (Riegel et al., 2004). 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's 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. Test-retest reliability was not tested.

Testing SCHFI v. 4, Yu et al. (Yu et al., 2011; Yu et al., 2010) administered the instrument to a sample of 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's 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 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 within the self-care management scale, which still appears in version 6.2, asks 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 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 (Riegel, Lee, et al., 2009). 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, 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, take an extra water pill) and treatment evaluation. The Self-Care Confidence scale uses 6 items to evaluate the patients' perceived ability to engage in each phase of the self-care process (e.g. preventing symptom onset, 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*) yielding a standardized score from 0 to 100; higher scores indicate better self-care. A cut-point score of ≥ 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 (Riegel, Lee, et al., 2009). 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. 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). Note that the scales go in the opposite direction: while higher scores on the SCHFI mean better self-care, higher scores in the EHFScBS mean worse self-care.

The SCHFI is clearly appealing to investigators worldwide, as it has been translated into numerous languages and tested for content validity in numerous cultural groups (Suwanno, Petpichetchian, Riegel, & Issaramalai, 2009; Tung et al., 2011; Yu et al., 2010). But, even after being updated, 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). For the current analysis, 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.

Methods

Design

A cross-sectional design was used to carry out this study.

Instruments

The following instrument was used.

The Self-Care of Heart Failure Index version 6.2 (SCHFI v. 6.2) (Riegel, Lee, et al., 2009). The Italian version of the SCHFI v. 6.2 was translated and back-translated in the following manner. First, it was translated from English into Italian by two Italian researchers with expertise in English cardiovascular terminology. Second, the Italian translated 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 assure correspondence between the English and the Italian versions. Items 4 (measuring physical activity) and 7 (measuring exercise) were discussed because the Italian translations of these items were quite similar and were thought to potentially generate confusion in responders. The Italian term for exercise (i.e. *ginnastica*) was used for Item 7 and examples were added to item 4 measuring 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 used in other studies (Riegel et al., 2010; Vellone et al., 2012). 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. Before data collection the Institutional Review Boards of each Center approved the study. To be enrolled in the study patients had to have a diagnosis of HF confirmed by echocardiography and clinical evidence of HF. In addition, patients had to be more than 18 years old and stable, not having experienced an acute coronary event in the last three months. Data collection took place during routine visits to the Cardiovascular Center 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 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 the non-perfect 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 three separate CFAs were 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.

We performed the cross-validation procedures in the following way. 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. Third, CFA was computed on subsample B based on the EFA results from subsample A.

EFA was performed 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 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 suffers from many problems such as being highly dependent on the number of variables that are factored (Fabrigar et al., 1999). As noted by Tabachnick and Fidell (Tabachnick & Fidell, 2013), the number of factors presenting an eigenvalue greater than 1 ranges from 1/3 to 1/5 of the number of variables, thus producing an excessive number of factors 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. 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 testing the scales scores in a subset of HF patients from a specialty HF clinic and a subset from a general ambulatory cardiology practice using Student *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 each first and second order factors were estimated using factor score determinacy coefficients (Muthén & Muthén, 1998-2010). Factor score determinancy coefficients represent an estimate of the internal consistency of the solution—the certainty with which factor axes are fixed in the variable space (Tabachnick & Fidell, 2013). Coefficients reflect the squared multiple correlations of factor scores predicted from item scores. As with Cronbach's 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.

Confirmatory Factor Analysis

When tested as a single model, as done previously, a poor model fit was found: χ^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 three separate CFAs were perform for each individual scale: self-care maintenance scale: χ^2 (35, 658) = 374.87, $p < .001$, CFI = .54, NNFI = .40, RMSEA = .12, 90% CI [.11, .13], SRMR = .10; self-care management scale: χ^2 (9, 359) = 34.83, $p < .001$, CFI = 92., NNFI = .87, RMSEA = .09, 90% CI [.06, .12], SRMR = .06; self-care confidence scale: χ^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 with the Self-Care Confidence scale, two factors were identified: Basic Self-Care Confidence and Advanced Self-Care Confidence (Table 4). The values of the eigenvalue 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 two factors 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 (Figure 1). All factor loadings were statistically significant. No significant correlation between the Autonomous Maintenance Factor and the Provider-Directed Factor was found on CFA ($r = .05$, $p = .55$). A second order factor was not specified since the correlation between the two factors was weak and not statistically significant.

