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Development and Initial Validation of the Heart Failure Symptom Management Motivation Instrument (HF-SMMI) for Older Adults

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Abstract

Background: Heart failure (HF) self-management requires motivation to initiate and sustain symptom-management behaviors. However, no instrument specifically assesses motivation for HF symptom management. This study reports the development of the Heart Failure Symptom Management Motivation Instrument (HF-SMMI) and evaluates its preliminary psychometric properties.

Methods: The HF-SMMI was informed by Self-Determination Theory, the Treatment Self-Regulation Questionnaire, standardized nursing terminologies, and HF self-management evidence. It assesses autonomous motivation, controlled motivation, and amotivation across 20 behaviors addressing edema, fatigue, dyspnea, anxiety, and depression. Nine HF experts and 10 older adults with HF evaluated content validity through two Delphi rounds and cognitive interviews, respectively. The instrument was then pilot-tested with 110 older adults with HF from an outpatient clinic. Analyses included content validity indices, Cronbach's alpha coefficients, item-total correlations, floor and ceiling effects, and exploratory Spearman correlations between symptom concerns and motivation scores.

Results: The HF-SMMI demonstrated excellent content validity (Scale-Content Validity Index= .92 for relevance and .88 for clarity). Cognitive interviews resulted in revisions to 10% of items. Cronbach's alpha coefficients were .85, .87, and .77 for autonomous motivation, controlled motivation, and amotivation, respectively. Greater concern regarding edema, fatigue, dyspnea, and anxiety was associated with higher autonomous motivation (ρ=.20-.28, all $p<.05$). Greater concern regarding dyspnea and anxiety was associated with lower

amotivation (ρ=-.19 and -.25, respectively; both p<.05). Floor effects were observed only for amotivation (4.5%), whereas ceiling effects were observed only for autonomous motivation (1.8%), both well below the 15% threshold for problematic floor or ceiling effects.

Conclusions: The HF-SMMI demonstrated strong content validity, acceptable internal consistency, and preliminary evidence of construct validity. Findings support the assessment of autonomous motivation, controlled motivation, and amotivation at the symptom level among older adults with HF. Future studies in larger and more diverse samples are needed to examine factor structure, construct validity, test-retest reliability, responsiveness, and Rasch measurement properties.

Keywords: heart failure; instrument development; motivation; older adults; psychometric evaluation; self-determination theory; self-management; validity and reliability.

Development and Initial Validation of the Heart Failure Symptom Management Motivation Instrument (HF-SMMI) for Older Adults

Introduction

Heart failure (HF) is the leading cause of hospitalization among older adults and is projected to affect over 7 million adults over the age of 65 within five years [1,2, 3]. Inpatient hospitalizations account for nearly 50% of HF-related healthcare costs, estimated to reach $35 billion by 2030 [4]. Alarmingly, 25% of patients with HF are readmitted within 30 days [2], and nearly two-thirds of patients are readmitted within a year of discharge [5]. The high readmission rate prompts the Centers for Medicare and Medicaid Services (CMS) to penalize hospitals with excessive readmissions [6].

The aging population and high prevalence of HF risk factors further contribute to the growing number of people dealing with the complexities of HF self-care [7]. Older adults with HF often misinterpret symptoms such as dyspnea, edema, and fatigue as normal aging [8], delaying care even as their ability to perform basic daily activities declines [9]. This overlooked symptom burden distinguishes HF from other chronic diseases in this population. Preventing symptom burden depends heavily on individuals' ability to maintain their health (i.e., engage in physical activity), monitor their symptoms (i.e., daily weight), and manage symptom changes (i.e., take extra water pills) [10]. Despite the importance of these behaviors, fewer than half of individuals can manage their care independently [11].

Effective self-care can reduce healthcare utilization and consequently hospitalization costs and mortality [12,13]. However, successful HF self-care requires more than simply

knowing what to do. HF self-care is a complex interplay of knowledge and motivation [14,15]. While increasing patient education matters [16,17], knowledge alone cannot drive and sustain long-term behavioral change [18-20]. Motivation is a critical driver of effective self-care and often determines whether knowledge translates into sustained behavior change [18]. Consequently, individuals with both adequate knowledge and strong motivation are better equipped to recognize, manage, and control symptoms at home.

The Information-Motivation-Behavioral Skills (IMB) model offers a valuable framework for supporting sustained behavioral changes [21]. Two studies applied the IMB model to investigate the influence of cardiac rehabilitation and treatment adherence interventions in patients with coronary artery disease. In a randomized controlled trial conducted by Li & Zhu, 108 individuals recruited from a cardiac rehabilitation program were randomized to routine nursing rehabilitation (n=52) or IMB model-based nursing rehabilitation (n=56) [22]. The intervention consisted of two parts: an interview about cardiac rehabilitation behavior motivation and assistance in sports rehabilitation to maintain or adopt good exercise routines. Individuals from the intervention group presented statistically significantly higher aerobic endurance, muscle strength, behavior management, cognitive symptom management, and disease management measures compared to those from the routine care ($p < .05$) [22].

Another trial with 112 Iranian cardiovascular individuals also supported the application of motivational educational sessions. In this study, participants were followed by telephone consultations for three months, totaling 10 educational sessions [23]. The

intervention effects on medication adherence were measured at baseline and three and six months after the end of the intervention. The study authors identified a higher total score of treatment adherence in the intervention group compared to the control group three and six months after the end of the intervention ($p<.001$) [23]. Although both studies reported significant findings, neither of them measured individuals' motivation pre-intervention.

A scoping review of instruments measuring motivation in clinical settings identified that almost two-thirds of the 13 included tools measure motivation in mental disorders, including schizophrenia, personality, and eating disorders [24]. The authors highlighted the lack of tools for measuring motivation in chronic diseases: only one tool emerged that measured motivation for the treatment of acute coronary syndrome and type 2 diabetes using an adaptation of the Treatment Self-Regulation Questionnaire (TSRQ) validated in Polish [25].

Building on these findings, our research team conducted a systematic review of the psychometric properties of instruments measuring motivation for cardiovascular diseases, including HF [26]. From the 22 included studies, only the TSRQ assessed motivation for more than one HF self-care behavior [26]. In the study by Stamp et al., the original TSRQ was adapted with items written by experts in HF self-care behaviors and applied to 117 dyads (patients with HF and their caregivers) recruited from outpatient clinics. It measured motivation to maintain a healthy diet and adhere to medications [27]. Moreover, none of the instruments focused on motivation to manage symptoms, an important trigger for hospitalization. Therefore, this study aimed to develop the Heart Failure Symptom

Management Motivation (HF-SMMI) instrument and examine its preliminary psychometric properties.

Methods

This methodological instrument-development and preliminary psychometric evaluation study was conducted in three stages from 2022 to 2025: 1) instrument development, 2) validation, and 3) pilot testing.

Stage 1: Instrument Development

We developed the **H**eart **F**ailure **S**ymptom **M**anagement **M**otivation **I**nstrument (HF-SMMI) following best-practice guidelines for creating instruments that measure complex psychological constructs (i.e., self-care), as recommended by instrument development standards [28]. Deductive item generation was informed by our previous systematic review, examining the psychometric properties of instruments assessing motivation for self-care in chronic diseases, including HF (under review). That review included 36 studies evaluating 22 instruments, most of which were grounded in the Self-Determination Theory (SDT) [26]. Insights from this review guided the initial pool of HF-SMMI items.

