Heart Failure

Establishment of a Weight Management Scale for Patients with Congestive Heart Failure

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Purpose: The aim of this study was to develop a rating scale for the weight management of patients with congestive heart failure (CHF).

Methods: The original pool of items was created through in-depth interviews and a literature review. Scale validity was analyzed based on face validity, content validity, and structure validity. The content validity and structure validity were evaluated. The overall internal consistency reliability were assessed by using Cronbach’s alpha and retest reliability test.

Results: A total of 190 CHF patients were enrolled but 5 refused. The original 19 items were then refined to a scale of 16 items. The final scale included four factors (weight monitoring, knowledge, confidence, and behaviours related to weight management), which accounted for 58.7% of the variance. Content validity ratio on the content validity was 0.88. The Cronbach’s alpha was 0.843 and the retest reliability was 0.833.

Conclusions: The Chinese CHF-related weight management scale developed has high reliability and validity.

Key Words: Congestive heart failure • Reliability • Scale • Validity • Weight management

INTRODUCTION

Congestive heart failure (CHF), a public health problem affecting all ages,1 is the final outcome of many heart diseases. CHF has high incidence as well as high morbidity and mortality.2-4 The prevalence of CHF in China has gradually increased, and the conservative estimate of the number of Chinese patients with heart failure (HF) is approximately 4 million.5 This number is approximately 5.7 million in United States.3 Although significant progress has recently been achieved in CHF drug treatment, the control of patient conditions remains unsatisfactory, and the readmission rate of patients with CHF three to six months after discharge ranges from 15% to 30%.6-8 Ditewig et al.3 found that self-management interventions are beneficial to the reduction of readmission rate and mortality of CHF patients. However, self-management has many requirements, some of which are not applicable to patients with relatively low educational levels or those who lack family support.9

The research team previously found that although self-management can reduce the hospitalization rate of patients with HF,10 patients with low educational levels show poor compliance to the requirements of self-management. Self-management of patients with CHF is mainly based on clinical signs and symptoms,11 where fluid retention is considered an important clinical sign. The European Society of Cardiology guidelines recommend that when the weight gain of a patient exceeds 2 kg within a short time (3 days), the patient should visit an outpatient clinic or the diuretic dosage should be adjusted. Likewise, the water/sodium intake should be controlled.12 The American Heart Association guidelines...
state that weight monitoring is the cornerstone of CHF self-management intervention.\textsuperscript{11,13} Given the increased volume load, the detection of clinical symptoms often requires 4 to 8 hours. Timely detection of weight gain and administration of appropriate treatment can effectively prevent disease progression, thereby reducing hospitalization frequency.\textsuperscript{14} Martje reported that 48\% of CHF patients believed that weighing themselves daily can reduce readmission rates. However, only 33\% of the patients with CHF are weighed daily because of the lack of supervision and guidance.\textsuperscript{15} A survey by Tian et al.\textsuperscript{16} showed that 46.7\% of CHF patients are never or rarely weighed. Therefore, our research team is the first to propose the weight management (WM) of CHF patients as part of self-management, both in China and abroad. The proposed method is economic, simple, objective, and easy to operate. However, no effective tools are available to evaluate the patient’s level of WM. This study aimed to establish a WM scale with high reliability and validity for CHF patients. This scale is intended for clinical use and for future nursing research studies.

**MATERIALS AND METHODS**

**Theoretical framework and conceptual definition**

The theoretical framework of self-management for CHF patients was established through a literature review.\textsuperscript{17} Fluid retention is an important clinical sign of CHF. Immediate detection and proper handling of weight increase to keep the body weight stable can effectively prevent CHF aggravation, thereby reducing hospitalization frequency.\textsuperscript{12} Qualitative studies also showed that weight monitoring is an important factor of self-management. WM differs from single weighing. In a self-management method, patients are allowed to monitor their own weight closely and to adjust their intake of medication, water, or salt according to their weight change. Consequently, patients’ weight becomes stable within the relatively normal range and thus improves CHF prognosis.

