Insufficient Self-Care Is an Independent Risk Factor for Adverse Clinical Outcomes in Japanese Patients With Heart Failure

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SUMMARY

Self-care is a cornerstone for the successful management of heart failure (HF). The purpose of this study was to examine the impacts of HF self-care on prognosis in Japanese patients with HF. A total of 283 HF outpatients (age 64 ± 14 , 70% male, 52% HF_{rEF}) were enrolled. We asked patients to answer about their adherence to 5 self-care behaviors (medication, eating a low-sodium diet, regular exercise, daily weight check, and treatment seeking behavior). On the basis of the results, we classified patients into a good self-care group and a poor self-care group. The primary outcome was HF hospitalization and/or cardiac death. In total, 65% of patients were classified into the poor self-care group. During a median follow-up of 2 years, cardiac events occurred more frequently in the poor self-care group (22% versus 9.6%, $P = 0.013$). Poor self-care was an independent risk factor for cardiac events in Cox regression analysis adjusted for clinical parameters (hazard ratio = 2.86, $P = 0.005$). Poor self-care was also associated with an increased number of HF hospitalizations as well as an extended length of hospital stay for HF. Poor knowledge about HF was an independent determinant for poor self-care in multivariate logistic regression analysis (odds ratio = 0.92, $P = 0.019$). Insufficient self-care is an independent risk factor for cardiac events in Japanese patients with HF. (Int Heart J 2013; 54: 382-389)

Key words: Compliance, Mortality, Morbidity, Patient education

Mortality from coronary heart disease has been consistently declining over the past several decades. In concert with this decline and aging of the population, the number of patients who are at risk for heart failure (HF) is increasing to the point where now there are > 1.2 million ambulatory care patients in Japan.¹⁾ The course of HF is marked by frequent exacerbations that result in hospitalization, which are costly and contribute to poor quality of life for patients with HF.²⁾ There are multiple modifiable factors known to precipitate hospitalization for HF exacerbation, which includes non-adherence to medications, diet, and failure to seek timely medical care for escalating symptoms.³⁾ For this reason, approximately half of admissions are considered to be potentially preventable with adequate self-care.^{3,4)}

Effective self-care is an essential and adjunctive strategy to evidence-based medical treatment in delaying the progression of HF. Data from a meta-analysis have demonstrated that HF disease management programs aimed at promoting self-care reduced rehospitalization rates and mortality.⁵⁾ HF patients require self-care behaviors to maintain their physiological stability (self-care maintenance) and to respond to symptoms when they occur (self-care management).⁶⁾ HF self-care main-

tenance behavior includes taking medications, eating a low-sodium diet, routine exercise, and symptom monitoring.⁶⁾

With respect to the relationship between such HF self-care behaviors and subsequent clinical outcomes, several studies have shown that poor adherence to medication is associated with adverse events in patients with HF.⁷⁾ However, there are few prospective studies describing the influence of HF self-care behaviors other than medication on health outcomes. Considering that HF patients require multiple self-care behaviors, it would be important to clarify the prognostic impacts of the composite HF self-care behaviors including taking medication, eating a low-sodium diet, and routine exercise. Therefore, the purpose of this study was (1) to examine the relationship between the composite HF self-care behaviors and prognosis, and (2) to explore factors influencing the composite HF self-care behaviors in Japanese patients with HF.

METHODS

Patients and study design: This study was a prospective, observational study of HF outpatients. All consecutive HF outpa-

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tients who were making scheduled visits to the cardiovascular outpatient clinic of one of two independent hospitals between 2006 and 2010 were enrolled. The exclusion criteria were age < 20 years, physical inability to complete the questionnaire, serious psychological distress (as determined by the primary physician), or unwillingness to provide informed consent. Patients were followed-up for 2 years, and they received usual care from their primary care physicians and/or cardiologists. All patients provided informed consent after the purpose of the study was thoroughly explained. The institutional review boards of the University of Tokyo (No. 1445, 1445-1, and No. 2145) and Sakakibara Heart Institute (September, 2010) approved this study.