SDT, developed by Deci and Ryan, established three types of motivation: intrinsic or autonomous motivation (performance of an activity for inherent interest and enjoyment), extrinsic/controlled motivation (performance of an activity to attain some separable outcome for reward, avoid punishment or judgment), and amotivation (lacking the intention to act or act without intent). The theory also explains how types of motivation are regulated by three regulatory styles: intrinsic regulation, extrinsic regulation, and non-regulation [29]. These

forms of regulation are influenced by three basic psychological needs: autonomy, competence, and communication or relatedness [30]. Higher levels of intrinsic regulation are associated with stronger intrinsic (autonomous) motivation to engage in self-care behaviors, whereas extrinsic regulation reflects behaviors driven by external pressure, rewards, and punishments, etc. [29]. Amotivation, although less frequently measured, has gained increasing attention as a barrier to initiating or maintaining medical treatment because it is associated with reduced treatment engagement and poorer health outcomes [31]. Our systematic search identified the TSRQ as the most prevalent SDT-based instrument used to understand motivation in cardiovascular conditions [26], providing a theoretical foundation for the HF-SMMI's structure. Figure 1 defines the SDT regulatory styles.

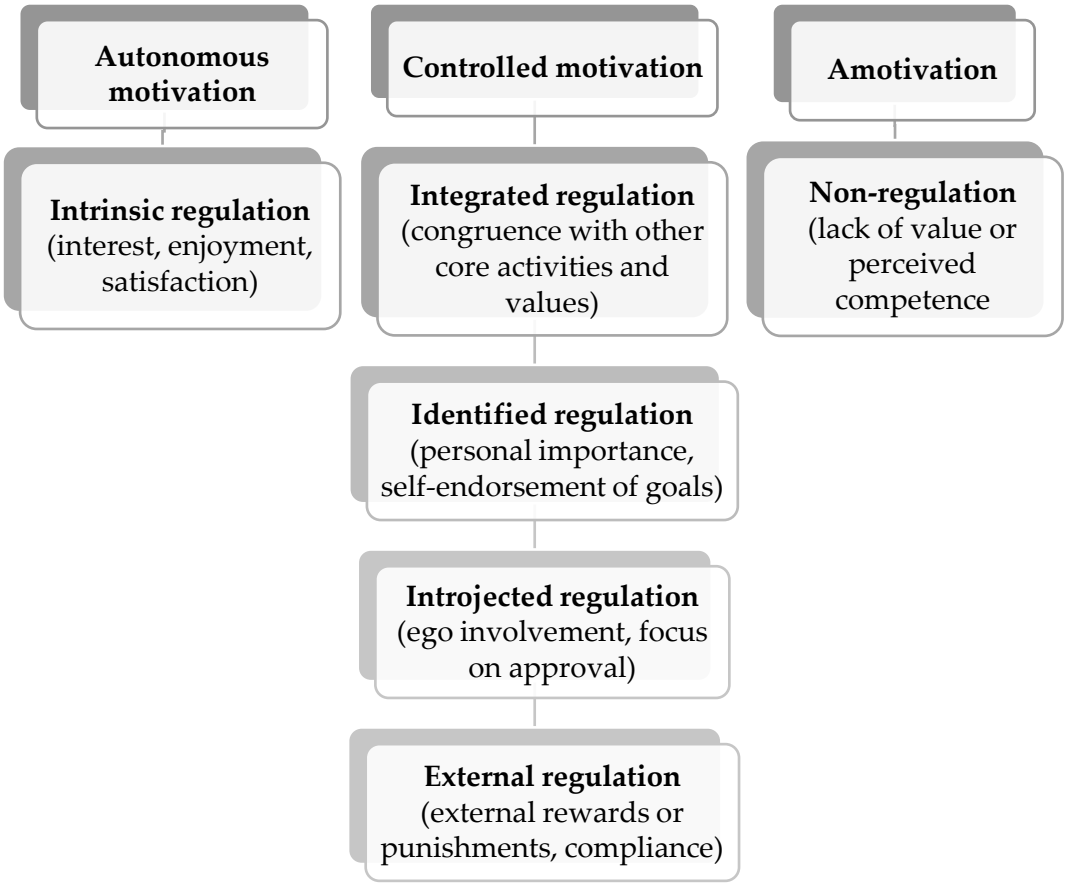

Figure 1. Motivation regulatory styles and definitions in SDT.

The TSRQ was proposed as a general approach to assess self-regulation modes designed to be adapted to any health behavior [32]. The original validation study has resulted in a four-factor structure, encompassing autonomous motivation, introjected regulation, external regulation, and amotivation [32]. It assesses a patient's motivation for following health behaviors and their recommended treatment regimen across settings with 15 items representing taking responsibility, motivation for performing the behavior (guilt or shame), and belief in following the behaviors of diet and medication adherence. The foundation validation study of the TSQR by Levesque et al. supported a three-factor analysis structure [32]. More recent perspectives have still been considering introjected and external regulation as controlled motivation, leading to a 3-factor questionnaire structure that includes autonomous, controlled, and amotivation [33,34]. We designed the HF-SMMI questionnaire based on its original three-factor structure.

We designed the questionnaire items to assess motivation for performing specific symptom management behaviors using mapping derived from standardized nursing terminologies. Standardized nursing terminologies enable the systematic linkage of patient signs and symptoms to corresponding and relevant nursing outcomes and interventions, ensuring that care plans reflect measurable changes in response to nursing actions [35]. Guided by the Nursing Outcomes Classification (NOC) [36] and the Nursing Interventions Classification (NIC) [37], two members of the research team with extensive experience

caring for patients with HF identified the most clinically relevant nursing outcomes capable of capturing symptom change. They then selected four interventions sensitive to each outcome. Questionnaire items were subsequently constructed to measure three motivation subscales associated with performing these interventions: autonomous motivation, controlled motivation, and amotivation.

Item wording was adapted from the original TSRQ, preserving its theoretical grounding in SDT. To differentiate symptom concern, behavior frequency, and motivation to perform the behavior, symptom-specific concern was measured as a separate contextual variable, independent of the HF-SMMI motivation scale. Participants rated their concern about experiencing common HF symptoms. Using the stem *"How much are you concerned about having…"*, participants assessed their concerns about some common HF symptoms. Each item was rated on a 5-point Likert scale ranging from 1 (Not at all concerned) to 5 (Extremely concerned).

Behavior frequency was measured separately to establish discriminant validity between motivation and action. According to SDT, motivation is the *quality* of an individual's reasons for engaging in a behavior, not the behavior itself SDT [29]. Including a behavior-frequency item allows us to demonstrate that motivation scores are not simply proxies for behavior and that meaningful intention–behavior gaps exist. This separation is essential for construct validity, ensuring that the motivation items assess psychological regulation rather than behavioral frequency.

In summary, the HF-SMMI distinguishes symptom-specific concern, behavior frequency, and motivation as three conceptually and empirically separate constructs. Symptom specific concern reflects the patient's appraisal of individual HF symptoms and is measured independently to capture perceived relevance or worry. Behavior frequency represents the actual enactment of self-management behaviors (e.g., daily weighing) and is assessed with direct behavioral items. Motivation reflects the quality of the psychological regulation underlying these behaviors, consistent with Self-Determination Theory, and is measured through autonomous, controlled, and amotivated reasons. By separating these symptoms, the HF-SMMI avoids construct contamination, ensures discriminant validity, and allows examination of how concern and motivation relate to—but do not determine—behavior frequency.