**Concept of WM**

According to the theory of knowledge-attitude/belief-practice, health care knowledge and information are the foundations for active and proper belief and attitude establishment, which can further affect health-associated behavior, whereas belief and attitude are the motivating power before behavior change. Patient can actively form health-giving behavior and then acquire good health only after learning about health knowledge and establishing active and correct beliefs and attitudes.\textsuperscript{18} As an important factor of self-management, WM differs from the concept of a patient who only weighs himself. WM implies that CHF patients know how to monitor their weight correctly and closely by themselves. The patients use available knowledge to cope with abnormal weight gain and obtain a positive attitude toward the practice of WM measures, which eventually decreases their admission rates because of their improved prognosis. WM interventions include: (1) the use of a WM booklet containing information on the association among weight gain, edema, and increased HF knowledge as well as the proper methods of monitoring weight and edema, the concept of abnormal weight gain, foods rich in salt and potassium, potassium sparing, efflux potassium diuretics, and the usual side effects of common diuretics such as tiredness, abdominal distention, and cardiac arrhythmia; (2) the emphasis on weighing daily or more than three times per week (according to the concept of weight gain > 2 kg within 3 days)\textsuperscript{11} and the delivery of booklets and record sheets to HF patients; (3) the recording of weight values to identify abnormal changes in patients’ weight; and (4) the coping measures including control of water and salt intake, with reasonable additions or diuretic intake upon consultation with a doctor.

**Content validity**

The item pool was derived from two sources: (1) in-depth interviews with 10 CHF patients to obtain their WM practices with a phenomenological study by the researcher; and (2) a combined system review of 56 local and foreign publications. The initial questionnaire included a total of 20 items in three sections. Using the Delphi method, seven chief physicians of cardiovascular medicine, six clinical nurses/nursing educators, one nutritionist, one psychologist, and two teachers with experience in scale development were invited for two sessions of face-to-face consultation (or written com-
munication) to evaluate or modify the item pool. The experts were asked to evaluate whether each item in the scale was a logical representative of the content to be measured. The Content Validity Ratio (CVR) was calculated for each item in accordance with the formula proposed by Lawshe:20

\[ CVR_i = \frac{2(n_e - N/2)}{N} \]

where \( n_e \) denotes the number of experts completely in agreement with the content of entry \( i \), and \( N \) stands for the total number of experts. Five CHF patients were then invited to evaluate the readability of the item pool. Items that were repeated, ambiguous in meaning, and irrelevant were deleted. The contribution of individual items in each dimension was adjusted. Finally, a pre-test scale with 19 items was established.

**Scale structure and scoring**

The subscale form was adopted in establishing the questionnaire. The initial scale for WM included the following dimensions: “behavior management,” “belief management,” and “knowledge management.” Finally, the dimensions were amended or confirmed by factor analysis. The response items in the behavior management subscale used a Likert 4-grade scoring system. The scores for “never,” “sometimes,” “often,” and “always” were 0, 1, 2, and 3 points, respectively. Similarly, the response items in the belief management subscale had a Likert 4-grade scoring system. The scores for “complete lack of confidence,” “somewhat confident,” “confident,” and “completely confident” were 0, 1, 2, and 3 points, respectively. The response items in the knowledge management subscale used a Likert 3-grade scoring system. A higher score indicated a higher level of WM management.

**Sample tests**

The questionnaire investigators were uniformly trained, including the researcher and two graduate students who assisted in the study. Before administering the survey, its objectives and methods were explained to the participating CHF patients and their informed consent was obtained. All investigators were familiar with the contents of the questionnaire and assisted patients who could not correctly fill in the questionnaire. The time required to complete the questionnaire was approximately 10 min to 20 min.