CFA of the Self-Care Management scale with 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 (Figure 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. Since 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.

Contrasting Groups Validity of the SCHFI v.6.2

Contrasting groups validity of the SCHFI v.6.2 was tested by comparing 50 patients treated in a HF specialty clinic with 50 patients 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, 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 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, that 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 with valid and reliable primary and second-order factors. This in-depth view of the structure of the three self-care scales is interesting because it allows users to identify narrow and specific dimensions of self-care (e.g. Autonomous Maintenance) as well as broader dimensions (e.g. Self-Care confidence), which can have implications for intervention. However, we should acknowledge that EFA with oblique rotation and CFA that 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 allow 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-maintenance scale.

We also tested contrasting groups validity, 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) separated 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. An item that performed unexpectedly was the item measuring adherence to a low-salt diet, which cross-loaded on the Provider-Directed Maintenance and the Autonomous Maintenance factors. This was not an entirely surprising result, though, 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., 2012). Another item that performed in an unexpected fashion was item 10 (use a system such as a pill box 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 (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. prevent HF symptoms) that require specific education and training. This dichotomy again reflects the premise of the situation-specific theory of HF self-care which states that 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. That is, prior CFAs tested the three scales in a single model, which yielded poor model fit. Examining each scale individually with more dimensions significantly improved the fit. This approach to analysis reflects 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. Further, using factor score determinacy coefficients instead of coefficient alpha supported internal consistency.

All the SCHFI v.6.2 scales were able to discriminate between patients educated in self-care versus those who were not. Differences between the two groups were statistically and clinically significant. The biggest 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, thus it is not surprising that some change occurred simply in response to taking 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 that is amenable 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 that the study was conducted 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 of the study was that the fit indices of the self-care maintenance scale were not all supportive. Sources of misfit may have been the quite large sample size (n = 330), the causal heterogeneity (e.g., possible differences among males and females), and non-normality (that in our model was adjusted by the use of Satorra-Bentler correction). 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 Italian population showed supportive psychometric properties of validity and reliability and more information regarding

specific aspect of the self-care process than before. From this study emerged sub-dimensions of the three original Self-Care Maintenance, Self-Care Management and Self-Care Confidence dimensions that 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 individual scale. Further studies are needed to confirm the processes suggested by this analysis of the SHCFI v.6.2 data in other cultural groups.

References

Barbaranelli, C. (2007). *Analisi dei dati* (2nd ed.). Milan: LED.

Braunschweig, F., Cowie, M. R., & Auricchio, A. (2011). What are the costs of heart failure? *Europace, 13 Suppl 2*, ii13-17. doi: 10.1093/europace/eur081

Buck, H. G., Lee, C. S., Moser, D. K., Albert, N. M., Lennie, T., Bentley, B., . . . Riegel, B. (2012). Relationship Between Self-care and Health-Related Quality of Life in Older Adults With Moderate to Advanced Heart Failure. *Journal of Cardiovascular Nursing, 27*(1), 8-15. doi: 10.1097/JCN.0b013e3182106299

Cancian, M., Battaggia, A., Celebrano, M., Zotti, F. D., Novelletto, B. F., Michieli, R., . . . Toffanin, R. (2012). The care for chronic heart failure by general practitioners. Results from a clinical audit in Italy. *The European Journal of General Practice*. doi: 10.3109/13814788.2012.717925

Davis, R. C., Hobbs, F. D., Kenkre, J. E., Roalfe, A. K., Hare, R., Lancashire, R. J., & Davies, M. K. (2002). Prevalence of left ventricular systolic dysfunction and heart failure in high risk patients: community based epidemiological study. *British Medical Journal, 325*(7373), 1156. doi: doi: 10.1136/bmj.325.7373.1156

Dickson, V. V., Deatrick, J. A., & Riegel, B. (2008). A typology of heart failure self-care management in non-elders. *European Journal of Cardiovascular Nursing, 7*(3), 171-181. doi: 10.1016/j.ejcnurse.2007.11.005