Stage 2: Validation

Content Validation by Experts (Delphi Method)

The content validation process occurred between October 2023 and April 2024. We ensured that the instrument accurately captured the construct of motivation for symptom management to establish strong content validity. In other words, we confirmed that the measure reflects the true underlying concept [38]. We listed a panel of 12 professional experts using purposive and snowball sampling techniques, approaches recommended for assembling reviewers with specialized knowledge while maintaining adequate control over chance agreement [38]. Experts were eligible if they held at least a master's degree in nursing and had a minimum of five years of experience in HF.

Each expert received an email invitation to participate in a Delphi study followed by a mailed survey packet with 1) a cover letter describing the survey and inviting participation, 2) a paper copy of the content validation survey, and 3) a demographic survey. The content validation survey is presented in the Supplementary Material S1. A paper copy was used because the postal questionnaires have been shown to achieve higher response rates than electronic questionnaires, particularly when surveys are complex or require substantial respondent effort [39]. They received instructions not to complete the questionnaire, but rather to determine the items' relevance and clarity to measure motivation for HF self-management using a scale from 1-4 (1=very irrelevant, very unclear; 2= irrelevant, unclear; 3= relevant, clear; and 4= very relevant, very clear). Relevance was defined as *"*item is important to measure motivation to manage HF symptoms"[40]. Clarity was defined as "wording is clear to avoid ambiguity"[40]. In addition to numerical ratings, experts responded to open-ended questions that invited them to comment on missing content, unnecessary elements, or inaccuracies. When an item or its response options received a rating ≤ 2, experts were asked to provide qualitative suggestions for revision.

Experts were asked to mail the completed surveys in the postage-paid return envelope up to two weeks from the day they received the survey packet. If experts did not return the surveys after two weeks, we sent an email extending the return deadline. We excluded experts who did not return the completed survey at the end of four weeks. Experts received a $50 Amazon gift certificate upon completing the survey. If a second round of

review was required, experts were invited to evaluate revised items and received an additional $25 gift certificate for their participation.

Content Validation by Patients with HF (Cognitive Interviews)

We used a structured cognitive interview approach to evaluate how patients interpreted the items and whether any refinements were needed. The think-aloud method used in this phase allowed researchers to explore the thought processes individuals use when responding to questionnaire items and to identify potential sources of misunderstanding [41]. An interview guide was created to assess how patients understood the HF-SMMI questionnaire. The interview guide is presented in the Supplementary Material S2. The guide included targeted comprehension questions (e.g., “In your own words, what does this phrase mean?”) and supplemental probes designed to elicit deeper explanation (e.g., “If you were explaining this to someone else, how would you say it?”). This iterative probing helps ensure that the participant’s interpretation remains accessible and relevant in working memory [41]. Each questionnaire sentence, target, and probe question was treated as a cognitive interview item.

Participants were recruited in January and February 2025 from a single academic medical center in the Midwestern U.S. The principal investigator screened hospitalized adults with a primary diagnosis of heart failure who had been admitted for at least 24 hours, using information available in the electronic health record. Following methodological recommendations, each round of cognitive interviews included five participants [39]. Because the instrument contained 60 items, two pilot groups were created: one evaluating

psychological symptom-management items (24 items) and another evaluating physical symptom-management items (36 items).

Eligibility criteria required participants to be 65 years or older, native English speakers, diagnosed with heart failure for at least one year, and free of cognitive or visual impairments. Cognitive status was assessed using the Short Portable Mental Status Questionnaire (SPMSQ) [42]. Individuals making two or fewer errors were classified as cognitively intact; those with three to four errors as mildly impaired; five to seven errors as moderately impaired; and eight or more errors as severely impaired [42].

After screening potential participants, the research team coordinated with bedside nurses to identify time windows free of clinical procedures and conducted interviews outside of visitation hours. A research assistant (RA) explained the study and obtained written consent before recording the individual face-to-face interviews conducted in the hospital rooms by a trained RA. Participants were shown one HF-SMMI item at a time on large-print paper (Arial bold, size 48) and asked to read the item and verbalize the mental steps they used to formulate their response [43]. Items were presented sequentially, and participants were encouraged to pause or stop the interview at any point if they felt fatigued, overwhelmed, emotionally distressed, or experienced worsening symptoms. Recordings were pseudonymized and transcribed verbatim by trained transcriptionists. Participants received a $40 gift card from a local grocery store at the end of the interview.

Stage 3: Pilot Testing

Pretesting is a critical step in instrument development because it evaluates whether respondents interpret items as intended and whether item order influences their responses. Effective pretesting helps reduce misunderstanding, measurement error, and respondent burden [28,44]. The HFSMMI developed in English language is presented in the Supplementary Material S3. A pilot test of the HF-SMMI was conducted from July to September 2026 at an academic medical center in the Midwestern United States. We recruited 110 participants aged 65 years or older, native English speakers, diagnosed with HF for at least six months, and without cognitive or visual impairments to complete the instrument. Participants received a compensation check of $60 after completion of the instrument.

Data Analysis

Descriptive statistics were used to summarize participant characteristics and pilot-test responses. Continuous variables were summarized using means and standard deviations (SDs), and categorical variables were summarized using frequencies and percentages. Content validity based on expert feedback was evaluated using the item-level content validity index (I-CVI**)** and the scale-level content validity index using the average method (S-CVI/Ave). Thresholds of I-CVI ≥ .78 and S-CVI/Ave ≥ .90 were considered indicative of acceptable content validity [45]. I-CVIs were calculated separately for item relevance and clarity based on expert ratings obtained during each Delphi round. Items with an I-CVI ≥ .80 were considered acceptable. S-CVI/Ave values were calculated separately for relevance and clarity, and an overall S-CVI/Ave was calculated by averaging the relevance

and clarity S-CVIs. Changes in I-CVI and S-CVI/Ave values between the first and second Delphi rounds were examined descriptively to evaluate improvement following item revision.

We evaluated the content validity from the patient perspective through cognitive interviews. Recorded interview data were reviewed to identify difficulties with item comprehension, terminology, interpretation, and response processes. Participant feedback was analyzed descriptively and used to identify items requiring modification. Revisions were made when participant feedback indicated ambiguity, misunderstanding, or difficulty interpreting an item. The frequency and proportion of items modified following cognitive interviews were calculated.

For the pilot study**,** participant characteristics, symptom concern, and symptom-management behaviors were summarized using descriptive statistics. Symptom concern responses were summarized as frequencies and percentages across the five response categories, ranging from 1 (*not at all concerned*) to 5 (*extremely concerned*). Symptom-management behaviors were summarized as frequencies and percentages of participants reporting whether they performed each behavior. Symptom concern responses and symptom-management behaviors were not included in the SDT-based HF-SMMI motivation construct and were therefore treated as separate variables. Motivation scores were calculated separately for autonomous motivation, controlled motivation, and amotivation. Within each symptom, the four items representing each motivation subscale were summed, yielding symptom-specific scores ranging from 4 to 20. Scores were subsequently

summed across the five symptoms to obtain total autonomous motivation, controlled motivation, and amotivation scores, each ranging from 20 to 100. Higher scores indicated greater autonomous motivation, controlled motivation, or amotivation. Means, standard deviations (SDs), observed ranges, and 95% confidence intervals were calculated for this pilot study.

