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Development of an Evaluation Scale for Self-Monitoring by Patients with Heart Failure

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Many chronic heart failure patients are hospitalized repeatedly because many of them are still uncertain about the methods necessary for managing their own health. "Self-monitoring" is a useful concept for breaking through this vicious cycle. However, there are no suitable tools to measure aspects of self- monitoring. This study aimed at the development of an evaluation scale for self-monitoring by patients with chronic heart failure based on the concept of self-monitoring.

Outpatient with chronic heart failure completed a self-administered scale comprises 2 domains and covers 38 items. Domain 1 deals with "awareness" and "measurement" of aspects of self-monitoring, domain 2 with "interpretation" of aspects of self-monitoring. The reliability and validity of this scale were thoroughly evaluated. Of the 167 patients asked to participate in the study, 142 gave valid responses. Factor analysis showed that the domain1 comprised six factors (21 items) and the domain2 four factors (16 items). Cronbach's α coefficient was 0.91 for domain1, 0.89 for domain2. The intra-class correlation coefficient of total score was 0.74 for domain1, 0.67 for domain2. Concurrent validity with the Heart Failure Self-care Behavior Scale was demonstrated. The scale is reasonably reliable and valid, and was proved to be useful for assessing conditions related to patient self-monitoring. Since it has become an indicator that shows to what degree patients can perceive their own health status, and nurses have been utilizing it to provide individual support to reduce the risks of exacerbated heart failure.

To prevent exacerbation of their condition, chronic heart failure patients need to manage their own health by contributing to their own recuperation, by paying attention to the occurrence of weight gain or edema, and being aware of aggravated shortness of breath and malaise associated with physical activity. However, many of these patients are still uncertain about the methods necessary for managing their own health, and many patients are hospitalized repeatedly (9, 11, 14). "Self-monitoring" is a useful concept for breaking through this vicious cycle.

One of the aims of nursing for chronic heart failure patients is to enhance patients' self-care behavior (15). While "self-care" is a large-scale concept, the details of "self-monitoring" are part of the processes affecting self-care behavior (6). And since the appropriateness of patients' self-monitoring directly affects self-care behavior, self-monitoring is considered to be a key for the improvement of self-care behavior. Self-monitoring is defined as "awareness of symptoms or bodily sensations that is enhanced

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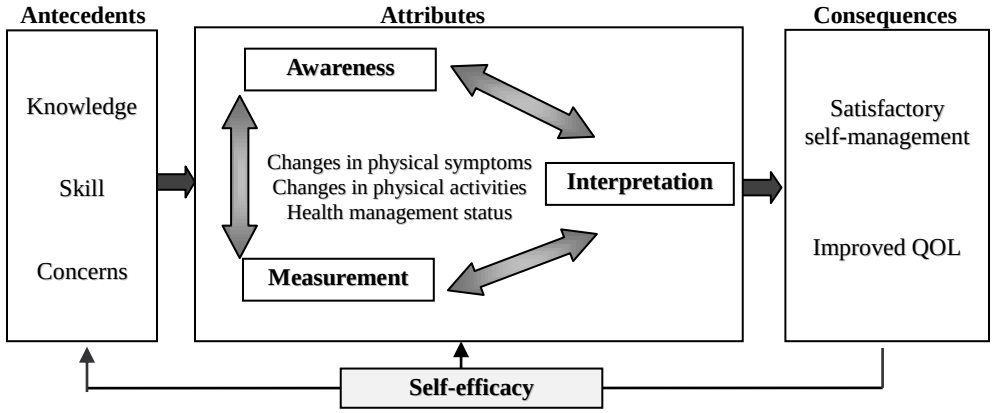
through periodic measurements, recordings, and observations to provide information for improved self-management" by Wilde and Garvin (16). However, there has been some ambiguity in nursing practice regarding the question of what exactly constitutes self-monitoring for chronic heart failure patients, as well as what specific types of symptoms and bodily sensations need to be observed and measured for self-monitoring by heart failure patients. We therefore clarified the concept of self-monitoring for chronic heart failure patients in a previous study in this field (6). Our research showed that self-monitoring by chronic heart failure patients comprised "awareness" and "measurement" of changes in physical symptoms, changes in physical activities and health management status in relation to heart failure, as well as "interpretation" of the data related to "awareness" and "measurement", in order to help patients attain satisfactory self-management and an improved quality of life. Therefore, to break through the vicious circle of conditions leading to exacerbation of cardiac failure and increase patients' self-care behavior, nurses need to support patients with appropriate methods for self-monitoring. It is therefore necessary for nurses to understand the concept of self-monitoring and to have the tool to measure to self-monitoring, so that nurses may understand the problems concerning patients' health care. However, there are no suitable tools to measure the various aspects of self-monitoring by patients with heart failure. Hence, the aim of this research was the development of an evaluation scale for self-monitoring by patients with chronic heart failure (ESSMHF) based on the concept of the self-monitoring clarified in a previous study.

