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## Validity and Reliability of the European Heart Failure Self-care Behavior Scale Among Adults from the United States with Symptomatic Heart Failure

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### Abstract

**Background**—Heart failure (HF) self-care is an important component of disease management and the focus of many interventions.

**Aim**—The aim of this study was to evaluate the validity and reliability of the 9-item European HF Self-Care Behavior Scale (EHFScB-9) in a sample of 200 adults from the United States with symptomatic HF.

**Methods**—Psychometric tests included item and confirmatory factor analyses, convergent and discriminant validity, and internal consistency.

**Results**—Item-total correlations ranged from 0.25–0.65. Many fit indices for the EHFScB-9 and the 4-item consulting behaviors reached thresholds of acceptability. As expected, the EHFScB-9 was associated with other measures of HF self-care but not with quality-of-life. Coefficient  $\alpha$  was 0.80 for the EHFScB-9 and 0.85 for the consulting behaviors subscale.

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**Conclusion**—The EHFS<sub>c</sub>B-9 was a valid and reliable measure of HF self-care among English-speaking U.S. adults with symptomatic HF.

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## Background

Self-care of heart failure (HF), a critical element of disease management, is associated with multiple health outcomes and a common target of therapeutic interventions.<sup>1–3</sup> The reliable and valid measurement of HF self-care is central to advancing our understanding of how we can optimize self-care and help patients with HF best influence their own health.<sup>4</sup> There are two instruments commonly used to measure self-care of HF; namely the Self-Care of HF Index (SCHFI v.6)<sup>5</sup> and the 9-item European Heart Failure Self-care Behavior Scale (EHFS<sub>c</sub>B-9).<sup>6</sup> While the SCHFI was developed and evaluated in a United States (U.S.), there are no data published on the psychometric properties of the EHFS<sub>c</sub>B-9 scale among U.S. adults. Accordingly, the aim of this study was to evaluate the validity and reliability of the EHFS<sub>c</sub>B-9 in a sample of U.S. adults with symptomatic HF.

## Methods

We completed an analysis of enrollment data in a prospective cohort study of symptoms among adults with symptomatic HF who were recruited through a single advanced HF clinic in the Pacific Northwest of the U.S. between October, 2010 and October, 2012. Eligible participants were 23 years old or greater, had current HF symptoms (New York Heart Association (NYHA) functional class II-IV) and were English speaking. Patients were excluded if they received heart transplantation or a ventricular assist device, had major cognitive impairment, or had major and uncorrected visual impairments. Written informed consent was obtained from all study participants; this study conforms to the principles of the Declaration of Helsinki, and was reviewed and approved by the institutional review board.

## Measurement

Self-reported socio-demographics were assessed using a questionnaire. Clinical and treatment characteristics were collected by review of the electronic medical record. NYHA class was assessed by the HF cardiologist immediately prior to enrollment. Comorbidities were assessed during the medical record review using the Charlson Comorbidity Index.<sup>7</sup>

**The European Heart Failure Self-Care Behavior Scale**—The 12-item European Heart Failure Self-care Behavior Scale was developed a decade ago as a valid, reliable and practical measure of HF self-care behaviors,<sup>8</sup> and has been translated and validated in several languages and in several countries.<sup>9–13</sup> In 2009, the instrument was shortened to include nine items (EHFS<sub>c</sub>B-9), each rated by five response options ranging from 1 (I completely agree) to 5 (I don't agree at all).<sup>6</sup> Scores on the EHFS<sub>c</sub>B-9 range from 9–45; lower scores indicate better self-care.<sup>6</sup> The EHFS<sub>c</sub>B-9 also has a 4-item “consulting behavior” subscale that captures patients’ endorsement of contacting providers when symptoms occur;<sup>6</sup> the consulting behavior subscale ranges from 4–20.

**The Self-Care of Heart Failure Index**—We used the Self-Care of HF Index (SCHFI v.6)<sup>5</sup> for self-care convergent validity testing. In the SCHFI, 22 items are provided with four

to five response options. Responses are standardized into three scores ranging from 0–100 that represent *self-care maintenance* (routine daily behaviors), *self-care management* (symptom recognition, evaluation, and treatment), and *self-care confidence* (confidence in self-care behaviors); higher values on the SCHFI indicate better self-care.<sup>5</sup> In this sample, Cronbach's  $\alpha$  was 0.64, 0.60, and 0.84 on the SCHFI maintenance, management, and confidence scores respectively.