Preliminary psychometric properties of the HF-SMMI motivation subscales were examined using internal consistency, corrected item-total correlations, and floor and ceiling effects. Cronbach's α was calculated separately for the 20-item autonomous motivation, controlled motivation, and amotivation subscales. Corrected item-total correlations were calculated by correlating each motivation item with the corresponding subscale total after excluding that item. Cronbach's α if the item were deleted was also examined to identify items that could potentially reduce internal consistency. Floor and ceiling effects were evaluated for each overall motivation subscale by determining the proportion of participants obtaining the minimum (20) or maximum (100) possible score. The observed score range was also examined relative to the possible score range. Given the exploratory nature and small sample size of the pilot study, all reliability and item-level analyses were considered preliminary and intended to inform subsequent psychometric evaluation in a larger sample.

Results

Stage 1: Instrument Development

The initial HF-SMMI version included five HF symptoms: edema, fatigue, dyspnea, anxiety, and depression. Each symptom included four symptom management behaviors, for a total of 20 symptom-management behaviors resulting in 20 behaviors operationalized from patient-adopted nursing interventions. Figure 2 presents the symptom-specific NOC outcomes, NIC interventions, and corresponding codes, and associated symptom-management behaviors. Each behavior was paired with three motivation statements assessing autonomous motivation, controlled motivation, and amotivation, resulting in 60 motivation items.

Symptom	(Code) Nursing Language	Symptom management behaviors
Edema	**NOC Outcomes** (0601) Fluid Balance (3105) Self-Management: Heart Failure	• Weigh themselves everyday • Raise legs above the heart level for 30 minutes 3 or 4 times/day • Exercise like go to cardiac rehabilitation or walk • Monitor the amount of salt in the diet
	NIC Interventions (4120) Fluid Management (4066) Circulatory Care: Venous Insufficiency (1100) Nutrition Management	
Fatigue	**NOC Outcomes** (0007) Fatigue Level (0306) Self-Care: Instrumental Activities of Daily Living (IADL) (0004) Sleep	• Choose to do things when have the most energy during the day • Ask for help with house chores when needed • Get some rest everyday

	(0002) Energy Conservation (3105) Self-Management: Heart Failure	• Eat 2-3 meals during the day
	NIC Interventions (0180) Energy Management (1800) Self-Care assistance (4044) Cardiac Care (1100) Nutrition Management	
Dyspnea	**NOC Outcomes** 0415) Respiratory Function (3105) Self-Management: Heart Failure	• Take notes about the amount of liquid drink every day • Use a recliner or raise bed with pillows to sleep better • Use a walker or handrail to make feel less tired when walking • Avoid smoke or being around people who smoke
	NIC Interventions (4120) Fluid Management (0840) Positioning (1665)Functional Ability Enhancement (4490) Smoke Cessation Assistance	
Anxiety	**NOC Outcomes** (1211) Anxiety Level (1402) Anxiety Self-Control	• Talk about anxiety with a family member, friend, or healthcare team • Enjoy gardening or cooking or other activities • Use relaxation techniques like breathing exercises, meditation, yoga, or prayer, etc.
	NIC Interventions (5820) Anxiety Reduction (5880) Calming Technique (5330) Mood Management	

		• Exercise frequently
Depression	**NOC Outcomes** (1208) Depression Level (1209) Depression Self-Control	• Write your bad or unhappy thoughts in a journal • Walk frequently • Go to support groups with other people with heart failure • Talk about sad or unhappy thoughts with a family member, friend, or healthcare team
	NIC Interventions (94740) Journaling (5330) Mood Management (5430) Support Group	

Figure 2. Symptom-specific NOC outcomes, NIC interventions with corresponding codes, and symptom-management behaviors.

Motivation items were tailored to each symptom-management behavior. For participants who did not currently engage in a specific behavior, the items were adapted to assess motivation toward performing the behavior by incorporating the modal auxiliary verb *would*. Motivation items were rated on a 5-point Likert scale ranging from 1 (do not agree at all) to 5 (strongly agree). The instrument was developed in English and required approximately 10 minutes to complete. Figure 3 presents an example of items assessing motivation for edema management. The original full HF-SMMI is attached in the Supplemental file.

How much are you concerned about having edema?

( ) 1. Not at all concerned. ( ) 2. Slightly concerned. ( ) 3. Moderately concerned.

( ) 4. Very concerned. ( ) 5. Extremely concerned.

Do you weigh yourself every day?

( ) Yes ( ) No

On a scale from 1 to 5 (1= do not agree at all and 5 = strongly agree), how much do you agree with the sentences below?

I (would) weigh myself every day because I think it is important to make the effort.

I (would) weigh myself every day because I want others to see I can control my weight.

I do not weigh myself every day because it is not important to me

Figure 3. Example of a question about motivation for edema self-management.

Stage 2: Validity

Content Validity (Expert Evaluation)

Twelve experts were invited to evaluate the HF-SMMI, of whom nine participated in two Delphi rounds. Most experts were female (89%). Experts had a mean of 17.1 years (SD = 10.7) of clinical experience and 11.6 years (SD = 7.4) of HF research experience. In the first Delphi round, 31 of 48 items (64.6%) achieved an item-level content validity index (I-CVI) ≥.80 for relevance, and 23 (48.0%) achieved an I-CVI ≥ .80 for clarity. The scale-level content validity index (S-CVI) was .83 for relevance and .79 for clarity, resulting in an overall S-CVI/Ave of 0.81. Items were revised based on experts' recommendations and reevaluated in a second Delphi round (Figure 4).

Original item	**Subjects' quotes**	**Modifications**
General comment for motivation for edema self-management	**S.5.** "I was surprised not to see an item about daily weights for this subscale/ section on managing edema"	We replaced the item about diuretics pills and included daily weights
I take diuretic pills when I gained too much weight in the week because I want to take responsibility for my own health.	**S.5.** "Is it best to use lay terms in addition to "diuretic"? **S.8.** "Water pills. Replace take responsibility for take care."	
I take diuretic pills when I gained too much weight in the week because I want others to see I can control my medication.	**S.9.** "Control my HF? People may not know the term "diuretic" Use water pills."	
I take extra diuretic pills when I gained too much weight in the week because it is easier to do what I am told than think about it.	**S.6.** "Does "it is easier to do what I am told than think about it" really reflect lack of motivation?"	
I elevate my legs above the heart level because I believe it is the best thing to do.	**S.1.** "Change "I believe it is the best thing to do" for "I believe it is the best for my health/ to meet my goals"	I *raise my legs* above the heart level because I believe it is the best *for my health*