MATERIALS AND METHODS

Definition and concept of self–monitoring for heart failure patients

In a previous study using the concept analysis method of Rogers and Knalf (13), we defined the self-monitoring as "being aware and measuring changes in physical symptoms, changes in physical activities and health management status in relation to heart failure, as well as interpreting the data for satisfactory self-management and improved QOL (6)". The attribute component of "awareness" is defined as a subjective understanding of one's own status and relevant changes; "measurement" as an objective understanding of these two aspects, and "interpretation" as comprehension resulting from considering the implications for oneself of what has been understood. The antecedent factors of self-monitoring are "knowledge", "skill", and "concern", and the consequences are "satisfactory self-management" and "improved QOL" (Figure 1).



Figer1. Concept of self-monitoring for patients with heart failure

Participants

Patients with chronic heart failure were selected from the outpatient clinic of Kobe University Hospital's Department of Internal Medicine. We selected patients diagnosed as heart failure for research participants under the consultation of physicians.

First, a physician introduced the researcher to the patient on the day of consultation with the doctor. The researcher explained the purpose of the investigation to each patient and written consent was obtained. The researcher asked the patient to complete a self-administered scale (evaluation scale for self-monitoring by patients with chronic heart failure, ESSMHF). After the patient completed the scale, another copy of the ESSMHF was placed in a stamped envelope and was given to the patient in order to evaluate the reproducibility, and patients were asked to administer the instrument at home within 1 month and return the completed form by mail. Since it is predicted that a heart failure patient's self-monitoring changes with their condition, it was necessary to set up the period of the re-test. Thus, we decided to re-test within 1 month so that we could monitor whether any change in condition had occurred on the next consultation day.

Measures

The ESSMHF was developed from the results of semi-structured interviews conducted with 23 patients with chronic heart failure, who were selected from the files of outpatients under the physician's supervision. The interviewed population comprised 17 men and 6 women; average age was 67.2 years old. All participants had been diagnosed with chronic heart failure caused by cardiomyopathy, myocardial infarction or angina pectoris. The standardized interview sought responses to two questions: 1) What do you do to become aware of your conditions? and 2) How do you interpret your condition? Responses were then analyzed for content, and a pool of responses identified by the respondents was generated. From this, only those items that reflected self-monitoring of their conditions in relation to choric heart failure were selected for inclusion. The result was a 38-item scale comprising two domains. Domain 1 deals with "awareness" and "measurement" of aspects of self-monitoring (22 items), and domain 2 with "interpretation" of aspects of self-monitoring (16 items). Responses to the items were rated on a 5-point Likert scale (1 = "I don't think so" to 5 = "I think so"), with the higher subscale score indicating higher frequency of self-monitoring as a regimen. The scores of the scale were calculated by addition.

Five specialists examined the content validity of the scale, and all indicated that the items were relevant and contained a representative sample of possible self-monitoring by patients with chronic heart failure. Also, we completed the small sample pilot-test and the reading level of the scale was assessed.

To examine the concurrent validity of the scale, the Japanese version of the European Heart Failure Self-care Behaviour Scale (EHFScBS) was also completed by study participants (10). EHFScBS is a 12-item scale that measures the self-reported, self-care behavior of heart failure patients and face-validity and concurrent validity were established. The internal consistency of Cronbach's alpha was 0.81. This is useful for assessing the self-care behavior of chronic heart failure patients (8, 10). Since the scale which measures self-monitoring was not present in others, we made selection using the scale of self-care which is the nearest concept, in order to evaluate concurrent validity. It was expected that the ESSMHF would partially correlate with the self-care measurements of the EHFScBS, because self-monitoring is measured in terms of "Awareness", "Measurement", and "Interpretation" which have focus to the partial process of the self-care. In the expectation, items 1, 6, and 10 of the EHFScBS, which measure patients' "awareness" and

"measurement" of fluid intake, weight and medication, were considered to correlate with domain 1. Moreover, items 2-5 and 8 of the EHFScBS, which measure patients' "interpretation" of shortness of breath, swelling of the legs, weight gain and fatigue were considered to correlate with domain 2.