Measures:

Heart failure self-care behaviors

We examined adherence with 5 HF self-care behaviors on the basis of HF guidelines^{8,10)} and prior studies:^{6,11,12)} (1) taking medication as prescribed, (2) eating a low-sodium diet, (3) daily weight check, (4) regular exercise, and (5) seeking help from health care providers if their feet/legs become more swollen than usual. The first 4 behaviors are required for HF patients to maintain their health status. Although fluid restriction is also important, its necessity depends on the patient's individual pathological condition, such as the severity of HF. For this reason, we did not include its adherence in the study. Self-management behavior is also crucial. Inadequate self-management behaviors cause a delay in seeking treatment. In prior studies, edema was identified as one of the most common symptoms that contribute to a delay in seeking care,^{4,13)} and it predicted a two-fold risk of increased delay.^{14,15)} On the basis of these findings, we decided to examine if the patients sought care when their feet/legs became more swollen.

We asked patients about their adherence with 5 self-care behaviors after referring to prior studies:^{12,16)} "I take my medications as prescribed," "I eat a low salt diet," "I weigh myself every day," "I exercise regularly" and "If my feet/legs become more swollen than usual, I contact my doctor or nurse". Patients answered these questions with a 5 point scale from 1 ("I completely agree") to 5 ("I do not agree at all"). We defined a patient as performing sufficient self-care behavior when they answered the score of 1, and as performing insufficient self-care behavior when they answered the score > 1.

Knowledge about HF

We assessed the level of knowledge about HF using a 15-item Japanese HF knowledge scale, the validity and reliability of which have been confirmed.¹⁷⁾ The scale evaluates patient knowledge regarding HF symptoms, HF related treatment, and self-care such as "HF is a condition in which the heart is not able to pump blood through the body in sufficient amounts," "short-term weight gain is one of the signs of worsening HF" and "salt causes water retention." The items on the scale were represented by questions to which patients could respond with "yes," "no," or "I do not know." A correct answer was scored 1; an incorrect answer or an answer of "I do not know" was scored 0. Scores for each item were summed, giving a range of total scores from 0 to 15. Higher scores indicate greater knowledge about HF.

Demographic and clinical characteristics

The following characteristics of the subjects were investigated: gender, age, marital status, living status, employment, etiology of HF, prior hospitalization with HF, B-type natriuret-

ic peptide (BNP) levels, left ventricular ejection fraction (LVEF), New York Heart Association functional class, systolic/diastolic blood pressure, heart rate, comorbidity such as diabetes mellitus and chronic kidney disease (defined as estimated glomerular filtration rate < 60 mL/minute/1.73 m²) calculated using the Japanese formula, and medication. These data were collected from patients' medical records.

Primary and secondary outcomes

The primary outcome was the composite endpoint of hospitalization for worsening HF and/or cardiac death. Hospitalization for worsening HF was defined as an admission with symptoms or signs of HF. The secondary outcomes included cardiac death, all-cause death, total number of hospitalizations for HF, and length of the hospital stay for HF. The information on outcomes was collected from medical records. We also mailed a follow-up letter to all patients or their family approximately 2 years after the initial assessment to inquire about the patients' clinical outcomes. If the requested information was not received within 4–6 weeks after mailing, we asked the attending physicians about the clinical outcomes.

Statistical analysis: Categorical data are presented as frequencies and percentages. For continuous variables with a normal distribution, the mean and standard deviations are reported. Characteristics of patients were compared using the unpaired *t*-test or Mann-Whitney *U*-test for continuous variables, and the chi-square test or Fisher exact test for categorical variables, as appropriate. With respect to BNP, we first performed logarithmic transformation, and then analyzed the data using parametric methods. The values of BNP are shown after antilogarithm in the results.

To evaluate the impacts of the composite HF self-care behaviors, we created a HF self-care risk score as follows. First, we examined the prognostic effects of each HF self-care behavior using univariate Cox regression analyses. On the basis of the results, we assigned risk scores to the patients, and examined the optimal cut-off value of the risk score using receiver operating characteristics (ROC) curve analysis. Next, we classified the patients into two groups according to the cut-off value. To evaluate the effects of adherence to the HF self-care behaviors on the outcomes, Kaplan-Meier survival curves were developed, using the log-rank test for statistical comparison. Cox proportional hazard models were also used to assess the relationship between the self-care behaviors and the outcomes after adjustment for age, logarithmic BNP, and HF treatment.