	S.5. “Unclear when is it all the time or just when they notice edema” **S.8.** I "raise" my legs	
I elevate my legs above the heart level for 30 minutes 3 or 4 times/day because I want others to see that I am doing what my nurse/doctor asked me to do.	**S.3.** “Health care team instead of "nurse/doctor"	I raise my legs above my heart level when I notice swelling in my legs because I want others to see that I am doing what my *healthcare team* asked me to do.
I control the amount of salt in my diet because it is consistent with my treatment goals.	**S.9.** “Clinicians have treatment goals. Patients have life or health goals”	I control the amount of salt in my diet because it is consistent with my *health goals*.
I control the amount of salt in my diet because I feel pressure from others to do so.	**S.1.** “This is not reward or approval. You can say: "others may see me as careless about my health" or something on that line”	I control the amount of salt in my diet because I *would feel guilty if I did not do what my healthcare team said*.
I control the amount of salt in my diet because it is easier to do what I am told than think about it.	**S.5.** “Might there be some issues for people to know/ understand what you mean by "control"- is limit a better word?”	I *monitor* the amount of salt in my diet because it is easier to do what I am told than think about it.
General comment for amotivation for fatigue self-management	**S.9.** “See this measure for examples of phrasing for amotivation *Academic motivation*	Changed two items to address comments: “I do not ask for help with house chores when I need

	scale. Amotivation may require some move thought. Maybe "I am not sure why I avoid… I could it really care less"	because *I do not see why I should have to*" and "I do not eat 2-3 meals during the day because *I do not see the point of doing it*."
I ask for help with activities because it is an important choice I really want to make.	**S.1**. "Add "I really want to make for xxxx". Need to link it to something as motivation" **S.2.** A little too wordy. "It is an important choice I want to make"	I ask for help with house chores when I need because I *want to have energy to enjoy my day.*
I talk about my anxiety with a close friend or family member because it is an important choice I really want to make.	**S.3.** "Why? To vent?" **S.8.** "Why is this an important choice? Maybe important decision	I talk about my anxiety with a friend, family member, or healthcare team because I think it is important to *let my feelings ou*t.
I do something that I enjoy doing like gardening because I believe it is the best thing for my mental health.	**S.3.** "Good for my mental health?" **S.9.** "Maybe include other options with gardening"	I enjoy gardening, *cooking, or other activities because I get pleasure and satisfaction doing it*.
I use relaxation techniques like breathing exercises or meditation because I would feel guilty or ashamed of	**S.1.** "I suggest adding "if I did not control my anxiety in front of others" to give it the "approval"	I use relaxation techniques like breathing exercises, meditation, yoga, or prayer because *other people would be concerned or*

myself if I did not control my anxiety.		*upset if I do not control my anxiety*.
I write my bad thoughts in a journal because it is an important choice I really want to make.	**S.9.** "I write my "sad/unhappy thoughts."	I write my sad *or unhappy* thoughts in a journal because it is an important choice I really want to make.

Figure 4. Original and adapted questionnaire items after the 1st Delphi round content analysis.

Following revision, 41 items (85.5%) achieved an I-CVI ≥ .80 for relevance and 38 (79.1%) for clarity. The S-CVI increased to .92 for relevance and .88 for clarity, resulting in an overall S-CVI/Ave of .90. Table 1 summarizes changes in content validity between the two Delphi rounds.

Table 1. Comparison of the content validity Delphi rounds.

Variable	**1st Delphi round N(%)**	**2nd Delphi round N(%)**
Relevance		
I-CVI ≥ .80	31 (64.6%)	41 (85.5%)
Min. and Max. I-CVI	.44 - 1.00	.57 - 1.00
S-CVI	.83	.92
Clarity		

I-CVI ≥ .80	23 (48.0%)	38 (79.1%)
Min. and Max. I-CVI	.44 - 1.00	.42 - 1.00
S-CVI	.79	.88
Overall S-CVI/Ave	.81	.90

Content Validity (Patient Evaluation)

Ten participants with HF completed the content-validity phase. Participant characteristics are presented in Table 2. The estimated mean age was 78.5 years (SD = 9.7). Participants were predominantly retired (90%) and male (60%); all were White and had preserved cognition. Half were married or living with a domestic partner (50%), 40% had a bachelor's degree or higher, and 60% reported having a formal or informal caregiver. Most participants (70%) reported sufficient financial resources to meet expenses. Clinically, 70% had a reduced left ventricular ejection fraction (<40%), and 50% had been diagnosed with HF for at least 5 years. Diabetes was the most common self-reported comorbidity (60%), followed by cardiovascular disease and kidney disease (40% each).

Table 2. Characteristics of the participants recruited for face validity and pilot test.

Characteristic	**Face Validity (n=10) Mean (SD)**	**Pilot Test (n=110) Mean (SD**
Age, years	78.5 (9.7)	74.2 (6.7)
Race		

White	10 (100.0)	93 (97.9)
Sex		
Male	6 (60.0)	48 (50.5)
Female	4 (40.0)	47 (49.5)
Employment status		
Retired	9 (90.0)	99 (90.0)
Employed full or part-time	1 (10.0)	11 (10.0)
Cognitive status		
Preserved cognitive status	10 (100.0)	110 (100.0
Marital status		
Married/ living with a domestic partner	5 (50.0)	56 (50.9)
Widowed	3 (30.0)	23 (20.9)
Divorced/single	2 (20.0)	31 (28.2)
Education		
Less than high school	1 (10.0)	3 (2.7)
High school diploma/ some college, no degree	5 (50.0)	80 (72.7)
Bachelor's degree or higher	4 (40.0)	27 (24.5)
Caregiver availability		
No formal or informal caregiver	4 (40.0)	26 (23.6)
Family member	5 (50.0)	81 (73.6)
Professional caregiver	1 (10.0)	3 (2.7)

Financial resources to make ends meet		
Just enough/more than enough to meet the expenses	7 (70.0)	104 (94.5)
Not enough to make ends meet	3 (30.0)	6 (5.5)
Clinical characteristics		
Left ventricular ejection fraction (LVEF)		
Reduced ejection fraction (<40%)	7 (70.0)	NA*
Preserved ejection fraction (>50%)	3 (30.0)	NA*
Duration of heart failure diagnosis		
1-4 years	5 (50.0)	49 (44.5)
≥ 5 years	5 (50.0)	61 (55.5)
Comorbidities		
Diabetes	6 (60.0)	51 (46.4%
Cardiovascular disease	4 (40.0)	52 (47.3%
Chronic kidney disease	4 (40.0)	30 (27.3%

Note. LVEF: left ventricular ejection fraction; SD: standard deviation.

***** LVEF was not collected during the pilot-test phase.

Based on the cognitive interviews, six of the 60 items (10%) were revised to improve clarity and comprehension. Revisions primarily addressed terminology, interpretation of behavioral statements, and wording of motivation items. Five symptom-concern questions were administered separately and were not included in the HF-SMMI motivation construct.

Figure 5 presents the original items, participant feedback illustrating sources of misunderstanding, and the corresponding revisions.