Sample size was calculated based on an estimate of 10 observations per item20 for a total of 190 targeted participants. From October 2011 to March 2012, 190 CHF patients were selected from five Class-3 Grade-A hospitals in Jiangsu, Zhejiang, and Shanghai (50 cases from two hospitals in Shanghai, 104 cases from three hospitals in Suzhou, 21 cases from one hospital in Changzhou, and 21 cases from one hospital in Zhejiang). The following inclusion criteria were used: 1. confirmatively diagnosed with CHF for a course of more than 1 month; 2. cardiac function status was classified into grade II to IV according to cardiac function grading assessment by the New York Heart Association (NYHA); 3. age \( \geq 18 \) years old; and 4. could freely communicate, having given their informed consent to participate in the research. The exclusion criteria included: 1. patients with mental disorder or cognitive dysfunction; 2. patients with acute CHF (acute left ventricular failure and cardiogenic shock) or transient HF (pregnancy of HF, acute myocardial infarction of HF, etc.); and 3. patients with other organ diseases and tumors such as in the liver and kidneys.

**Structure validity and internal consistency coefficient**

The structure validity was analyzed using exploratory factor analysis.21,22 The criterion used for item selection were the following: 1) sample data with Kaiser-Meyer-Olkin (KMO) < 0.5 are not suitable for factor analysis; 2) eigen value > 1 is taken to screen the number of factors; 3) items with factor loading coefficient < 0.4 are deleted; 4) an item’s critical ratio is significant when \( p < 0.05 \); and 5) correlation coefficients of items and scale and those of subscales and the total scale are analyzed, and \( p < 0.05 \) is considered significant.

Cronbach’s alpha and re-test reliability were used for the overall internal consistency reliability of the instrument.23 Cronbach’s alpha over 0.70 for the scales and 0.6 for the subscales were adopted, whereas 0.70 was set for the re-test reliability.

**Ethical considerations**

Approval to conduct the study was obtained from the Ethics Committee of the First Affiliated Hospital of Soochow University. Subjects willing to participate signed a written informed consent form. All subjects were assured of confidentiality and the right to decline participation from the study.
Statistical analysis
SPSS 17.0 software was used for data entry and analysis. Exploratory factor analysis was employed to evaluate the construct validity of the scale. The critical ratio (CR), which indicates whether the entry decision value was used to analyze the items, as well as values with \( p > 0.05 \), was deleted. The correlations between each item and total score as well as between each section and total score were analyzed using Pearson correlation analysis. Items with a coefficient less than 0.4 were deleted. The internal consistency reliability and re-test reliability were used as indicators of reliability.

RESULTS
Participant characteristics
Overall, 190 copies of questionnaires were distributed, but five patients refused to fill in the questionnaire. Thus, only 185 valid questionnaires were recovered for an effective rate of 97.4%. The ages of patients ranged from 38 years to 93 years, with an average of 70.0 ± 11.6 years. Among the patients, 112 cases (60.5%) were male, whereas 81 cases (43.8%) attained an educational level of primary school or below. Two patients were divorced, whereas eight patients (5.4%) were widowed. The following NYHA grading scheme was used: grade II with 36 cases (19.5%), grade III with 98 cases (53.0%), and grade IV with 51 cases (27.6%) (Table 1).

Surface validity and content validity
In this scale, subscales and the item pool were drafted based on the literature and on interviews with CHF patients. Thereafter, two sessions of Delphi expert consultation were held. The average CVR of the scale was 0.88.

Structure validity
CR analysis results were consistent with the results of correlation analysis between the entry and total score. The CR value and correlation coefficient for one of the entries (whether confidence in eating less or not eating high-salt food exists) showed no statistical significance. The KMO measure of sampling adequacy for the other 18 items was 0.835, which indicated that these items were suitable for factor analysis. However, two items (average daily fluid intake and salt intake in the “knowledge management” section) had relatively low factor loadings. Therefore, these items were deleted. The load of the remaining items ranged from 0.563 to 0.862. The original scale was subjected to three sections of Scree plot and analysis. The items were grouped into four factors: weight monitoring (three items), WM knowledge (four items), belief (four items), and behavior management (five items), contribution ratios of which were 31.9%, 12.5%, 7.4%, and 6.8%, respectively. The final scale had 16 items. The cumulative variance contribution rate, which represents the explainable variation, was 0.587.