Dickstein, K., Cohen-Solal, A., Filippatos, G., McMurray, J. J., Ponikowski, P., Poole-Wilson, P. A., . . . Zamorano, J. L. (2008). ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2008: the Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2008 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association of the ESC (HFA) and endorsed by the European Society of Intensive Care Medicine (ESICM). *European Heart Journal, 29*(19), 2388-2442. doi: 10.1093/eurheartj/ehn309

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*, 272-299. doi: doi.apa.org/journals/met/4/3/272.pdf

Goldbeck, L., & Melches, J. (2005). Quality of life in families of children with congenital heart disease. *Quality of Life Research, 14*(8), 1915-1924. doi: 10.1007/s11136-005-4327-0

Iavazzo, F., & Cocchia, P. (2011). [Quality of life in people with heart failure: role of telenursing]. *Professioni Infermieristiche, 64*(4), 207-212.

Jaarsma, T., Stromberg, A., Ben Gal, T., Cameron, J., Driscoll, A., Duengen, H. D., . . . Riegel, B. (2013). Comparison of self-care behaviors of heart failure patients in 15 countries worldwide. *Patient Education and Counseling*. doi: 10.1016/j.pec.2013.02.017

Jaarsma, T., Stromberg, A., Martensson, J., & Dracup, K. (2003). Development and testing of the European Heart Failure Self-Care Behaviour Scale. *European Journal of Heart Failure, 5*(3), 363-370. doi: 10.1016/S1388-9842Ž02.00253-2

Jurgens, C. Y., Moser, D. K., Armola, R., Carlson, B., Sethares, K., & Riegel, B. (2009). Symptom clusters of heart failure. *Research in Nursing and Health, 32*(5), 551-560. doi: 10.1002/nur.20343

Krum, H. (2005). The Task Force for the diagnosis and treatment of chronic heart failure of the European Society of Cardiology. Guidelines for the diagnosis and treatment of chronic heart

failure: full text (update 2005). *European Heart Journal, 26*(22), 2472; author reply 2473-2474. doi: 10.1093/eurheartj/ehi549

Lainscak, M., Blue, L., Clark, A. L., Dahlstrom, U., Dickstein, K., Ekman, I., . . . Jaarsma, T. (2011). Self-care management of heart failure: practical recommendations from the Patient Care Committee of the Heart Failure Association of the European Society of Cardiology. *European Journal of Heart Failure, 13*(2), 115-126. doi: 10.1093/eurjhf/hfq219

Lee, C. S., Carlson, B., & Riegel, B. (2007). Heart failure self-care improves economic outcomes, but only when self-care confidence is high. *Heart Failure Society of America, 13*(6), S75.

Leenerts, M., Teel, C., & Pendleton, M. (2002). Building a model of self-care for health promotion in aging. *Journal of Nursing Scholarship, 34*(4), 355-361. doi: 10.1111/j.1547-5069.2002.00355.x

Mosterd, A., Hoes, A. W., de Bruyne, M. C., Deckers, J. W., Linker, D. T., Hofman, A., & Grobbee, D. E. (1999). Prevalence of heart failure and left ventricular dysfunction in the general population; The Rotterdam Study. *European Heart Journal, 20*(6), 447-455. doi: 10.1053/euhj.1998.1239

Mulligan, K., Mehta, P. A., Fteropoulli, T., Dubrey, S. W., McIntyre, H. F., McDonagh, T. A., . . . Newman, S. (2011). Newly diagnosed heart failure: Change in quality of life, mood, and illness beliefs in the first 6 months after diagnosis. *British Journal of Health Psychology*. doi: 10.1111/j.2044-8287.2011.02047.x

Muthén, L. K., & Muthén, B. O. (1998-2010). *Mplus user's guide* (5th Ed ed.). Los Angeles, CA: Muthén & Muthén.

Naccarelli, G. V., Johnston, S. S., Lin, J., Patel, P. P., & Schulman, K. L. (2010). Cost burden of cardiovascular hospitalization and mortality in ATHENA-like patients with atrial fibrillation/atrial flutter in the United States. *Clinical Cardiology, 33*(5), 270-279. doi: 10.1002/clc.20759

O'Flaherty, M., Bishop, J., Redpath, A., McLaughlin, T., Murphy, D., Chalmers, J., & Capewell, S. (2009). Coronary heart disease mortality among young adults in Scotland in relation to social inequalities: time trend study. *BMJ (Clinical Research Ed.), 339*, b2613. doi: 10.1136/bmj.b2613

Orem, D. (2001). *Concepts of practice*. St Louis: Morby.