Original item	**Subjects' quotes**	**Modifications**
Choose the option most consistent with your motivation for each activity.	S1: "Choose the option most consistent with your motivation for each activity." What's the activity?"	Remove "most consistent with your motivation"
Do you raise your legs above your heart level when you notice edema or swelling in your legs?	**S1. "**I don't think I would [understand the term edema] **S5.** I don't think I would [understand the term edema].	Do you raise your legs above your heart level when you notice *swelling* in your legs?
I raise my legs above my heart level when I notice edema or swelling in my legs because I want others to see that I am doing what my healthcare team asked me to do.		I raise my legs above my heart level when I notice *swelling* in my legs because I want others to see that I am doing what my healthcare team asked me to do.
I do not raise my legs above my heart level when I notice edema or swelling in my legs because I think it is a waste of time.		I do not raise my legs above my heart level when I notice *swelling* in my legs because I think it is a waste of time.
I talk about my anxiety with a friend, family member or	**S10.** "Well, they could. Yeah. Well, I mean, that's kind of	I talk about my anxiety with a friend, family member or

healthcare team because I feel pressure to talk to them	redundant because you feel like the pressure to talk to them is not internalizing it. It's like you feel like you need to talk to somebody."	healthcare team because I *feel I have to*.
I do not write my sad or unhappy thoughts in a journal because I do not see how it will help me.	**S7. "**And when you say I do not see how, I think that's a pretty strong, I do not write because I have said because? Well, because it does not help me."	I do not write my sad or unhappy thoughts in a journal because *it does not help me*.
I do use a walker or handrail to make me feel less tired when I walk because I feel more confident and independent.	**S2. "**Now, personally, I don't see those connected. I use a walker or a handrail to make me less likely to fall on my xxx." **S4. "**Wouldn't being safe from falling the same thing? So put the falling in there."	I do use a walker or handrail to make me feel less tired when I walk because *I feel safe from falling.*

Figure 5. Original and adapted questionnaire items after cognitive interviews' content analysis.

Stage 3: Pilot Testing

One hundred and ten participants completed the pilot testing. Participant characteristics are presented in Table 2. The mean age was 74.2 years (SD = 6.7). Participants were predominantly retired (90%), 50.5% were male, 97.3% were White, and all of them had preserved cognitive status. More than half were married or living with a domestic partner (50.9%), 72.7% had a high school diploma, but no college degree, and

76.3% reported having a family or professional caregiver. Most participants (94.5%) reported having sufficient or more than sufficient financial resources to meet expenses. More than half (55.5%) had been diagnosed with HF for at least 5 years. Cardiovascular disease was the most prevalent self-reported comorbidity (47.3%), followed by diabetes (46.4%) and chronic kidney disease (27.3%). Table 3 shows the level of concern for each of the five symptoms on a 5-point Likert scale. Table 4 shows the frequency of behaviors specific to each symptom.

Symptom Concern and Symptom-Management Behaviors

Participants reported varying levels of concern across the five HF symptoms (Table 3). Fatigue and dyspnea elicited relatively high levels of concern, with 57.3% of participants reporting being very or extremely concerned about fatigue, and 58.2% about dyspnea. In contrast, responses for anxiety and depression were more broadly distributed across levels of concern.

Table 3. Participants' Level of Concern About Heart Failure Symptoms (N = 110)

Symptom	**1.Not at all concerned N(%)**	**2. Slightly concerned N(%)**	**3. Moderately concerned N(%)**	**4. Very concerned N(%)**	**5. Extremely concerned N(%)**
Edema	11 (10.0%)	22 (20.0%)	27 (24.5%)	37 (33.6%)	13 (11.8%)
Fatigue	6 (5.5%)	12 (10.9%)	29 (26.4%)	42 (38.2%)	21 (19.1%)
Dyspnea	9 (8.2%)	8 (7.3%)	29 (26.4%)	30 (27.3%)	34 (30.9%)
Anxiety	39 (35.5%)	27 (24.5%)	22 (20.0%)	14 (12.7%)	8 (7.3%)

Depression	44 (40.0%)	22 (20.0%)	25 (22.7%)	12 (10.9%)	7 (6.4%)

Engagement in heart failure self-management behaviors varied across symptom domains (Table 4). Behaviors related to fatigue were reported most frequently, including performing activities when energy levels (85.5%), and consuming two to three meals daily to maintain energy (83.6%). For edema management, more than half of participants reported engaging in recommended self-care behaviors, such as raising their legs when swelling occurred (63.6%) and monitoring dietary salt intake (67.3%).

Greater variability was observed in self-care behaviors related to dyspnea, anxiety, and depression. Most participants reported engaging in activities such as gardening or cooking to manage anxiety (92.7%) and exercising regularly (73.6%). However, fewer than two-thirds reported discussing anxiety (51.8%) or depressive thoughts (61.8%) with family members, friends, or healthcare providers. Notably, nearly all participants (95.5%) reported not attending heart failure support groups, suggesting a low level of engagement with structured support resources.

Table 4. Symptom-Management Behaviors Reported by Pilot-test Participants (N = 110).

Symptom/ Self-care behavior	**Yes, n (%)**	**No, n (%)**
Edema		
Weighs self every day	62 (56.4%)	48 (43.6%)
Raises legs when swelling occurs	70 (63.6%)	40 (36.4%)
Exercises/walks or attends cardiac rehabilitation	75 (68.2%)	35 (31.8%)
Monitors dietary salt intake	74 (67.3%)	36 (32.7%)

Fatigue		
Performs activities when energy is highest	94 (85.5%)	16 (14.5%)
Asks for help with household chores when needed	76 (69.1%)	34 (30.9%)
Gets some rest every day	105 (95.5%)	5 (4.5%)
Eats 2–3 meals per day	92 (83.6%)	18 (16.4%)
Dyspnea		
Records daily fluid intake	20 (18.2%)	90 (81.8%)
Uses a recliner or raises bed with pillows	66 (60.0%)	44 (40.0%)
Uses a walker or handrail to reduce fatigue while walking	44 (40.0%)	66 (60.0%)
Avoids smoking or being around people who smoke	88 (80%)	22 (20.0%)
Anxiety		
Talks about anxiety with family, friends, or healthcare team	57 (51.8%)	53 (48.2%)
Engages in activities such as gardening or cooking	102 (92.7%)	8 (7.3%)
Uses relaxation techniques	60 (54.5%)	50 (45.5%)
Exercises	81 (73.6%)	29 (26.4%)
Depression		
Writes sad or unhappy thoughts in a journal	7 (6.4%)	103 (93.6%)
Walks frequently	76 (69.1%)	34 (30.9%)
Attends heart failure support groups	5 (4.5%)	105 (95.5%)

Talks about sad/unhappy thoughts with family, friends, or healthcare team	68 (61.8%)	42 (38.2%)

Motivation for Symptom Management

Table 5 presents HF-SMMI motivation scores across the five symptoms, preliminary estimates of internal consistency, and floor and ceiling effects. Across symptoms, autonomous motivation scores were higher than controlled motivation and amotivation scores. Mean total scores for autonomous motivation were 73.7 (SD = 14.5, 95% CI [71.0-76.4]), compared with 47.6 (SD = 15.3, 95% CI [44.7- 50.6]) for controlled motivation, and 32.1 (SD = 9.1, 95% CI [30.4- 33.9]) for amotivation. At the symptom level, autonomous motivation was highest for anxiety (Mean = 16.0, SD = 3.5) and lowest for depression (Mean = 12.1, SD = 4.4). Depression also had the lowest mean controlled motivation (Mean=7.3, SD = 3.3). Floor effects were only observed for amotivation (4.5%). Ceiling effects were only observed for autonomous motivation (1.8%). Observed scores ranged from 42 to 100 for autonomous motivation, 22 to 88 for controlled motivation, and 20 to 70 for amotivation.