Various background factors of the subjects were also investigated, such as occupation, living situation, method of treatment, New York Heart Association's functional classification (7), EF and B-type natriuretic peptide (BNP) levels.

Data analysis

The reliability and validity of this scale were thoroughly evaluated. Each domain was subjected to exploratory factor analysis (EFA) using the principal factor method and varimax rotation to test the validity of models based upon postulated constructs, i.e., whether all the items for a single factor loaded > 0.35 and to confirm that the item loadings were theoretically coherent. Initial factor selection was based on eigen values > 1.0. After items that did not load > 0.35 for a given factor had been removed, the models were tested by means of factor analysis followed by confirmatory factor analysis (CFA) to test the models. The ratio of $\chi 2$ to degree of freedom ($\chi 2$/df), Akaike's information criterion (AIC), the comparative fit index (CFI), and root mean square error of approximation (RMSEA) were used to evaluate the fit of the models to the data. For the AIC, the smallest value represented the best classification. Moreover, RMSEA values of 0.05 and below reportedly indicate a close fit of the model and those between 0.05 and 0.08 indicate a reasonable error in approximating a given structure (1). $\chi 2/df < 2.0$ and CFI > 0.9 were considered to indicate an adequate fit. Selection of the final measurement model was then determined by examining the four indices of fit and choosing the model with the best indices. Pearson's correlation coefficients for the ESSMHF and EHFScBS were calculated to evaluate concurrent validity. Cronbach's α coefficient was calculated for each of the subscales to assess their internal consistency. Intraclass correlation coefficients for test and retest, which measure the strength of agreement between repeated measurements (4), were calculated to evaluate test-retest reliability. PASW Statistics 18 for Windows was used for the analysis and the level of significance was defined as .05 (two-sided test).

Ethical considerations

This investigation complied with the principles outlined in the Declaration of Helsinki. The Ethics Committee of Kobe University approved the protocol of this study, which was conducted from August 2008 to March 2011.

RESULTS

Samples

Of the 167 patients asked to participate in the study, 152 consented (response rate: 91.0%) and 142 gave valid responses to the questionnaire (validity rate: 93.4%). The 15 patients who did not agree to join this study cited lack of time as the reason. The 10 patients' responses had missing items and invalid data that were excluded from our analysis.

In the test-retest, the retest was collected from 88 of the original 142 patients and all gave valid responses (response rate: 62.0%). Table I presents the subjects' background characteristics. NYHA was assessed on the consultation day by the physician.

Table I. Characteristics of the subjects

Sex		
Male	92	(64.8)
Female	50	(35.2)
Age (years）	64.8 ± 13.7	(22–88)
Employment status		
Employed (Full-time)	33	(23.2)
Employed (Part-time)	11	(7.8)
Homemaker	35	(24.7)
Unemployed	8	(5.6)
Retired	53	(37.3)
Student	2	(1.4)
Living situation		
Living with another or other persons	121	(85.2)
Living alone	21	(14.8)
Diagnosis of cardiac disease		
Dilated cardiomyopathy	53	(37.3)
Hypertrophic cardiomyopathy	13	(9.2)
Angina pectoris	19	(13.4)
Acute myocardial infarction	5	(3.5)
Chronic myocardial infarction	16	(11.3)
Sarcoidosis	7	(4.9)
Valvular incompetence	18	(12.9)
Others	11	(7.7)
Duration of Heart Failure (years）		
＜1 years	13	(9.2)
<2-3 years	25	(17.6)
<4-5 years	20	(14.1)
<6-10 years	36	(25.4)
> 10 years	9	(6.3)
Readmission due to aggravated heart failure (times）		
Never	24	(16.9)
Once	46	(32.4)
Twice	28	(19.8)
3-5 times	37	(67.6)
6-10 times	4	(2.8)
>10 years	3	(2.1)
NYHA (The New York Heart Association) Functional Classification		
Class 1: No limitations of activities; no symptoms during ordinary activities	31	(21.8)
Class 2: Slight or mild limitation of activity;comfortable during rest or mild exertion	84	(59.2)
Class 3: Marked limitation of activity; comfortable only at rest	25	(17.6)
Class 4: Any physical activity brings on discomfort, and symptoms occur at rest	2	(1.4)
Ejection Fraction (%)	43.2 ± 10.5	(16.0–60.0)
BNP (B-type natriuretic peptide) (pg/ml)	156 ± 180.3	(4.0–156.4)

Data represent n (%) or means ± SD (range). n = 142.