Rete Infermieri GISSI-HF. (2009). [Quality of life, depression and cognitive functions 5. Depression]. *Assistenza Infermieristica e Ricerca, 28*(1), 27-33. doi: 10.1702/419.4971

Riegel, B., Carlson, B., Moser, D. K., Sebern, M., Hicks, F. D., & Roland, V. (2004). Psychometric testing of the self-care of heart failure index. *Journal of Cardiac Failure, 10*(4), 350-360. doi: 10.1016/j.cardfail.2003.12.001

Riegel, B., & Dickson, V. V. (2008). A situation-specific theory of heart failure self-care. *Journal of Cardiovascular Nursing, 23*(3), 190-196. doi: 10.1097/01.JCN.0000305091.35259.85

Riegel, B., Dickson, V. V., Cameron, J., Johnson, J. C., Bunker, S., Page, K., & Worrall-Carter, L. (2010). Symptom recognition in elders with heart failure. *Journal of Nursing Scholarship, 42*(1), 92-100. doi: 10.1111/j.1547-5069.2010.01333.x

Riegel, B., Lee, C. S., Albert, N., Lennie, T., Chung, M., Song, E. K., . . . Moser, D. K. (2011). From novice to expert: confidence and activity status determine heart failure self-care performance. *Nursing Research, 60*(2), 132-138. doi: 10.1097/NNR.0b013e31820978ec

Riegel, B., Lee, C. S., Dickson, V. V., & Carlson, B. (2009). An update on the self-care of heart failure index. *Journal of Cardiovascular Nursing, 24*(6), 485-497. doi: 10.1097/JCN.0b013e3181b4baa0

Riegel, B., Moser, D. K., Anker, S. D., Appel, L. J., Dunbar, S. B., Grady, K. L., . . . Whellan, D. J. (2009). State of the science: promoting self-care in persons with heart failure: a scientific statement from the American Heart Association. *Circulation, 120*(12), 1141-1163. doi: 10.1161/CIRCULATIONAHA.109.192628

Setoguchi, S., Glynn, R. J., Avorn, J., Mittleman, M. A., Levin, R., & Winkelmayer, W. C. (2008). Improvements in long-term mortality after myocardial infarction and increased use of cardiovascular drugs after discharge: a 10-year trend analysis. *Journal of the American College of Cardiology, 51*(13), 1247-1254. doi: 10.1016/j.jacc.2007.10.063

Suwanno, J., Petpichetchian, W., Riegel, B., & Issaramalai, S. A. (2009). A model predicting health status of patients with heart failure. *Journal of Cardiovascular Nursing, 24*(2), 118-126. doi: 10.1097/JCN.0b013e318197a75c

Tabachnick, B. G., & Fidell, L. S. (2013). *Using Multivariate Statistics* (6th ed.). Boston Allyn & Bacon.

Teng, T. H., Hung, J., Knuiman, M., Stewart, S., Arnolda, L., Jacobs, I., . . . Finn, J. (2011). Trends in long-term cardiovascular mortality and morbidity in men and women with heart failure of ischemic versus non-ischemic aetiology in Western Australia between 1990 and 2005. *International Journal of Cardiology*. doi: 10.1016/j.ijcard.2011.01.061

Tung, H. H., Chen, S. C., Yin, W. H., Cheng, C. H., Wang, T. J., & Wu, S. F. (2011). Self care behavior in patients with heart failure in Taiwan. *European Journal of Cardiovascular Nursing*. doi: 10.1016/j.ejcnurse.2011.02.002

Vellone, E., Riegel, B., Cocchieri, A., Barbaranelli, C., D'Agostino, F., Glaser, D., . . . Alvaro, R. (2012). Validity and Reliability of the Caregiver Contribution to Self-care of Heart Failure Index. *Journal of Cardiovascular Nursing*. doi: 10.1097/JCN.0b013e318256385e