To clarify factors influencing the composite HF self-care behaviors, logistic regression analyses were performed. In the multivariate analyses, the variables that were related to self-care at *P* < 0.10 in the univariate analysis were entered into the multivariate model. Age and logarithmic BNP were forcibly inserted into the multivariate model.

All statistical tests were two-tailed, and statistical significance was defined as *P* < 0.05. All analyses were performed with SAS version 9.3 (SAS Institute Inc., Cary, North Carolina, USA).

RESULTS

Baseline characteristics: Of the 312 patients who participated in the survey, 29 were excluded for the following reasons: 21 patients missed items regarding self-care in the questionnaire,

and the follow-up data of 8 patients was not available. Thus, 283 patients were included in the final analysis. The effective response rate was 90.7%.

Demographic and clinical characteristics of the study patients are shown in Table I. The mean age at baseline was 64 years and most patients were male (70%). The median plasma BNP level was 115.7 ± 3.4 pg/mL. Fifty-two percent of study patients had HF with reduced EF (LVEF < 50%). Concerning comorbidity, 30% and 51% had diabetes mellitus and chronic kidney disease, respectively. With regard to medication, beta-blockers and angiotensin-converting enzyme inhibitors (ACEI) and/or angiotensin receptor blockers (ARB) were prescribed in 72% and 66% patients, respectively. The incidences of insufficient adherence to medication as prescribed, eating a low-sodium diet, exercising regularly, daily weighing, and seeking help were 7%, 64%, 62%, 49%, and 70%, respectively.

Self-care and clinical outcomes: The median follow-up was

22.8 months (IQR, 16.6–24.0). During the follow-up period, 48 (22%) patients either died from a cardiac cause or were hospitalized for HF at least once. To investigate the impacts of the composite HF self-care behaviors, we first created an HF self-care risk score. For that purpose, we investigated the relationships between adherence to each HF self-care behavior and outcomes (Table II). Insufficient adherence to exercise was associated with an increased risk of HF hospitalization and/or cardiac death (hazard ratio [HR] 1.94; 95% confidence interval [CI] 1.01–3.72, $P = 0.048$). After adjustment for clinical parameters including age, BNP, beta-blocker use, and ACEI/ARB use, insufficient adherence to exercise remained to predict the cardiac events (HR 1.96; 95% CI 1.01–3.78, $P = 0.046$). Meanwhile, the other 4 self-care behaviors had no significant associations. In the subgroup analyses regarding the 5 self-care behaviors, insufficient adherence to exercise was associated with an increased risk of HF hospitalization and/or

Table I. Characteristics of Study Patients at Baseline

	Total ($n = 283$)	Good Self-Care ($n = 99$)	Poor Self-Care ($n = 184$)	P
<i>Demographic characteristics</i>				
Gender, male	199 (70%)	71 (72%)	128 (70%)	0.706
Age, years	64.3 ± 13.7	65.7 ± 12.5	63.6 ± 14.3	0.214
Age ≥ 65 years	165 (59%)	61 (62%)	104 (57%)	0.407
Marital status, married	205 (73%)	71 (72%)	134 (74%)	0.842
Living alone	33 (12%)	15 (15%)	18 (10%)	0.185
Employment, employed	121 (43%)	35 (35%)	86 (47%)	0.054
HF knowledge score (range, 0–15)	9.9 ± 3.9	10.8 ± 3.7	9.5 ± 3.9	0.010
<i>Cardiac characteristics</i>				
Etiology of HF				0.913
Cardiomyopathy	118 (42%)	41 (41%)	77 (42%)	
Ischemic	72 (25%)	24 (24%)	48 (26%)	
Hypertension	12 (4.2%)	5 (5.1%)	7 (3.8%)	
Valvular heart disease	54 (19%)	18 (18%)	36 (20%)	
Others or unknown	27 (10%)	11 (11%)	16 (8.7%)	
Prior hospitalization for HF	213 (76%)	76 (77%)	137 (75%)	0.723
Heart rate, bpm	70.6 ± 12.6	69.7 ± 13.1	71.1 ± 12.4	0.372
Systolic BP, mmHg	121.1 ± 21.9	120.6 ± 21.0	121.4 ± 22.4	0.782
Diastolic BP, mmHg	68.7 ± 12.9	67.9 ± 11.8	69.2 ± 13.5	0.439
BNP, pg/mL	115.7 ± 3.4	131.8 ± 3.2	108.1 ± 3.5	0.226
LVEF, %	47.6 ± 15.1	46.8 ± 16.3	48.1 ± 14.3	0.482
LVEF < 50%	146 (52%)	55 (56%)	91 (49%)	0.328
NYHA functional class				0.798
I	173 (61%)	63 (64%)	110 (60%)	
II	81 (29%)	27 (27%)	54 (29%)	
III	29 (10%)	9 (9.1%)	20 (11%)	
<i>Comorbidity</i>				
Atrial fibrillation	112 (40%)	40 (41%)	72 (39%)	0.732
Diabetes mellitus	84 (30%)	28 (28%)	56 (30%)	0.706
Chronic kidney disease	144 (51%)	51 (52%)	93 (51%)	0.876
<i>Treatment</i>				
Use of β -blocker	203 (72%)	69 (70%)	134 (73%)	0.577
Use of ACEI and/or ARB	188 (66%)	65 (66%)	123 (67%)	0.840
Use of aldosterone blocker	116 (41%)	37 (37%)	79 (43%)	0.364
CRT-D or CRT-P	10 (3.5%)	4 (4.0%)	6 (3.3%)	0.744
<i>Insufficient adherence</i>				
Taking medication	19 (6.7%)	0 (0%)	19 (10%)	< 0.001
Eating a low-sodium diet	181 (64%)	32 (32%)	149 (81%)	< 0.001
Exercise regularly	175 (62%)	15 (15%)	160 (87%)	< 0.001
Daily weighing	140 (49%)	24 (24%)	116 (63%)	< 0.001
Seeking help	199 (70%)	45 (45%)	154 (84%)	< 0.001