Among participants, ischemic and non-ischemic heart failure patients were mixed. Then, it was concerned whether there was any significant difference between the ischemic group and non-ischemic group, and the Independent-Samples t-test of EF was performed. Table II showed there was no significant difference between the two groups. Also, Chi-Square tests using crosstabs were performed separately for NYHA (x^2=1.07, p<0.79) and Readmission Times due to Aggravated Heart Failure (x^2=5.64, p<0.60), no significances were observed between the two groups.

A summary of ESSMHF scores is presented in Table III; neither a ceiling-effect nor a floor-effect were found. The participants take 10 minutes to complete the survey.

TableII. the Independent-Samples t-test of EF for ischemia and non-ischemia heart failure Groups

Cause of Heart Failure	n	EF		t score	p value
		M	SD		
Heart failure based on the non-Ischemic heart disease	102	43.80	10.37	1.11	0.27
Heart failure based on the Ischemic heart disease	40	41.60	10.72		

n = 142. M = means, SD = Standard Deviation, EF = Ejection Fraction

Table III. Summary of the ESSMHF score

Subscale	Number of items	Minimum score	Maximum score	Mean ± SD	Range of total score
Domain 1. Self-monitoring related to “awareness” and “measurement”					
Factor 1	6	6	30	20.4 ± 7.3	6 - 30
Factor 2	3	3	15	12.5 ± 3.6	3 - 15
Factor 3	3	3	15	11.2 ± 3.9	3 - 15
Factor 4	3	3	15	8.8 ± 3.7	3 - 15
Factor 5	4	4	20	12.9 ± 4.4	4 - 20
Factor 6	2	2	10	9.5 ± 1.2	4 - 20
Domain 1 Total	21	21	105	75.4 ±17.2	37 - 103
Domain 2. Self-monitoring related to “interpretation”					
Factor 1	4	4	20	17.2 ± 3.1	4 - 20
Factor 2	8	8	40	31.4 ± 6.3	14 - 40
Factor 3	2	2	10	8.5 ± 2.1	2 - 10
Factor 4	2	2	10	7.8 ± 2.2	2 - 10
Domain 2 Total	16	16	80	64.8 ± 11.0	26 - 79

Factor validity

Domain 1: Self-monitoring related to degree of awareness and measurements (Table IV)

Factor analysis of domain 1 generated six factors. One item, “awareness of salt in diet”, loaded < 0.35 and was removed. The six factors (21 items) were “concern about signs of exacerbation”, “regular measurement of physical condition”, “concern about the results of measurement”, “concern about the volume of water”, “concern about how movements affect body”, and “concern about physician’s consultations and instructions for medications” with eigen value > 1.0 ($\chi 2/df = 1.93$, AIC = 451.25, CFI = 0.87, RMSEA = 0.08).

Domain 2: Self-monitoring related to interpretation (Table V)

Factor analysis of domain 2 generated four factors. All the variables loaded > 0.35. The four factors (16 items) were "prognostic interpretation of signs of exacerbation", "interpretation of symptoms and physical condition management", "interpretation of deterioration of pulse", and "interpretation of water retention" with eigen value > 1.0 (χ 2/df = 1.42, AIC = 215.54, CFI = 0.94, RMSEA = 0.055).