**The Minnesota Living with Heart Failure Questionnaire**—We used the Minnesota Living with HF Questionnaire (MLHFQ)<sup>14</sup> for health-related quality-of-life (QOL) discriminant validity testing. The MLHFQ measures the influence of HF and its treatment on preventing participants from living as they wanted. 21 items are provided with six response options from 0 (No) to 5 (very much); higher scores indicate worse QOL. Summary scores include physical (range 0 to 40), and emotional (range 0 to 20) QOL indices. In this sample, Cronbach's  $\alpha$  was 0.93 and 0.90 on the MLHFQ physical and emotional scores, respectively.

## Analysis

Item response means and SDs, and corrected item-total correlations were quantified. Item difficulty/endorsement was assessed by quantifying the proportion of participants who provided the best possible response (completely agree). Item difficulty of 0.3 indicates that few (30%) participants endorsed the item, and 0.7 indicates that many (70%) participants endorsed the item; 0.3 and 0.7 is the best range for item difficulty. Item discrimination was quantified by comparing item difficulty scores between participants with EHFScB-9 total scores in the top and bottom thirds of the distribution. Confirmatory factor analyses of the EHFScB-9 and the 4-item consulting behavior subscale were performed in *Mplus* v.6 (Los Angeles, California) using weighted least square parameter estimation using a diagonal weight matrix with standard errors, and mean- and variance-adjusted statistics that use a full weight matrix (i.e. WLSMV); all indicators were appropriately identified as ordered categorical data. Results are presented in parameter estimates and standard errors. To assess model fit, overall model  $\chi^2$  tests, root mean square errors of approximation (RMSEA), weighted root mean square residuals (WRMR), comparative fit indices (CFI), Tucker-Lewis indices (TLI), normed fit index (NFI), and adjusted goodness-of-fit index (AGFI) were calculated using common thresholds of acceptability.<sup>15</sup>

Pearson's correlations were used to quantify convergent and discriminant validity. Based on finding in the original EHFScB-9 psychometric paper,<sup>6</sup> we assumed there would be strong relationships between the EHFScB-9 and the 4-item consulting behavior subscale and the SCHFI maintenance and management scores (convergence), and a weak and insignificant relationship between the EHFScB-9 and the 4-item consulting behavior subscale and indices of QOL (divergence). Cronbach's alpha and 95% confidence intervals (CI) were calculated as an index of internal consistency.

## Results

The sample was predominantly male and Caucasian and most participants had low comorbid burden (Table 1). The average age of the sample was 57 years and a majority of participants (60%) were classified as NYHA functional class III or IV.

Item-total correlations on the EHFS<sub>c</sub>B-9 ranged from 0.25 (taking medications as prescribed) to 0.65 (if I gain 5 pounds in one week) (Table 2). Item difficulty scores ranged from 0.22 (exercise regularly – the most difficult to endorse) to .91 (taking medications as prescribed – the easiest item to endorse). Most items were discriminatory regarding the top and bottom 33.3% of HF self-care performers. In contrast, taking medications as prescribed was not helpful in discriminating between participants who reported better or worse self-care.

The confirmatory factor analysis of the EHFS<sub>c</sub>B-9 and consulting behaviors subscale are presented in Table 3. Half of the fit indices reached and others were close to reaching thresholds of acceptability; thus, the fit of the EHFS<sub>c</sub>B-9 as a single scale and the fit of the 4-item consulting behaviors subscale could be improved in this population but are acceptable.

Convergent validity testing of the EHFS<sub>c</sub>B-9 with the SCHFI, and discriminant validity testing of the EHFS<sub>c</sub>B-9 with the MLHFQ are presented in Table 4. There were moderate to strong correlations among the EHFS<sub>c</sub>B-9 and consulting behaviors subscale and both the SCHFI maintenance and management scores. The EHFS<sub>c</sub>B-9 and consulting behaviors subscale were not correlated with SCHFI confidence scores or with indices of physical and emotional QOL as measured by the MLHFQ.

Cronbach's alpha of the EHFS<sub>c</sub>B-9 was 0.80 (95% CI was 0.76–0.84). Single item deletion did not result in significant improvement of internal consistency. Cronbach's alpha was 0.85 (95% CI 0.81–0.88) on the 4-item consulting behaviors subscale.