HF indicates heart failure; BP, blood pressure; BNP, B-type natriuretic peptide; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association; ACEI, angiotensin-converting-enzyme inhibitor; and ARB, angiotensin II receptor blocker. Chronic kidney disease was defined as estimated glomerular filtration rate < 60. Values are n (%), mean $\pm$ standard deviation.

Table II. Impacts of Insufficient Adherence to Self-Care Behaviors on Clinical Outcomes in Cox Regression Analysis ($n = 283$)

	Taking medications				Eating a low-sodium diet				Exercise regularly				Daily weighing				Seeking help			
	HR	95% CI	P	P*	HR	95% CI	P	P*	HR	95% CI	P	P*	HR	95% CI	P	P*	HR	95% CI	P	P*
<i>Insufficient adherence versus sufficient adherence†</i>																				
All patients	1.69	(0.67 - 4.25)	0.270	—	1.10	(0.60 - 2.01)	0.756	—	1.94	(1.01 - 3.72)	0.048	—	0.76	(0.43 - 1.35)	0.350	—	1.51	(0.77 - 2.96)	0.232	—
<i>Subgroup analyses</i>																				
Age				0.994				0.283				0.497				0.767				0.495
Age < 65 years	1.76	(0.40 - 7.79)	0.458		0.72	(0.25 - 2.10)	0.543		1.43	(0.46 - 4.49)	0.540		0.66	(0.24 - 1.86)	0.433		1.09	(0.35 - 3.42)	0.883	
Age ≥ 65 years	1.80	(0.55 - 5.88)	0.334		1.47	(0.71 - 3.02)	0.300		2.34	(1.06 - 5.20)	0.036		0.81	(0.41 - 1.60)	0.537		1.81	(0.79 - 4.17)	0.164	
Sex				0.864				0.820				0.643				0.453				0.865
Male	1.63	(0.49 - 5.41)	0.423		1.02	(0.47 - 2.22)	0.955		1.67	(0.74 - 3.79)	0.221		0.93	(0.45 - 1.96)	0.855		1.41	(0.60 - 3.31)	0.436	
Female	1.98	(0.46 - 8.52)	0.361		1.17	(0.45 - 3.04)	0.754		2.29	(0.77 - 6.86)	0.138		0.59	(0.24 - 1.48)	0.260		1.60	(0.54 - 4.79)	0.400	
Marital status				0.717				0.160				0.989				0.893				0.301
married	1.88	(0.67 - 5.31)	0.233		0.89	(0.46 - 1.71)	0.719		1.93	(0.91 - 4.09)	0.086		0.74	(0.39 - 1.42)	0.368		1.26	(0.61 - 2.61)	0.526	
not married	1.22	(0.16 - 9.54)	0.849		4.24	(0.54 - 33.16)	0.168		1.90	(0.50 - 7.15)	0.345		0.82	(0.25 - 2.70)	0.749		3.96	(0.51 - 30.94)	0.190	
Living situation												0.908				0.469				
Living alone	—				—				2.09	(0.19 - 23.00)	0.549		1.77	(0.16 - 19.50)	0.642		—			
Living with someone	1.57	(0.62 - 3.98)	0.343		1.002	(0.54 - 1.84)	0.996		1.87	(0.95 - 3.69)	0.071		0.72	(0.40 - 1.30)	0.270		1.33	(0.67 - 2.61)	0.418	
Employment				0.154				0.469				0.473				0.800				0.210
Employed	0.62	(0.08 - 4.70)	0.646		0.84	(0.31 - 2.26)	0.725		1.45	(0.51 - 4.12)	0.485		0.71	(0.28 - 1.85)	0.484		0.89	(0.29 - 2.73)	0.836	
Unemployed	3.20	(1.12 - 9.17)	0.030		1.32	(0.62 - 2.80)	0.474		2.38	(1.03 - 5.53)	0.043		0.82	(0.40 - 1.68)	0.595		2.19	(0.94 - 5.08)	0.069	

