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# Measures of Self-Care in Heart Failure: Issues with Factorial Structure and Reliability

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## Abstract

Dear Editor

We read with great interest the recently published paper by Dr Lambrinou and colleagues[1] entitled "The Greek version of the 9-item European heart failure self-care behaviour scale: A multidimensional or an uni-dimensional scale?" The paper is one of several papers published on the psychometric properties of the European Heart Failure Self-care Behaviour Scale (EHFScBS) and continues to raise the important questions: (1) Is self-care of heart failure (HF) a multidimensional or an uni-dimensional construct? (2) Is self-care of HF a generalizable construct across countries? (3) Is Cronbach's alpha the best approach to estimate reliability of instruments?

## Disciplines

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

# Measures of self-care in heart failure: issues with factorial structure and reliability

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Dear Editor

We read with great interest the recently published paper by Dr Lambrinou and colleagues[1] entitled "The Greek version of the 9-item European heart failure self-care behaviour scale: A multidimensional or a uni-dimensional scale?" The paper is one of several papers published on the psychometric properties of the European Heart Failure Self-care Behaviour Scale (EHFScBS) and continues to raise the important questions: (1) Is self-care of heart failure (HF) a multidimensional or an uni-dimensional construct? (2) Is self-care of HF a generalizable construct across countries? (3) Is Cronbach's alpha the best approach to estimate reliability of instruments?

In prior psychometric studies conducted on the EHFScBS investigators have struggled to define a generalized construct. When Jaarsma and colleagues [2] developed the EHFScBS they hypothesized three dimensions within the scale: *complying with regimen, asking for help,* and *adapting activities*. With Principal Component Analysis with Varimax rotation, only the *asking for help* factor was identified while items of the remaining factors loaded on more than one factor. In 2009 the EHFScBS evolved into a 9-item version with two dimensions: *consulting behaviors* and *adherence with the regimen*.[3] In that study, confirmatory factor analysis (CFA) was used to test various EHFScBS models but the best models, with very similar fit indices, were the one factor model and the two factor model. However not all fit indices were adequate (normative fit index and comparative fit index $\leq 0.81$). In that study, reliability tested with Cronbach's alpha was adequate (0.80) for the total scale and the *consulting behaviour* factor (0.85) but reached a poor 0.56 for the *adherence with regimen* factor.

After the 9-item version was developed, the EHFScBS was also tested in United States, Germany and Italy. In United States[4] two separate CFAs were conducted with only the *consulting behaviors* factor and the total scale: CFA of the *consulting behavior* factor yielded satisfactory fit indices but CFA of the total scale had two indices that only approached adequacy. However, EHFScBS

reliability, tested with Cronbach's alpha, was adequate in this sample: 0.85 for the *consulting behaviors* factor and 0.80 for the total scale. In Germany[5] investigators tested the EHFScBS first for reliability and then for the validity. Reliability, tested with Cronbach's alpha, was 0.71. When factorial validity was tested with principal component analysis, a 3-factor structure was found; only the *consulting behavior* factor remained the same (Cronbach's alpha 0.86). Interestingly, for the other two factors, the first factor reflected fluid restriction, salt restriction, and exercise; the second factor reflected daily weighing and medication taking. In the Italian study [6] the factorial structure of the EHFScBS was tested for a new factorial structure based on an analysis of the Self-Care of Heart Failure Index[7] and three factors were identified: *consulting behaviors* (same items as in prior studies), *provider-based adherence* and *autonomous-based adherence*. All fit indices were adequate in the Italian EHFScBS model. In the Italian study reliability, tested with the factor score determinacy coefficient, was adequate for all three factors (0.77 to 0.95).

In the current study by Lambrinou et al.,[1] the two factor model specified by Jaarsma et al.[3] showed poor fit so the investigators performed Principal Component Analysis with Varimax rotation. Their approach yielded 4 factors with an eigenvalue greater than one but they repeated the analysis with a different rotation, specifying three factors. The three factors of this solution were named: *adhering to recommendations*, *fluid and sodium management, physical activity* and *recognition of deteriorating symptoms*. When reliability was tested with Cronbach's alpha and factor score determinacy, factor score determinacy was higher than Cronbach's alpha in two factors out of three.

In total, these various psychometric studies have yielded an elusive factorial structure that changes across populations, except for the *consulting behavior factor*, which is fairly stable. Also, so far only reliability testing with factor score determinacy coefficient has produced an adequate reliability estimate for this scale.

A similar history can be seen with the Self-Care of Heart Failure Index (SCHFI). When it was developed in 2004,[8] the three hypothesized dimensions (self-care maintenance, self-care management, and self-care confidence) were tested with CFA, which showed poor fit to the data (e.g., comparative fit index = .73). Reliability was inadequate for one of the three scales: 0.56, 0.70 and 0.83 for self-care maintenance, management and confidence, respectively. Even when the SCHFI evolved in version 6.2 to include 22 items, reliability did not change when tested with Cronbach's alpha (0.55, 0.60 and 0.83 respectively). Other investigators have continued to analyze the SCHFI factorial structure and reliability and repeatedly shown poor model fit and poor reliability.[9,10]

In 2013 we used a different approach to test validity and reliability of the SCHFI.[7] Using a cross-validation approach, with exploratory and confirmatory factor analysis for each separate SCHFI scale, we confirmed that self-care maintenance and management scales were multidimensional. When specifying these new dimensions, an adequate model fit was found for each scale. As reliability testing with Cronbach's alpha assumes that the scale is unidimensional, we tested reliability in each factor with factor score determinacy and found adequate reliability. We have recently conducted another study on the SCHFI using US samples.[11] When we specified the same dimensions of self-care that emerged in the Italian studies,[7,12] the model fit was adequate. Reliability was adequate in all scales when we used the more appropriate method based on the dimensionality found in CFA.

The lesson we learned by testing the factorial validity and reliability of the EHFScBS and SCHFI is that dimensionality is the first step to establish the psychometric properties of an instrument. From there, reliability should be tested with the most appropriate method rather than assuming that Cronbach's alpha is the best measure. Lambrinou and colleagues were right to test the EHFScBS dimensionality first and then reliability of each dimension with factor score determinacy coefficient. We conclude that self-care of HF is a multidimensional construct that is generalizable across

countries in spite of unique cultures and belief systems. We argue, however, that Cronbach's alpha is not the best approach to estimate instrument reliability, especially for multidimensional scales and with instruments with few items.

We recommend the use of reliability coefficients like factor score determinacy [13] composite reliability[14] and maximal reliability[15] in the case of unidimensional constructs, and the model-based internal consistency index[16] or the global reliability index for multidimensional scales[17] when constructs are multidimensional.

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