Table IV. Factor analysis of self-monitoring related to "awareness" and "measurement"

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Factor 1: Concern about signs of exacerbation						
Awareness of physical listlessness	0.70	0.06	0.04	0.09	0.19	0.03
Awareness of coughing	0.67	0.05	0.24	0.27	-0.02	-0.01
Awareness of palpitations	0.65	0.23	0.12	0.20	0.25	-0.09
Awareness of not getting enough sleep	0.65	0.01	0.12	-0.10	-0.14	0.26
Awareness of feeling breathless	0.59	-0.11	0.13	0.04	0.30	0.21
Awareness of swelling	0.45	0.24	0.25	0.33	0.24	0.21
Factor 2: Regular measurement of physical condition						
Regular pulse measurement	0.13	0.89	0.19	0.05	0.12	-0.01
Regular blood pressure measurement	-0.03	0.87	0.18	0.09	0.07	-0.01
Regular weight measurement	0.20	0.58	0.05	0.14	-0.12	0.07
Aware of salt in diet	0.12	0.33	0.17	0.27	0.09	0.29
Factor 3: Concern about the results of measurements						
Concern about slight changes in blood pressure	0.14	0.17	0.83	0.12	0.11	0.14
Concern about slight changes in pulse	0.32	0.20	0.63	0.07	0.24	-0.14
Concern about slight changes in weight	0.23	0.23	0.54	0.28	0.20	0.09
Factor 4: Concern about volume of water						
Awareness of amount of water drunk	0.31	0.28	0.15	0.73	0.14	0.13
Awareness of quantity of urine produced	0.29	0.04	0.04	0.57	0.20	0.00
Drinking only as much water as desired	-0.09	0.14	0.23	0.40	0.31	-0.02
Factor 5: Concern about how movements affect body						
Awareness of any physical changes after movements that exert strain on the body	0.44	0.16	-0.13	0.06	0.51	0.21
Awareness of any changes in ability to move the body as usual when exercising	0.34	0.23	0.16	0.23	0.49	0.15
Awareness of body when moving	0.39	0.19	0.34	0.05	0.48	0.10
Ability to move as desired	0.03	-0.04	0.07	0.10	0.42	0.03
Factor 6: Concern about physician's consultations and instructions for medications						
Conscientious about attending medical examinations as instructed by physician	0.13	0.12	-0.14	0.09	0.23	0.65
Conscientious about taking prescribed medication properly	0.07	-0.03	0.14	-0.02	-0.08	0.61
Sum of square for factor loadings	3.28	2.51	1.93	1.55	1.50	1.19
Contribution ratio of factors	14.91	11.40	8.77	7.03	6.81	5.41
Cumulative contribution ratio of factors	14.91	26.30	35.07	42.10	48.90	54.31

n=142

Table V. Factor analysis of self-monitoring related to "interpretation"

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1: Prognostic interpretation of signs of exacerbation				
Awareness that too much salt is not good for the heart	0.63	-0.06	-0.10	0.30
Awareness that movements that put the body under strain leads to worsening of physical condition	0.60	-0.07	0.14	0.09
Awareness that inability to move as usual indicates that the heart is under strain	0.59	0.30	0.34	0.17
Awareness that getting proper amount of sleep improves physical condition	0.45	0.16	0.19	0.00
Factor 2: Interpretation of symptoms and physical condition management				
Awareness that when the body feels listless, the heart is under strain	0.24	0.58	0.26	-0.13
Awareness that weight gain puts strain on the heart	0.26	0.45	0.37	0.26
Awareness that taking medication properly will prevent illness from getting worse	0.02	0.44	0.17	0.08
Awareness that greater difficulty with urination indicates worsening of heart condition	0.32	0.43	0.20	0.34
Awareness that breathlessness means that the heart is under strain	0.30	0.42	0.25	0.23
Awareness that attending medical examinations as per physician's instructions will prevent illness from getting worse	0.03	0.38	-0.05	0.15
Awareness that when coughing does not stop, heart failure is exacerbated	0.20	0.37	0.18	0.24
Awareness that low blood pressure impairs stamina	0.31	0.36	0.22	0.20
Factor 3: Interpretation of deterioration of pulse				
Awareness that when pulse feels irregular, something is wrong	0.17	0.19	0.78	0.14
Awareness that an increase in the pulse rate may indicate worsening of physical condition	0.35	0.31	0.44	0.04
Factor 4: Interpretation of water retention				
Awareness that drinking too much water is not good for the heart	0.09	0.22	0.17	0.69
Awareness that swelling indicates exacerbation of heart failure	0.43	0.30	0.05	0.45
Sum of square for factor loadings	2.27	1.90	1.61	1.36
Contribution ratio of factors	14.19	11.87	10.04	8.81
Cumulative contribution ratio of factors	14.19	26.05	36.09	44.60

n=142

Concurrent validity

Pearson's correlation coefficients for the ESSMHF and EHFScBS scores are shown in Table VI. The factors of ESSMHF and the items of EHFScBS which were predicted to correlate did in fact correlate. Since EHFScBS items 1, 6, and 10 measure patients'

"awareness" and "measurement" of fluid intake, weight measurement and medication, they correlated with the corresponding factors of domain 1. Also, since EHFScBS items 2-5, and 8 measure patients' "interpretation" of shortness of breath, swelling of the legs, weight gain and fatigue, they correlated with the corresponding factors of domain 2.