HR indicates hazard ratio; CI, confidence interval; †, reference category; and *, interaction. Other abbreviations as in Table I. We asked patients about their adherences to self-care behaviors with a 5 point scale from 1 ("I completely agree") to 5 ("I do not agree at all"). Patients were defined as performing insufficient self-care behavior when the score was > 1.

Figure 1. Comparisons of (A) the composite endpoint of heart failure hospitalization and/or cardiac death and (B) cardiac death between the poor self-care group and good self-care group.

cardiac death among patients aged 65 or older and unemployed patients (HR 2.34; 95% CI 1.06–5.20, $P = 0.036$; HR 2.38, 95% CI 1.03–5.53, $P = 0.043$, respectively, Table II). The percentage of insufficient adherence to exercise was not different between patients aged 65 or older and patients under 65 years (59% versus 66%, $P = 0.211$), and between unemployed and employed patients (61% versus 63%, $P = 0.709$). Age in unemployed patients was significantly higher than that in employed patients (68.6 ± 11.9 years versus 58.6 ± 14.0 , $P < 0.001$). Concerning medication, insufficient adherence was observed in 9 unemployed patients (5.6%) and 10 employed patients (8.3%), and the percentage was not different between the two groups ($P = 0.382$). Medication compliance was related to clinical outcomes only in unemployed patients (HR 3.20, 95% CI 1.12–9.17, $P = 0.030$). With respect to cardiac death, none

of the HF self-care behaviors were related to the outcome.

On the basis of the above results, we assigned the following risk score to patients if their adherence was insufficient; the adherence to exercise was given one more point than the others: (1) taking medication, 1 point; (2) eating a low-sodium diet, 1 point; (3) daily weighing, 1 point; (4) exercising regularly, 2 points; and (5) seeking help from health care providers, 1 point. A total HF self-care risk score was calculated by adding up the risk scores; the range was from 0 to 6. ROC curve analysis showed that the optimal cut-off point of the risk score was 3 (sensitivity, 0.813, specificity, 0.615). Based on the above results, patients were stratified into two groups: a good self-care group (score ≤ 2 , $n = 99$) and a poor self-care group (3 $\leq$ score, $n = 184$). As shown in Table I, there were no significant differences in demographic and cardiac characteristics,

Table III. Impacts of Adherence to the Composite Heart Failure Self-Care Behaviors on Clinical Outcomes in Cox Regression Analysis ($n = 283$)

	HF hospitalization or Cardiac death			Cardiac Death		
	HR	95% CI	P	HR	95% CI	P
<i>Poor self-care versus good self-care*</i>						
Univariate analysis	2.45	(1.18 - 5.05)	0.016	2.99	(0.66 - 13.48)	0.155
Multivariate analysis†	2.86	(1.37 - 5.97)	0.005	3.98	(0.78 - 20.41)	0.098

* indicates reference category; and †, adjusted variables: age, log BNP, use of beta-blocker, use of ACEI and/or ARB, and the HF knowledge score. Other abbreviations as in Table I and Table II.

except for the HF knowledge score, between the two groups. Patients in the poor self-care group had a significantly lower HF knowledge score than those in the good self-care group (9.5 ± 3.9 versus 10.8 ± 3.7 , $P = 0.010$, Table I).