## Discussion

In this sample of 200 U.S. adults with symptomatic HF, the EHFS<sub>c</sub>B-9 was a valid and internally consistent measure of HF self-care behaviors. There are some minor limitations of the EHFS<sub>c</sub>B-9 regarding the item on medication adherence, which had the lowest item-total correlation, poor discrimination and was the easiest item to endorse. It is also known that HF patients overestimate adherence to medications using self-report measures compared with objective indices.<sup>16, 17</sup> Conceptually, however, removing an item on medication adherence from a measure of HF self-care would be difficult to justify from a validity perspective. Additionally, the EHFS<sub>c</sub>B-9 has sufficient internal consistency that would not be significantly improved with the removal of the medication adherence item. Thus, the EHFS<sub>c</sub>B-9 will be useful in models predicting HF self-care or using HF self-care to predict other outcomes in this population without further adjustment.

Consistent with a review of the psychometric properties of HF self-care measures,<sup>4</sup> linear associations between scores in this study indicate that the EHFS<sub>c</sub>B-9 is most closely associated with the routine self-care behaviors (SCHFI maintenance) and moderately

associated with symptom response behaviors (SCHFI management) but not confidence in self-care behaviors (SCHFI confidence). In addition, both the EHFScB-9 and consulting behaviors subscale were not significantly associated with QOL metrics; these findings are consistent with results of other EHFScB-9 psychometric analyses,<sup>6</sup> and indicate that self-care is a different construct than QOL.

The 4-item consulting behaviors subscale that captures behaviors in response to signs/symptoms of congestion also had acceptable fit and internal consistency. The consulting behaviors subscale was moderately associated with routine self-care behaviors but not to confidence in self-care or QOL. Although there are conceptual dissimilarities, the consulting behaviors subscale was moderately associated with the SCHFI management score. Thus, patients who are better at consulting with providers in response to signs/symptoms of congestion are also better at recognizing and engaging in self-initiated strategies to ameliorate HF symptoms.

The relatively young age, functional limitations, and English-speaking ability of the sample may limit the generalizability of these findings. The cross-sectional nature of this study also impairs our ability to comment on the utility of the EHFScB-9 over time. Finally, due to the relative small size of this sample, further psychometric testing is warranted in larger and more diverse patient populations.

## Conclusion

Self-care of HF is an important element of disease management and a focus of a large and expanding body of international clinical research. The EHFScB-9 and consulting behaviors subscale are valid and reliable measures of self-care among English-speaking U.S. adults with moderate to advanced HF.

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**Table 1**

## Characteristics of the Sample (n=200)

<b><i>Patient Characteristics:</i></b>	<b>Mean±SD or n (%)</b>
Age (years)	57.0 ± 13.3
Female	100 (50%)
Caucasian	170 (85%)
Body Mass Index (kg/m <sup>2</sup> )	30.7 ± 7.4
Charlson Comorbidity Category:	
Score of 1 or 2 (low)	124 (62%)
Score of 3 or 4 (medium)	64 (32%)
Score of 5 or more (high)	12 (6%)
<b><i>Heart Failure Characteristics:</i></b>	
Left Ventricular Ejection Fraction (%)	28.5 ± 12.3
NYHA Functional Class:	
Class II	80 (40%)
Class III	113 (56.5%)
Class IV	7 (3.5%)
Last Known Cardiac Index (L/min/m <sup>2</sup> )	2.0 ± 0.5
Last Known PCWP (mm/Hg)	18.9 ± 8.8
<b><i>European Heart Failure Self-care Behavior Scale</i></b>	
9-item (range 9–45)	18.1 ± 6.8
Consulting Behaviors (range 4–20)	8.4 ± 4.3
<b><i>Self-Care of Heart Failure Index</i></b>	
Maintenance (range 0–100)	70.2 ± 15.1
Management (range 0–100)	65.7 ± 20.1
Confidence (range 0–100)	63.3 ± 21.2
<b><i>Quality-of-Life:</i></b>	
MLHFQ Physical Dimension (range 0–40)	20.0 ± 11.1
MLHFQ Emotional Dimension (range 0–20)	10.0 ± 7.4

*Abbreviations:* MLHFQ = Minnesota Living with Heart Failure Questionnaire; NYHA = New York Heart Association; PCWP = pulmonary capillary wedge pressure; SCHFI = Self-Care of Heart Failure Index (v6); SD = standard deviation

**Table 2**

Item Analysis for the EHFS<sub>c</sub>B-9 in a U.S. Sample (n=200)