Vellone, E., Riegel, B., D'Agostino, F., Fida, R., Rocco, G., Cocchieri, A., & Alvaro, R. (2013). Structural equation model testing the situation-specific theory of heart failure self-care. *Journal of Advanced Nursing*. doi: 10.1111/jan.12126

Wang, S. P., Lin, L. C., Lee, C. M., & Wu, S. C. (2011). Effectiveness of a self-care program in improving symptom distress and quality of life in congestive heart failure patients: a preliminary study. *Journal of Nursing Research, 19*(4), 257-266. doi: 10.1097/JNR.0b013e318237f08d

Yu, D. S., Lee, D. T., Thompson, D. R., Jaarsma, T., Woo, J., & Leung, E. M. (2011). Psychometric properties of the Chinese version of the European Heart Failure Self-care Behaviour Scale. *International Journal of Nursing Studies, 48*(4), 458-467. doi: 10.1016/j.ijnurstu.2010.08.011

Yu, D. S., Lee, D. T., Thompson, D. R., Woo, J., & Leung, E. (2010). Assessing self-care behaviour of heart failure patients: cross-cultural adaptation of two heart failure self-care instruments. *Hong Kong Medical Journal, 16 Suppl 3*, 13-16.

Zambroski, C. (2008). Self-care at the end of life in patients with heart failure. *Journal of Cardiovascular Nursing, 23*(3), 266-276. doi: 10.1097/01.JCN.0000317425.19930.c9

Table 1

Sociodemographic and Clinical Characteristics 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 separed	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
Age (Mean – SD)	72.63	11.70
Ejection Fraction (%) (Mean – SD)	44.21	10.53
Time Since Diagnosis (years) (Median and Interquartile ranges)	3.42	2.00 - 5.50

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 primary factor on which the item loads regardless of absolute value.

Table 3

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 primary factor on which the item loads regardless of absolute value.