During a follow-up period of approximately 2 years, the composite endpoint of HF hospitalization and/or cardiac death occurred more frequently in the poor self-care group (22% versus 9.6%, $P = 0.013$, Figure 1A; HR 2.45; 95% CI 1.18–5.05, $P = 0.016$, Table III). After adjustment for age, log BNP, beta-blocker use, ACEI/ARB use, and HF knowledge score, poor self-care was still associated with a 2.9-fold increased risk of the endpoint (HR 2.86; 95% CI 1.37–5.97, $P = 0.005$). On the other hand, there were no significant differences in cardiac death or all-cause death between the poor self-care group and good self-care group (6.1% versus 3.1%, $P = 0.135$, Figure 1B; 7.9% versus 8.0%, $P = 0.637$). With respect to the number of hospitalizations for worsening HF, compared with patients in the good self-care group, patients in the poor self-care group were more frequently hospitalized for HF during the 2-year follow-up (0.14 ± 0.53 versus 0.32 ± 0.76 , $P = 0.021$, Figure 2). In the 2-year follow-up period, 7.6% in the poor self-care group and 3.0% in the good self-care group experienced 2 or more hospitalizations for HF. The length of hospital stay in the poor self-care group was also extended (4.8 ± 16.5 versus 3.9 ± 18.7 , $P = 0.027$).

Determinants of composite HF self-care behaviors: As shown in Table IV, a lower HF knowledge score was associated with poor adherence to the composite HF self-care behaviors in univariate logistic regression analysis (odds ratio [OR] 0.91; 95% CI 0.85–0.98, $P = 0.011$). Being employed was likely to be related the poor adherence (OR 1.64; 95% CI 0.99–2.71, $P = 0.055$). On the other hand, neither severity of HF such as BNP level nor age was related to the poor adherence. In multivariate analysis, a lower HF knowledge score was an independent determinant for poor adherence to the composite HF self-care behaviors (OR 0.92; 95% CI 0.85–0.99, $P = 0.019$).

DISCUSSION

Self-care is considered to be a cornerstone of the successful management of HF. The present study is, to our knowledge, the first to demonstrate an independent association of the composite HF self-care behaviors (taking medication, eating a low-sodium diet, regular exercise, daily weight determination, and treatment seeking behavior) and outcomes in Japanese patients with HF. Interestingly, poor adherence to the composite HF self-care behaviors was also associated with an increased number of hospitalizations due to HF as well as extended length of hospital stay for HF. Moreover, only adherence to regular exercise was associated with clinical outcome. Our

Figure 2. Comparisons of the total number of hospitalizations for HF in two years between the poor self-care group and good self-care group. P by Wilcoxon rank sum test.

findings confirm that adequate HF self-care practice is crucial to improve clinical outcomes, and suggest that HF interventions are more likely to be effective if they include a strong component of regular exercise.

It is noteworthy that there were no significant associations between each HF self-care behavior other than exercise and subsequent outcomes, although the composite HF self-care behaviors predicted HF hospitalization and/or cardiac death. This relationship remained significant after adjustment for clinical parameters that included age, BNP, and HF treatment. Similar findings were obtained from the previous study by van der Wal, *et al.*¹⁸⁾ They found that insufficiencies in 4 self-care behaviors, specifically daily weighing, sodium restricted diet, fluid restriction, and exercise, were associated with a 1.4-fold increased risk of mortality or HF readmission. This similarity in results indicates that an accumulation of insufficient self-care behaviors is a strong risk factor for poor prognosis among patients with HF.