Furthermore, the structure validity of the scale was examined according to the correlation coefficient between each subscale and the total score. The results showed that the correlation coefficients ranged from 0.693 to 0.835, which indicates high structure validity (Table 2).

Internal consistency coefficient
The internal consistency coefficient of the total scale, known as the Cronbach’s α coefficient, was 0.843. The internal consistency coefficients of the weight monitoring, WM knowledge, belief, and behavior management sections were 0.608, 0.755, 0.790, and 0.677, respectively.

Re-test reliability
Twenty CHF patients (number of valid questionnaires = 18) (Table 1).

<table>
<thead>
<tr>
<th>Table 1. The descriptive statistics of the sample (n = 185)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline items</td>
</tr>
<tr>
<td>Male [n (%)]</td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>Education [n (%)]</td>
</tr>
<tr>
<td>Primary school or below</td>
</tr>
<tr>
<td>Middle and high school</td>
</tr>
<tr>
<td>&gt; high school</td>
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<tr>
<td>Marital status [n (%)]</td>
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<tr>
<td>Married</td>
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<tr>
<td>Widowed</td>
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<tr>
<td>Divorced</td>
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<tr>
<td>NYHA functional class [n (%)]</td>
</tr>
<tr>
<td>Grade II</td>
</tr>
<tr>
<td>Grade III</td>
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<tr>
<td>Grade IV</td>
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</tbody>
</table>

NYHA, New York Heart Association.
naires was 20) were randomly selected, and a second measurement using same scale was performed one week after the first measurement. However, only the WM scale was re-tested in the second measurement. The re-test reliability values of the weight monitoring, WM knowledge, belief, and behavior management sections were 0.794, 0.885, 0.703, and 0.711, respectively, whereas that of the total scale was 0.833. All values were statistically significant, which indicates that the scale has high stability.

**DISCUSSION**

This study aimed to establish an evaluation tool for the WM ability of CHF patients by assessing their WM behavior. In the process of compiling the scale, literature review, interviews, expert consultations, actual investigation (via test-re-test), and statistical methods were used to ensure the validity and precision of the tool.

This scale was established for future use in clinical and nursing research studies. Therefore, representative samples must be used in the development and establishment of a WM scale for CHF patients. In this study, the convenience sampling method was adopted with strict inclusion criteria. CHF patients from different regions, different hospitals, and different medical treatment environments were included in the study, thereby making the samples better representatives of the region. In addition, the sample size of this study was 185, which complied with the sample size requirements for the assessment of the characteristics of a measuring scale, thereby supporting the reliability of the findings.

The internal consistency coefficient, also known as Cronbach’s $\alpha$ coefficient, was used to reflect the internal consistency of the research tools. The Cronbach’s $\alpha$ coefficient of the scale in this study was within the acceptable limits. The Cronbach’s $\alpha$ coefficient of the four dimensions were all above 0.60, which indicates that the tool had high internal consistency. The re-test reliability, which was used to reflect the stability of re-

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### Table 2. Results of structure validity analysis