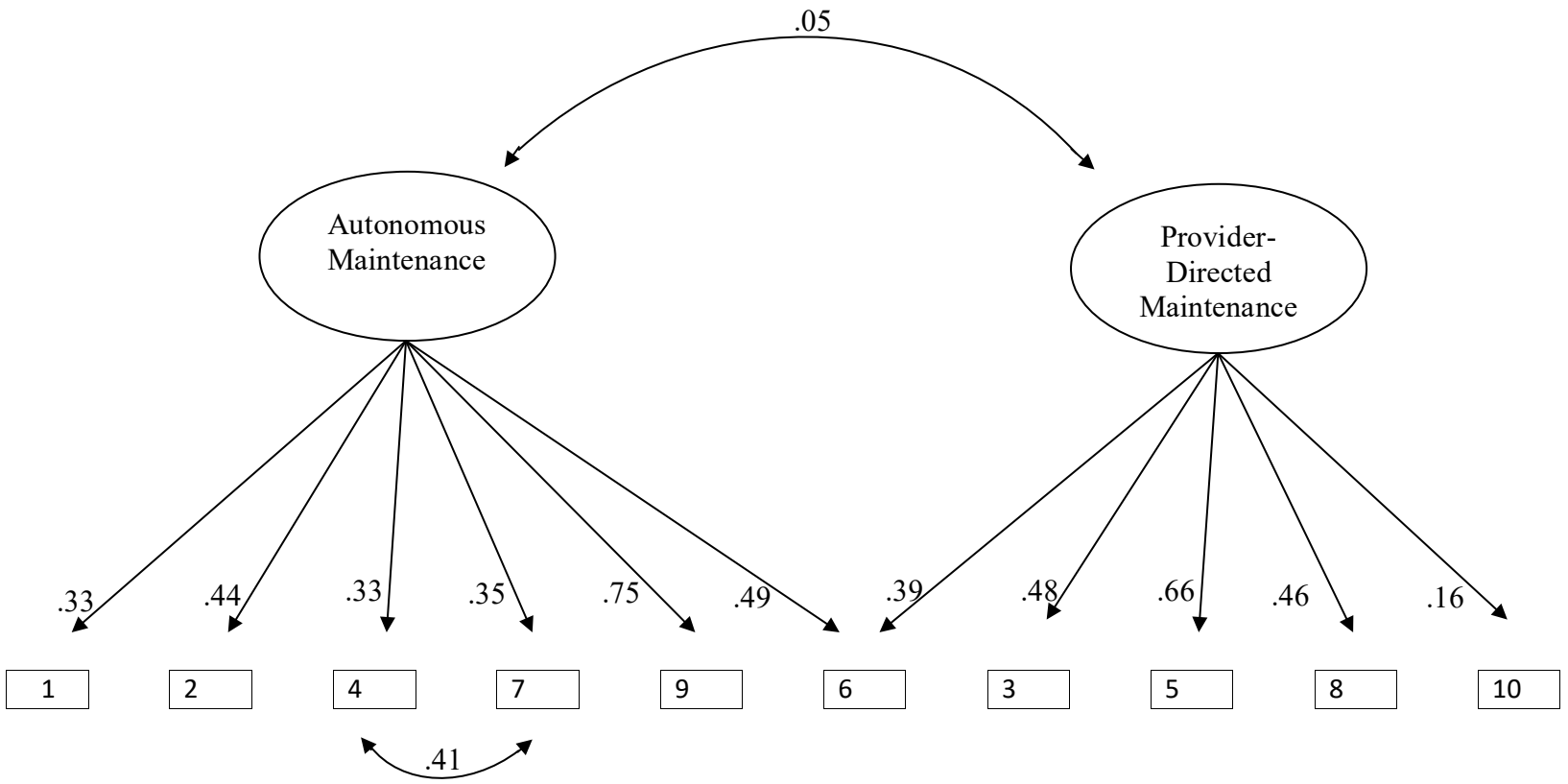

Figure 1. Confirmatory factor analysis of the Self-Care Maintenance scale. $\chi^2(32, 330) = 60.60$, p .002, CFI = .92, NNFI = .88, RMSEA = .052, 90% CI [.031 - .072], SRMR = .055. All relationships between latent variables and items are significant at p level < .001 except for Item 10 where p is 0.02.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

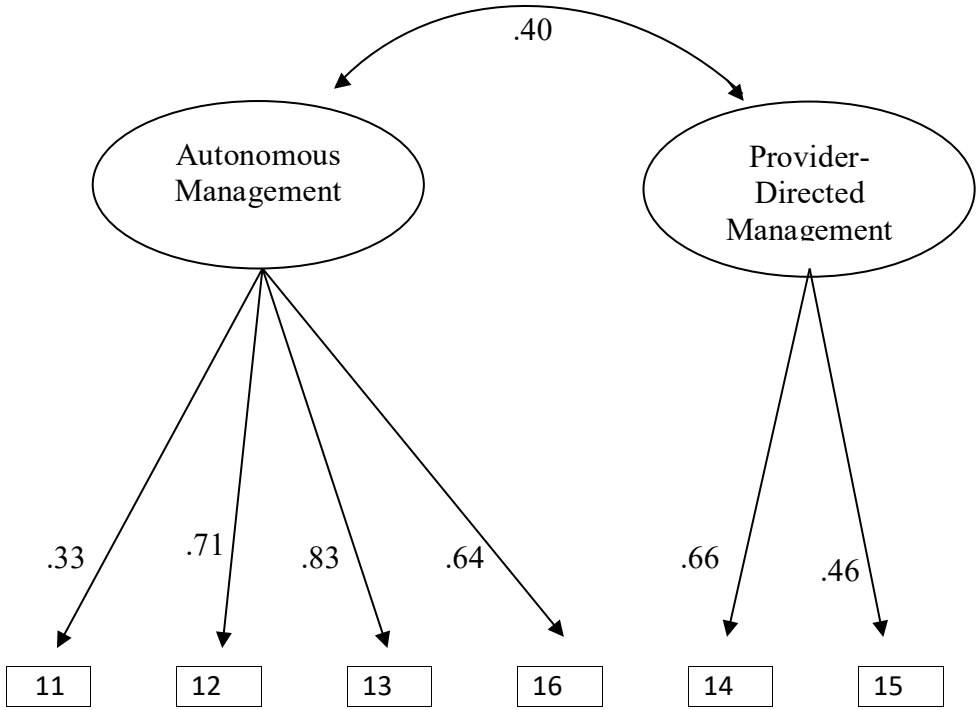

Figure 2. Confirmatory factor analysis of the Self-Care Management scale. $\chi^2(8, 359) = 12.35$, $p = .14$, CFI = .99, NNFI = .98, RMSEA = .040, 90% CI [.00, .079], SRMR = .027. All relationships between latent variable and the indicators are significant at p level < .001.