In addition to time to first cardiac event, we found that poor adherence to the composite HF self-care behaviors caused an increase in the number of hospitalizations for HF. The number of repeated hospitalizations has been shown to be a strong predictor for mortality.¹⁹⁾ Hospitalization itself may not only be the consequence of worse prognosis but may contribute to worse outcome. Large doses of intravenous diuretics,

Table IV. Factors Influencing Poor Adherence to the Composite Heart Failure Self-Care Behavior in Logistic Regression Analyses (*n* = 283)

	Univariate analysis			Multivariate analysis		
	OR	95% CI	<i>P</i>	OR	95% CI	<i>P</i>
<i>Demographic characteristics</i>						
Gender, female versus male*	1.11	(0.65 - 1.90)	0.706			
Age, per 10 years	0.89	(0.74 - 1.07)	0.214	0.87	(0.68 - 1.10)	0.239
≥ 65 years versus < 65 years*	0.81	(0.49 - 1.33)	0.407			
Marital status, married versus others*	1.06	(0.61 - 1.82)	0.842			
Employment, employed versus unemployed*	1.64	(0.99 - 2.71)	0.055	1.35	(0.74 - 2.46)	0.325
HF knowledge score	0.91	(0.85 - 0.98)	0.011	0.92	(0.85 - 0.99)	0.019
<i>Cardiac parameters</i>						
Ischemic etiology of HF	1.10	(0.63 - 1.94)	0.734			
Prior hospitalization for HF	0.90	(0.51 - 1.60)	0.723			
Heart rate, bpm	1.01	(0.99 - 1.03)	0.371			
Systolic BP, mmHg	1.002	(0.99 - 1.01)	0.781			
Diastolic BP, mmHg	1.01	(0.99 - 1.03)	0.438			
Log BNP, pg/mL	0.88	(0.71 - 1.09)	0.226	0.94	(0.74 - 1.19)	0.602
LVEF, %	1.01	(0.99 - 1.02)	0.480			
< 50% versus ≥ 50%*	0.78	(0.48 - 1.28)	0.328			
NYHA functional class, III versus I or II*	1.22	(0.53 - 2.79)	0.638			
<i>Comorbidity</i>						
Atrial fibrillation	0.92	(0.56 - 1.51)	0.732			
Diabetes mellitus	1.11	(0.65 - 1.90)	0.706			
Chronic kidney disease	0.96	(0.59 - 1.57)	0.876			
<i>Treatment</i>						
β-blocker	1.17	(0.68 - 2.00)	0.577			
ACEI and/or ARB	1.06	(0.63 - 1.77)	0.839			
Aldosterone blocker	1.26	(0.76 - 2.08)	0.365			
CRT-D or CRT-P	0.80	(0.22 - 2.91)	0.735			

OR indicates odds ratio; and *, reference category. Other abbreviations as in Table I and Table II.

and in particular inotropic therapy, even when used for short periods in hospital, have been associated with myocardial troponin leak, worsening renal function, and subsequent adverse outcomes.²⁰⁾ Thus, promoting HF self-care practice may lead to a better prognosis as well as preventing worsening HF. Given the finding that HF knowledge is an independent predictor for poor self-care behaviors, intervention aimed at increasing HF knowledge may play a pivotal role in successful management of HF.^{21,22)}

Consistent with results from earlier studies,¹⁸⁾ we found a significant association of exercise adherence with the outcomes. Although patients with better adherence to exercise were likely to be in a good condition. Even after adjustment for the severity of HF such as BNP level the relationship remained significant.

In the subgroup analysis, a positive association of sufficient exercise adherence with a better prognosis was observed in patients aged 65 or older and unemployed patients. Unemployed patients were significantly elderly in the present study, probably because most Japanese people leave their job at the age of 65. Engaging in a job is an important physical activity, and as most patients get older, their daily activity levels decrease. For this reason, unemployed patients and elderly patients may have lower levels of daily physical activity; therefore, exercise adherence is more likely to have an effect on their clinical outcomes. Further investigation with more detailed data such as physical activity levels and exercise tolerance is necessary to confirm this. There is robust evidence that exercise intervention reduces hospitalizations due to HF and improves quality of life among patients with HF.²³⁾ Nonetheless, implementation in clinical practice has been poor.²⁴⁾ Ad-

herence to exercise was approximately 40% in the present study, which is similar to the findings from the COACH study.²¹⁾ Many patients still mistakenly believe exercising is contraindicated,²⁵⁾ and more than 90% of patients needed information about exercise and physical activity.²⁶⁾ Taking into consideration these findings, it is extremely important to provide information on how to develop an exercise plan that fits into one's daily life as well as how to address barriers for non-adherence to exercise in daily clinical practice.