Item	Mean ± SD	Item-total correlation <sup>‡</sup>	α if deleted	Distribution of Item Responses					Item Discrimination
				1	2	3	4	5	
I weigh myself every day	2.02±1.41	0.453	0.79	58.0%	10.5%	14.5%	5.5%	11.5%	0.47
If my shortness of breath increases <sup>†</sup>	1.94±1.23	0.636	0.76	56.0%	13.0%	16.0%	11.0%	4.0%	0.70
If my feet/legs become swollen <sup>†</sup>	2.06±1.30	0.638	0.76	50.8%	15.1%	19.1%	7.5%	7.5%	0.71
If I gain 5 pounds in one week <sup>†</sup>	1.97±1.32	0.645	0.76	56.1%	15.7%	12.1%	8.1%	8.1%	0.68
I limit the amount of fluids I drink	2.05±1.19	0.461	0.79	46.7%	18.6%	22.1%	8.0%	4.5%	0.67
If I experience increased fatigue <sup>†</sup>	2.49±1.36	0.618	0.77	33.0%	20.5%	22.5%	13.0%	11.0%	0.92
I eat a low salt diet	1.67±0.97	0.429	0.79	59.5%	22.0%	13.0%	3.5%	2.0%	0.54
I take my medications as prescribed	1.13±0.44	0.246	0.81	90.5%	6.5%	2.5%	0.5%	0.0%	0.12
I exercise regularly	2.88±1.40	0.341	0.80	22.3%	19.3%	23.4%	17.8%	17.3%	0.68

<sup>†</sup> I contact my doctor or nurse

<sup>‡</sup> Corrected item-total correlation

Abbreviations: EHFS<sub>c</sub>B-9 = European Heart Failure Self-care Behaviors Scale; SD = standard deviation



**Table 3**Confirmatory Factor Analyses for the EHFS<sub>c</sub>B-9 and Consulting Behaviors Scale in a U.S. Sample (n=200)

	EHFS <sub>c</sub> B-9	Consulting Behaviors
<i>Standardized Parameter Estimates ± Standard Errors</i>		
I weigh myself every day	0.54±0.06	
If my shortness of breath increases <sup>†</sup>	0.82±0.04	0.83±0.04
If my feet/legs become more swollen <sup>†</sup>	0.84±0.04	0.88±0.04
If I gain 5 pounds in one week <sup>†</sup>	0.83±0.03	0.81±0.04
I limit the amount of fluids I drink	0.58±0.05	
If I experience increased fatigue <sup>†</sup>	0.77±0.04	0.80±0.03
I eat a low salt diet	0.56±0.06	
I take my medications as prescribed	0.43±0.10	
I exercise regularly	0.40±0.07	
<i>Goodness of Fit</i>		
$\chi^2$ (df)	103 (27)	9.54 (2)
p-value	<0.001	0.008
RMSEA <sup>‡</sup>	0.118	0.137
WRMR	0.997	0.397
CFI	0.942	0.992
NFI	0.923	0.990
TLI	0.922	0.976
AGFI	0.897	0.971

<sup>†</sup> I contact my doctor or nurse

*Abbreviations:* AGFI = Adjusted Goodness-of-fit Index; CFI = Comparative Fit Index; df = degrees of freedom; EHFS<sub>c</sub>B-9 = 9 Item European Heart Failure Self-care Behaviors Scale; NFI = Normed Fit Index; TLI = Tucker-Lewis Index; RMSEA = root mean square error of approximation; WRMR = weighted root mean square residuals.

<sup>‡</sup> 90% confidence interval 0.093–0.142, p<0.001, for the EHFS<sub>c</sub>B-9, and 0.03–0.20, p0.097, for the consulting behaviors subscale (calculated by necessity from models not considering the ordered categorical nature of these data).

*Thresholds for Acceptable Fit:*<sup>15</sup>

RMSEA = 0.05–0.08

WRMR <1.0

CFI and TLI 0.95

AGFI 0.85

NFI 0.90

**Table 4**

Convergent and Discriminant Validity for the EHFS<sub>CB-9</sub> in a U.S. Sample (n=200)

<i>Linear correlations</i>	SCHF Maintenance	SCHF Management	SCHF Confidence	MLHFQ Physical	MLHFQ Emotional
EHFS <sub>CB-9</sub>	-0.594 <sup>‡</sup>	-0.424 <sup>‡</sup>	-0.038	0.132	0.164
EHFS <sub>CB-CB</sub>	-0.415 <sup>‡</sup>	-0.338 <sup>‡</sup>	-0.010	0.109	0.104

<sup>‡</sup> p<0.0001 for all correlations with Bonferroni correction for multiple measures

*Abbreviations:* CB = EHFS<sub>CB</sub> Consulting Behaviors; EHFS<sub>CB</sub> = European Heart Failure Self-care Behaviors Scale; MLHFQ = Minnesota Living with Heart Failure Questionnaire (physical and emotional domains); SCHFI = Self-Care of Heart Failure Index (v6).