<table>
<thead>
<tr>
<th>Items</th>
<th>Critical ratio (CR)</th>
<th>Correlation coefficient of each individual item and total score</th>
<th>Correlation coefficient of each subscale total and total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight monitoring dimension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight measurement frequency</td>
<td>6.984*</td>
<td>0.634*</td>
<td></td>
</tr>
<tr>
<td>Correct weight measuring method</td>
<td>4.776*</td>
<td>0.485*</td>
<td>0.708*</td>
</tr>
<tr>
<td>How much kg weight gains within 3 days I will take measures or seek medical service?</td>
<td>4.136*</td>
<td>0.477*</td>
<td></td>
</tr>
<tr>
<td>Behavior dimension related to WM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When weight gains, I will take diuretics at a larger dosage</td>
<td>8.738*</td>
<td>0.629*</td>
<td></td>
</tr>
<tr>
<td>Urine output measurement frequency</td>
<td>8.568*</td>
<td>0.644*</td>
<td></td>
</tr>
<tr>
<td>Frequency of checking whether leg has edema</td>
<td>10.082*</td>
<td>0.580*</td>
<td>0.835*</td>
</tr>
<tr>
<td>Frequency of low-salt diet</td>
<td>6.498*</td>
<td>0.505*</td>
<td></td>
</tr>
<tr>
<td>When weight gains, I will reduce the frequency of water intake</td>
<td>7.355*</td>
<td>0.634*</td>
<td></td>
</tr>
<tr>
<td>Belief dimension related to WM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce number of hospitalizations through WM</td>
<td>7.373*</td>
<td>0.504*</td>
<td></td>
</tr>
<tr>
<td>Monitor condition through WM</td>
<td>7.956*</td>
<td>0.580*</td>
<td>0.693*</td>
</tr>
<tr>
<td>To control weight</td>
<td>7.540*</td>
<td>0.488*</td>
<td></td>
</tr>
<tr>
<td>Able to the daily weigh body weight</td>
<td>8.579*</td>
<td>0.598*</td>
<td></td>
</tr>
<tr>
<td>Knowledge dimension related to WM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High potassium food</td>
<td>6.934*</td>
<td>0.471*</td>
<td></td>
</tr>
<tr>
<td>Symptoms of hypokalemia</td>
<td>9.912*</td>
<td>0.640*</td>
<td>0.744*</td>
</tr>
<tr>
<td>High-salt food</td>
<td>5.850*</td>
<td>0.428*</td>
<td></td>
</tr>
<tr>
<td>Main side effects of hydrochlorothiazide or furosemide</td>
<td>6.934*</td>
<td>0.611*</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.001. CR means the entry decision value of items.
search tool, was acceptable. The measured variable was the WM behavior of patients with CHF before admission, which was stable. An interval of one week was used as re-test interval, after which the content of the test was assumed to have been forgotten. Both measurements were conducted in the ward by the same researcher. The re-test reliability coefficient of the total scale and of the four revised sections was also within the limits, which indicates that the tool had satisfactory stability.

The CHF patients in this study were involved in the establishment of the entry pool. The language used by the patients was incorporated into the items as much as possible, to ensure readability and suitability. Consequently, the scale was expected to have high surface validity. Seventeen cardiovascular professionals in clinical medicine, nursing, nutrition, and education were invited as experts in this study to evaluate and modify the appropriateness, logic, and representativeness of the items. For example, whether the items are clear and unambiguous or whether each entry had covered the various aspects of the intended field to be measured. Finally, by integrating the comments from the experts, the CVR of the scale was deemed sufficiently high (high content validity). Each entry could accurately express the contents of the item to be measured. Furthermore, the structure validity of the scale was established by factor analysis (except for the item deletion standards that comply with the results shown in the text). Three items were removed from the original scale, and four factors (sections) were extracted. The contribution of variance reached 58.7%. The appropriateness indicators were satisfactory and in line with the theoretical predictions.