Several classes of HF medications target neurohormonal activations. Taking HF medication is therefore associated with partial neurohormonal deactivations, which contributes to slowing the progressive nature of cardiac remodeling and improvement in survival.²⁷⁾ Actually, poor medication adherence predicted cardiac events among unemployed patients in the present study. Although we found no significant relationship between employment status and medication adherence, a study has shown that as total household income decreased, medication adherence decreased.²⁸⁾ Some unemployed patients who had financial problems adhered less to their medication regimens, which might have led to the poor prognosis in the study. Consistent with findings obtained from several investigators,^{7,29)} approximately 90% of patients reported that they took medications as prescribed. The study by Wu, *et al* has shown that there was a gap between self-reported adherence and objectively measured adherence, and only objectively measured adherence to medication was related to patient outcomes.⁷⁾ Although we failed to find a significant relationship between self-reported medication adherence and outcomes among employed patients, future study with objectively measured adherence is necessary. In view of increasing use of technology for poor

medication adherence, integrating technology-based reminders with in-person communication may help to improve health outcomes in patients with HF.³⁰⁾

With respect to restricting sodium intake, several investigators have documented that excess sodium intake was a precipitating factor for acute hospitalization;^{3,31)} however, few clinical trials have examined a low-sodium diet in HF patients. The recent study of Son, *et al* found that HF patients with a sodium-restricted diet, determined by a 24-hour urinary sodium excretion < 3 g, had a longer event-free survival.³²⁾ In Japanese people, average daily salt intake has been reported to be 10.5 g/day (4.1 g/day in sodium equivalents).³³⁾ There may be a cultural difference in self-care regarding salt intake. Future research on dietary salt intake is necessary among Japanese patients with HF.

Recently, delay in seeking treatment has been attracting attention, because it results in many unnecessary admissions. This delay may be due to a failure to routinely monitor symptoms or an inability to cope appropriately with those symptoms. Unfortunately, only half of the patients in the present study reported weighing themselves daily, and many less sought care when their feet/legs became more swollen than usual. Similar findings were obtained from previous studies.¹¹⁾ Patients should be educated regarding self-monitoring and coping behavior in order to detect early clinical deterioration, and receive early treatment for HF, which may contribute to improvement in health outcomes such as shorter hospitalizations, lower mortality, and reduced health care costs.

Regarding factors influencing HF self-care adherence, HF knowledge was a predictor for the adherence, which is consistent with previous studies.^{21,22)} On the other hand, our finding that there was no significant association between age and self-care adherence is not in agreement with earlier results.^{11,25)} Several studies have reported that elderly patients had better adherence than younger patients.²⁵⁾ This inconsistency may be because our study population was relatively young. Although our study was focused on clinical and demographical parameters, psychological parameters are known to be important predictors for self-care adherence.^{25,34,35)} Given that discrepancies in the impacts of psychological factors such as depression, cognitive function, and self-efficacy on self-care adherence have been reported,^{25,35,36)} future study should focus on such factors.

Limitations of the study: Several limitations should be noted. First, we collected information on self-care adherence with a self-administered questionnaire, so the patients may have overestimated their adherence in an effort to provide socially desirable answers. However, we showed the significant impact of poor adherence. Next, several HF self-care behaviors such as fluid management were not included in our analysis, because their need depends on the pathophysiological conditions of the patient. Future investigations are needed to clarify prognostic impacts of HF self-care behaviors according to HF severity. Finally, although we showed that HF knowledge was only a predictor of the composite HF self-care adherence, we could not comprehensively examine factors related to the adherence. Other psychosocial characteristics and relationships with healthcare providers and supportive family members might have influenced the adherence.

Conclusions: We demonstrated that an accumulation of insufficient self-care behaviors was an independent risk factor for

HF hospitalizations and/or cardiac death in Japanese patients with HF. We also found that poor adherence to the composite HF self-care behaviors was associated with an increased number of hospitalizations due to HF as well as extended hospital stays for HF. Inadequate knowledge about HF was an independent determinant of poor adherence to the HF self-care behaviors. Our findings suggest that patient education emphasizing HF self-care behaviors is indispensable for successful management of HF in Japan.

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