Table 5. HF-SMMI Motivation subscale scores by symptom, floor and ceiling effects among participants (N = 110)

Symptom	**Autonomous motivation Mean (SD), [95% CI], Range**	**Controlled motivation Mean (SD), [95% CI], Range**	**Amotivation Mean (SD), [95% CI], Range**
Edema	15.5 (3.2),95% CI [14.9-16.1], 7-20	10.5 (4.1), 95% CI [9.8-11.3], 4-20	5.7 (2.3), 95% CI [5.2-6.1], 4-15

Fatigue	15.3 (3.6), 95% CI [14.6-16.0], 5-20	9.5 (4.0), 95% CI [8.8-10.3], 4-19	6.0 (2.7), 95% CI [5.5-6.5], 4-16
Dyspnea	14.6 (3.9), 95% CI [13.9-15.4], 4-20	11.3 (3.7), 95% CI [10.6-12.0], 4-20	6.8 (2.9), 95% CI [6.3-7.4], 4-16
Anxiety	16.0 (3.5), 95% CI [15.3-16.6], 8-20	8.8 (4.1), 95% CI [8.0-9.6], 4-20	5.8 (2.1), 95% CI [5.4-6.2], 4-15
Depression	12.1 (4.4), 95% CI [11.3-13.0], 4-20	7.3 (3.3), 95% CI [6.7-7.9], 4-18	7.7 (2.9), 95% CI [7.1-8.2], 4-15
Total score, Mean (SD), CI	73.7 (14.5), 95% CI [71.0-76.4)	47.6 (15.3), 95% CI [44.7-50.6]	32.1 (9.1), 95% CI [30.4-33.9]
Observed range	42-100	22-88	20-70
Floor effect, %	0.0%	0.0%	4.5%
Ceiling effect, %	1.8%	0.0%	0**.0%**

Note. CI: confidence interval; HF-SMMI: Heart Failure Symptom Management Motivation; SD: standard deviation.

Symptom Concern Association with Types of Motivation

Exploratory Spearman rank-order correlations were conducted to examine associations between symptom concern and corresponding symptom-specific motivation scores (Table 6). Exploratory Spearman's rank-order correlations revealed several significant associations between symptom concern and motivation. Greater concern about edema, fatigue, dyspnea,

and anxiety was associated with higher levels of autonomous motivation, with small positive correlations ranging from ρ = .20 to .28 (all $p < .05$).

The strongest association was observed between dyspnea concern and autonomous motivation (ρ = .28, $p = .003$), followed by edema concern (ρ = .25, $p = .008$). Symptom concern showed limited associations with controlled motivation. Concern about depression was positively associated with controlled motivation (ρ = .19, $p = .045$), whereas associations with edema, fatigue, dyspnea, and anxiety were not statistically significant ($p > .05$). In contrast, symptom concern was generally negatively associated with amotivation. Greater concern about dyspnea (ρ = -.19, $p = .038$) and anxiety (ρ = -.25, $p = .009$) was associated with lower levels of amotivation. No significant associations were observed between amotivation and concern about edema, fatigue, or depression ($p > .05$).

Table 6. Exploratory associations between symptom concern and motivation (N=110).*

Symptom concern	Autonomous motivation ρ	*p*	Controlled motivation ρ	*p*	Amotivation ρ	*p*
Edema	.25	**.008**	.13	.177	-.11	.248
Fatigue	.21	**.025**	.11	.227	-.13	.268
Dyspnea	.28	**.003**	.11	.236	-.19	**.038**
Anxiety	.20	**.032**	.15	.100	-.25	**.008**
Depression	.18	0.05	.19	**.045**	-.04	.630

Note. ρ: Spearman's rank-order correlation coefficient.

Preliminary Psychometric Evaluation

Preliminary psychometric analyses provided evidence of acceptable internal consistency for the HF-SMMI motivation subscales (Table 7). Cronbach's alpha coefficients were .85 for autonomous motivation, .87 for controlled motivation, and .77 for amotivation. Corrected item-total correlations generally exceeded the recommended minimum threshold of .30, although several items demonstrated weaker relationships with their respective subscales. Despite these lower item-total correlations, Cronbach's alpha values remained relatively stable when individual items were deleted, indicating that item removal would provide little improvement in internal consistency. Collectively, these findings suggest that the HF-SMMI motivation subscales exhibit promising preliminary reliability characteristics and support continued evaluation of the instrument in larger and more diverse samples.

Table 7. Corrected Item-Total Correlations and Cronbach's Alpha if Item Deleted* for HF-SMMI Motivation Items in the Pilot Study (N = 110)

Symptom	**Symptom-Management behavior**	**Autonomous motivation (α=.85)**		**Controlled motivation (α=.87)**		**Amotivation (α=.77)**	
		CITC	**α if deleted**	**CITC**	**α if deleted**	**CITC**	**α if deleted**
Edema	Daily weighing	.34	.86	.49	.86	**.28**	.77
	Leg elevation	.41	.85	.53	.86	.34	.76

	Exercise	**.18**	.86	.37	.87	.46	.76
	Dietary sodium monitoring	.50	.85	.49	.86	.37	.76
Fatigue	Performs activities when energy is highest	.49	.85	.63	.86	.32	.76
	Asks for help with household chores	.46	.85	.45	.87	.50	.75
	Gets daily rest	.46	.85	.68	.86	.52	.75
	Eats 2–3 meals/day	.48	.85	.32	.87	.34	.76
Dyspnea	Records daily fluid intake	.58	.85	**.21**	.88	**.27**	.77
	Uses recliner or raises bed with pillows	**.29**	.86	.38	.87	.42	.75
	Uses walker/handrail	.43	.85	.49	.86	.34	.76
	Avoids smoking/smoke exposure	.35	.86	**.17**	.88	.30	.76
Anxiety	Talks about anxiety with others	.59	.85	.50	.86	.33	.76
	Engages in gardening, cooking, or other activities	**.25**	.86	.58	.86	.16	.77
	Uses relaxation techniques	.63	.84	.55	.86	.31	.76
	Exercises	.33	.86	.55	.86	.40	.76
Depression	Writes thoughts in a journal	.48	.85	.42	.87	.32	.76

	Walks frequently	.50	.85	.64	.86	.33	.76
	Attends HF support groups	.51	.85	.48	.87	.34	.76
	Discusses sad/ unhappy thoughts with others	.60	.85	.62	.86	**.24**	.77

Note. CITC: corrected item-total correlation; HF: heart failure.

*Boldface CITC indicates corrected item-total correlations below the prespecified criterion of *r* = .30.

Discussion

This study provides preliminary evidence supporting the validity and reliability of the HF-SMMI, a theory-based measure developed to assess motivation for symptom-management behaviors among older adults with HF. Guided by the SDT, one of the most widely applied frameworks about human motivation [30], the HF-SMMI was developed using a rigorous, multi-stage process that included a literature review, deductive item generation [46], expert and patient content validation, and preliminary psychometric testing. The final instrument consists of 60 items that assess autonomous motivation, controlled motivation, and amotivation across five HF symptoms: edema, fatigue, dyspnea, anxiety, and depression.

To our knowledge, the HF-SMMI is the first instrument specifically designed to assess motivation for symptom management among people with HF. Existing HF instruments primarily evaluate symptom burden (i.e., Symptom Status Questionnaire-HF)

[47], self-care behaviors (i.e., Self-Care of HF index) [48], or HF-related knowledge (i.e., Atlanta HF Knowledge Test) [49]. However, none directly assess the motivational processes that influence engagement in symptom management behaviors. This distinction is important because motivation is a modifiable determinant of behavior [50] and may explain individual differences in symptom self-management that are not fully captured by measures of symptom burden, knowledge, or self-care behaviors. Furthermore, the lack of motivation measures in intervention studies limits our ability to understand the mechanisms underlying intervention effectiveness. Without baseline motivation measures, it is difficult to determine whether observable behavioral changes result from the intervention itself or reflect individuals' pre-existing drive to engage in symptom management.