A significant increase in patients' body weight is an important indicator of increased HF. Once the diagnosis of HF was confirmed, patients were required to monitor their daily weight fluctuations. If the fluctuations were extremely large, the patient should immediately seek medical treatment. Alternatively, the patient should make appropriate changes to his diet, medication, and any other treatment. Thus, WM is an important factor in the self-management of CHF. For elderly patients with low educational levels, serious illness, or low compliance of self-management, the WM presented in this study is a simple, objective indicator that is easy to implement. Vander et al. reported that although 48% of CHF patients say that daily weight monitoring can reduce readmission rate, the majority of patients with CHF give little attention to WM because of the lack of effective supervision and guidance. The study of Vander et al. also revealed that only 33% of patients with CHF are weighed daily, whereas a fewer number of patients take the appropriate measures in response to abnormal body weight changes. Thus, studies on the effects of WM on the prognosis of patients with CHF are important. Our study provides an evaluation tool that supplements the self-management of CHF for relevant future studies.

Future directions

By using the successfully established measurement tool in this study, we will further investigate and analyze the correlation between the WM capacity of CHF patients and prognosis, as well as WM compliance. Furthermore, an appropriate intervention study will be conducted to explore effective methods for the WM capacity improvement of CHF patients.

CONCLUSIONS

The complexity of CHF self-management items causes part of the population, including low-educated patients, to be unable to adhere to the process. Thus, a simple and effective intervention that considers this factor is needed. Corresponding tool development is the premise of intervention efficacy evaluation. Given that the severity level of CHF is correlated with fluid retention, a study on WM scales is necessary. In this study, a WM scale for CHF patients was successfully established. This scale has a good reliability and validity, making it suitable for application in evaluating the WM capacity of CHF patients.

ACKNOWLEDGMENT

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ATTACHMENT

Weight Management Questionnaire (scores)

1. Weight monitoring
   1.1 How often do you weight yourself?
      □ Never/Rare (0) □ Sometimes (1) □ Frequently (2) □ Always/Daily (3)
   1.2 I know how to weight myself correctly.
      □ I don’t know (0) □ I’m not sure (1) □ I’m sure (2)
   1.3 In the case of sudden weight gain of ___ kg, I should adjust diuretics or contact my doctor.
      □ I don’t know (0) □ I’m not sure (1) □ I’m sure (2)

2. Knowledge
   2.1 The major side effect of diuretics is ___ ?
      □ I don’t know (0) □ I’m not sure (1) □ I’m sure (2)
   2.2 The symptoms of hypokalemia
      □ I don’t know (0) □ I’m not sure (1) □ I’m sure (2)
   2.3 Potassium-rich foods that can prevent hypokalemia
      □ I don’t know (0) □ I’m not sure (1) □ I’m sure (2)
   2.4 Sodium-rich foods that I should try to avoid to eat
      □ I don’t know (0) □ I’m not sure (1) □ I’m sure (2)

3. Confidences
   3.1 I can maintain a stable body weight
      □ I cannot (0) □ I’m not sure (1) □ I’m sure (2) □ I’m very sure (3)
   3.2 I can weight myself every morning
      □ I cannot (0) □ I’m not sure (1) □ I’m sure (2) □ I’m very sure (3)
   3.3 I can manage heart failure through weight monitoring
      □ I cannot (0) □ I’m not sure (1) □ I’m sure (2) □ I’m very sure (3)
   3.4 I can reduce readmission through weight monitoring
      □ I cannot (0) □ I’m not sure (1) □ I’m sure (2) □ I’m very sure (3)

4. Behaviors related to weight monitoring
   4.1 I keep low-salt diet
      □ Never/Rare (0) □ Sometimes (1) □ Frequently (2) □ Always/Daily (3)
   4.2 I observe my urinary volume
      □ Never/Rare (0) □ Sometimes (1) □ Frequently (2) □ Always/Daily (3)
   4.3 I check ankle edema
      □ Never/Rare (0) □ Sometimes (1) □ Frequently (2) □ Always/Daily (3)
   4.4 I take additional dose of diuretics when I had sudden weight gain
      □ Never/Rare (0) □ Sometimes (1) □ Frequently (2) □ Always/Daily (3)
   4.5 I reduce fluid intake when I had sudden weight gain
      □ Never/Rare (0) □ Sometimes (1) □ Frequently (2) □ Always/Daily (3)