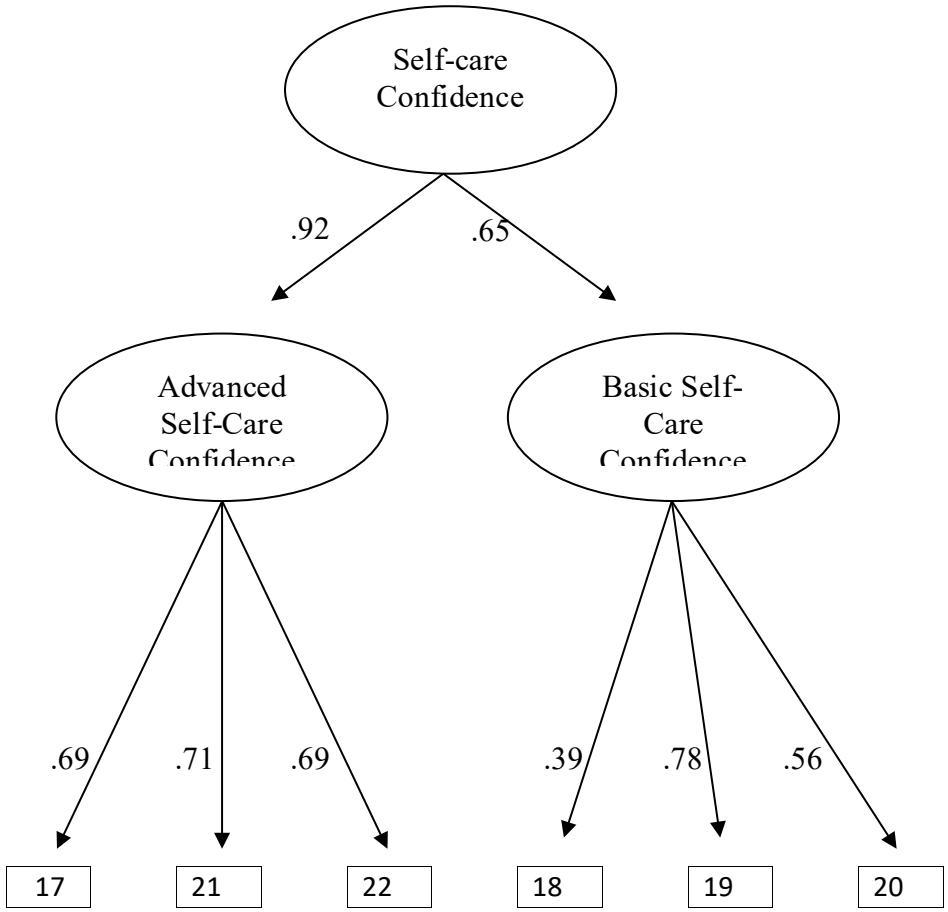

Figure 3. Confirmatory factor analysis of the Self-Care Confidence scale. $\chi^2(8, 330) = 9.69$, $p = .28$, CFI = .99, NNFI = .99, RMSEA = .025, 90% CI [.00, .072], SRMR = .030. All relationships between latent variable and the indicators are significant at p level < .001.

Table 4
Mean Comparison Between Patients Cared for in a Heart Failure Clinic and Those Cared for in a General Cardiovascular Clinic (n = 50 per Each Group)

	Specialty HF Clinic	Cardiovascular Clinic			
Scales	*M* (*SD*)	*M* (*SD*)	Mean Difference	95% CI	*p*
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.

Table 5

Test-Retest Reliability Data From the Self-Care of Heart Failure Index v. 6.2

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

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 correlation.

Table 6

Internal Consistency Reliability of the Self-Care of Heart Failure Index v. 6.2

Scales	Factor Score Determinacy
Self-Care Maintenance	--
Autonomous Maintenance	.83
Provider-Directed Maintenance	.78
Self-Care Management	--
Autonomous Management	.90
Provider Directed Management	.74
Self-Care Confidence	.82
Advanced Confidence	.87
Basic Confidence	.85