Table VI. Correlations between ESSMHF and EHFScBS

		Domain 1. Self-monitoring related to "awareness" and "measurement"					
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
EHFScBS Items†	1	0.28**	0.59**	0.30**	0.36**	0.39**	0.13
	2	0.28**	0,28**	0.21*	0.22**	0.36**	0.13
	3	0.20*	0.26**	0.11	0.26**	0.21*	0.05
	4	0.25**	0.27**	0.17	0.36**	0.34**	0.13
	5	0.38**	0.21*	0.25**	0.37**	0.44**	0.04
	6	0.23**	0.44**	0.25**	0.59**	0.36**	0.04
	7	0.15	0.27**	0.07	0.23**	0.23**	0.03
	8	0.30**	0.19*	0.16	0.24**	0.21**	0.08
	9	0.1	0.25**	0.22**	0.25**	0.06	0.06
	10	0.12	0.20*	0.20**	0.08	0.13	0.47**
	11	0.22**	0.27**	0.22**	0.26**	0.28**	0.11
	12	-0.02	0.25**	0.02	0.05	0.00	-0.05

		Domain 2. Self-monitoring related to "interpretation"			
		Factor 1	Factor 2	Factor 3	Factor 4
EHFScBS Items†	1	0.13	0.14	0.13	0.16
	2	0.45**	0.39**	0.38**	0.18*
	3	0.44**	0.28**	0.27**	0.21*
	4	0.41**	0.30**	0.27**	0.32**
	5	0.43**	0.45**	0.30**	0.36**
	6	0.15	0.29**	0.14	0.33**
	7	0.24**	0.29**	0.08	0.26**
	8	0.44**	0.44**	0.30**	0.28**
	9	0.23**	0.14	0.14	0.08
	10	0.18*	0.23**	0.24**	0.19*
	11	0.16	0.13	0.08	0.12
	12	0.14	-0.06	0.01	0.12

n = 142. *p < 0.05, **p < 0.01. : items predicted to show comparatively high correlation

†EHFScBS Items

Item 1: I weigh myself everyday
Item 2: If I am short of breath, I take it easy
Item 3: If my shortness of breath increases, I contact my doctor, or nurse
Item 4: If my feet/legs become more swollen than usual, I contact my doctor, or nurse
Item 5: If I gain 2 kg in 1 week, I contact a hospital, my doctor, or nurse
Item 6: I limit the amount of fluids I drink
Item 7: I take a rest during the day
Item 8: If I experience increased fatigue, I contact my doctor, or nurse
Item 9: I eat a low salt diet
Item 10: I take my medication as prescribed
Item 11: .I get a flu shot every year
Item 12: I exercise regularly

Internal consistency

Cronbach's α coefficient for all the subscales of the scale was between 0.53 and 0.84. The internal consistency of the scale was 0.91 for domain1and 0.89 for domain2 (Table VII).

Reproducibility

The intraclass correlation coefficient (ICC) for each subscale, calculated from the data obtained from the 88 subjects who returned their test-retest responses ranged from 0.42 to 0.74. The ICC of the total score was 0.74 for domain1 and 0.67 for domain2 (Table 7).

Table VII. Internal consistency and reproducibility of the scale

Subscale	Cronbach's α	Intraclass correlation coefficient
Domain 1. Self-monitoring related to "awareness" and "measurement"		
Factor 1	0.84	0.63
Factor 2	0.84	0.71
Factor 3	0.80	0.63
Factor 4	0.65	0.66
Factor 5	0.71	0.69
Factor 6	0.53	0.42
Domain 1 Total	0.91	0.74
Domain 2. Self-monitoring related to "interpretation"		
Factor 1	0.72	0.56
Factor 2	0.76	0.65
Factor 3	0.72	0.56
Factor 4	0.59	0.45
Domain 2 Total	0.89	0.67

DISCUSSION

Since the ESSMHF developed and presented in this study is based on a traditional psychometric rationale, the scale's reliability and validity could be thoroughly evaluated. As a result, the factors of "awareness" and "measurement" indicate whether patients can in fact recognize the extent of the changes in their physical symptoms, in physical activities, and in the status of health condition management. It was therefore considered that Domain 1 should be constructed from the items which measure patients' self-observation of their lifestyle. Factors of "interpretation" show whether they can properly interpret the data that were obtained in relation to "awareness" and "measurement" of Domain 1. Consequently, it was considered that Domain 2 should be constructed from the items which measure patients' understanding in connection with judgment of disease conditions and suitable coping behaviors.

Cronbach's coefficient ranged from 0.53 to 0.84 for all of the subscales, and the internal consistency of the scale was 0.91 for domain 1and 0.89 for domain 2, and secured as the whole. Furthermore, the intra-class correlation coefficient ranged from 0.42 to 0.74, and the ICC of the total score was 0.74 for domain 1 and 0.67 for domain 2. These values were modest and approaching satisfactory when judged against the recommended value of 0.70 or higher (3, 4). The EHFScBS (10) was used to evaluate concurrent validity of the scale. All factors which were predicted to have internal correlation, showed comparatively high correlation with the corresponding items of the EHFScBS. On the other hand, the ESSMHF did not show strong correlation with EHFScBS items 7, 9, 11 and 12. Because these items measure whether self-management activities such as "I take a rest during the day", "I eat a low salt diet", "I get a flu shot every year", and "I exercise regularly", these were not included in the self-monitoring contents. In another words, the EHFScBS measures self-care behavior including patient's self-monitoring and self-management activities related to heart

failure, while the ESSMHF focuses on measurement of self-monitoring details. The characteristic of the ESSMHF is therefore to facilitate an accurate understanding of the features of self-monitoring that are hard to understand with the EHFScBS.

One of the aims of nursing for heart failure patients is to enhance patient's self-care behavior (15). Improved self-care behavior is expected to lead to fewer unplanned readmissions and improved quality of life (2, 5). Self-care is defined as the decisions made and strategies undertaken by the individual in order to maintain a good quality of life, healthy functioning and well being (12). Self-monitoring has focus to the partial process of the self-care, and adequate self-monitoring is the key to enhancement of a patient's self-care behavior. However, many of these patients are still uncertain about the methods necessary for managing their own health, and many patients are hospitalized repeatedly (9, 11, 14). If self-care is not performed appropriately, it is necessary to determine how patients become aware of and measure changes in physical symptoms, physical activities and health management status in relation to heart failure, and interpret the resultant data for an understanding of these changes. Therefore, to lead patients to engage in appropriate self-care behavior, self-monitoring is necessary before appropriate self-care can be achieved. Since the symptoms during exacerbation of heart failure are similar to the body's responses to temporary cardiac stress associated with an increase in strenuousness of activities, we believe that patients cannot judge easily whether disease aggravation is the cause of the symptoms. We therefore consider that, when patients are aware that changes occurring in their body and are able to measure and interpret such changes by self-monitoring, self-care behavior can be enhanced. It will break through the vicious circle of conditions leading to exacerbation of cardiac failure and increase patient's self-care behavior.

In conclusion, since this study offers evidence that the ESSMHF developed in the present study is both reliable and valid, we believe this scale is helpful in assessing conditions related to patient self-monitoring as well as providing support leading to suitable self-management and self-care. In addition, since the details of self-monitoring by patients could be identified with this scale, it is thought that this scale will make it easier for nurses to provide individual support for patients.

This study has several limitations. The sample size and response late of participants were relatively small and the patients were limited to outpatient at a single university hospital in Kobe. Considering these points, self-monitoring might vary under different circumstances or different groups of patients and it must be taken consideration when interpreting our results. We believe further studies with a larger population to verify our findings are warranted, as well as to determine whether this scale can be adapted for patients who speak languages other than Japanese. Also, 37 items of the ESSMHF measures self-monitoring by self-report. This gives the patient the opportunity to answer in a socially desirable way and may not reflect the self-monitoring accurately. In addition, since this study was cross-sectional design, the influences on a long-term prognosis is unknown. Therefore, additional testing is needed to evaluate the correlation with other indirect measures of efficacy such as readmissions and adherence to medication and to prove the association with changes in QOL, because they are similar and influenced by self-monitoring.

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