A unique feature of the HF-SMMI is its assessment of motivation at the symptom level rather than as a global construct. This approach is informed by the concept of interoception, defined as the ability to recognize and interpret internal bodily sensations [51]. Interoceptive awareness plays a central role in symptom recognition and self-regulation of health behaviors, whereas reduced interoceptive awareness has been associated with poorer symptom recognition, interpretation, and management [52,53]. Furthermore, age-related changes contribute to greater variability in how older adults recognize and respond to HF symptoms [53]. Consequently, motivational processes may also differ across symptoms.

The findings from this pilot study provide preliminary support for the assumption that motivation for symptom management may be symptom-specific. Greater concern about edema, fatigue, dyspnea, and anxiety was associated with higher levels of autonomous

motivation, whereas greater concern about dyspnea and anxiety was associated with lower levels of amotivation. These findings align with SDT, which proposes that individuals are more likely to engage in health-related behaviors when they perceive those behaviors as personally meaningful and relevant to their goals and well-being [30].

Dyspnea, a major driver of emergency department visits and hospitalizations [54], demonstrated the strongest association with autonomous motivation. This finding may reflect the immediate and direct impact on activities of daily living such as bathing, dressing, and walking [55]. Individuals may be particularly more motivated to engage in dyspnea symptom-management behaviors to prevent or alleviate its impact on daily functioning and quality of life. In contrast, depression concern was associated with controlled motivation, suggesting that management of depressive symptoms may be influenced more strongly by external expectations than by personally goal-directed behaviors. Although these findings should be interpreted cautiously given the exploratory nature of the study, they provide preliminary evidence that different symptoms may activate distinct motivational processes and support the conceptual justification for assessing symptom-specific motivation rather than treating motivation as a uniform construct across all aspects of HF self-management.

Evidence supporting the relevance and clarity of the items was achieved through a strong Delphi expert panel consensus, reflected by excellent S-CVI values. These findings are comparable to those reported in the development and validation of other heart failure

self-care measures, such as the Self-Care of Heart Failure Index (SCHFI), which also demonstrated strong evidence of content validity and reliability during instrument refinement and psychometric testing [48]. In addition, cognitive interviews with older adults living with HF supported the clarity, comprehensibility, and acceptability of the instrument. Feedback obtained during cognitive testing resulted in revisions that made the instrument understandable and relevant to the target population. The use of cognitive interviews is consistent with best practices for patient-reported outcome measure development and has been employed in the development of other HF-specific instruments to ensure that item wording accurately reflects patients' experiences and interpretations [56].

Preliminary findings provide initial support for the internal consistency of the HF-SMMI subscales. Cronbach's alpha coefficients were .85 for autonomous motivation and .87 for controlled motivation, indicating good internal consistency. The amotivation subscale demonstrated a slightly lower reliability (α = .77), although this value remains above the commonly accepted threshold of .70 for newly developed instruments [57]. The lower reliability of the amotivation subscale may reflect the greater conceptual heterogeneity of amotivation. Unlike autonomous and controlled motivation, which represent specific forms of behavioral regulation, amotivation reflects the absence of perceived competence and can arise from multiple sources [30].

The HF-SMMI demonstrated acceptable score distribution characteristics. Floor effects were observed only for amotivation (4.5%), whereas ceiling effects were observed

only for autonomous motivation (1.8%). This finding is encouraging since both effects are substantially below the literature threshold of 15% for problematic floor or ceiling effects [58]. These findings suggest that the instrument captures a broad range of motivational experiences and is unlikely to suffer from substantial score compression at either end of the measurement continuum. Consequently, the HF-SMMI may be capable of distinguishing individuals with differing levels of motivation and detecting meaningful changes over time [59].

Exploratory analyses further provided preliminary evidence for construct validity. Overall, greater symptom concern was associated with higher autonomous motivation and, for selected symptoms, lower amotivation. For example, greater concern regarding dyspnea was associated with higher autonomous motivation and lower amotivation, a pattern that is theoretically consistent with SDT. Individuals who perceive symptoms as more concerning may be more likely to recognize the value of symptom-management behaviors while simultaneously being less likely to feel disengaged from those behaviors. In contrast, symptom concern demonstrated limited associations with controlled motivation, with depression being the only symptom significantly associated with higher controlled motivation. This pattern suggests that the three motivational constructs are functioning as theoretically distinct dimensions rather than reflecting a single underlying motivational tendency. However, given the pilot nature of the study and the exploratory analyses performed,

these findings should be viewed as preliminary and require replication in larger samples.

The HF-SMMI may provide researchers and clinicians with a novel tool to distinguish autonomous motivation, controlled motivation, and amotivation. This information may support individualized counseling and tailored interventions designed to enhance patient engagement in symptom-management behaviors. The instrument may be particularly useful in HF clinics and self-management programs, where understanding patients' motivational drivers can help inform person-centered care. Overall, findings from this pilot study suggest that the HF-SMMI is feasible for use in both research and clinical settings and demonstrates promising preliminary psychometric properties.

Limitations

Several limitations should be considered when interpreting these findings. First, the pilot sample was relatively small (N = 110), limiting statistical power and precision of psychometric properties. Second, participant were recruited from a limited demographic are which may limit the generalizability of the results. Third, cross-sectional data prevented examination of predictive validity, responsiveness to change, and test-retest reliability. Fourth, the study relied on self-reported symptom-management behaviors, which may be subject to recall and social desirability biases. Finally, factor analytic procedures were not conducted because the pilot sample size was insufficient for robust dimensionality testing. Therefore, future studies should

evaluate the underlying factor structure of the HF-SMMI using larger and more heterogeneous samples.

Conclusions

The HF-SMMI fills an important gap in HF self-management research by measuring symptom-specific autonomous motivation, controlled motivation, and amotivation related to edema, dyspnea, fatigue, anxiety, and depression management. Symptom concern was associated with autonomous motivation in theoretically expected ways and less consistently associated with controlled motivation, suggesting that the HF-SMMI captures distinct motivational processes at the symptom level. It demonstrated strong validity and promising psychometric properties. Future research in larger and more diverse HF populations is needed to confirm the factor structure, establish construct validity and test-retest reliability, evaluate responsiveness to change, and assess Rasch measurement properties.

List of abbreviations

The following abbreviations are used in this manuscript:

CMS	Centers for Medicare and Medicaid Services
HF	Heart failure
HF-SMMI	Heart Failure Symptom Management Motivation Instrument
IMB	Information-Motivation-Behavioral Skills
NIC	Nursing Interventions Classification
NOC	Nursing Outcomes Classification

RA	Research Assistant
SDT	Self-Determination Theory
SPMSQ	Short Portable Mental Status Questionnaire
TSRQ	Treatment Self-Regulation Questionnaire

Supplementary Information

The online version contains supplementary material available at xx. **S1**. Content Validity Survey. **S2.** Interview Guide – HFSMMI. **S3.** The Heart Failure Symptom Management Motivation Instrument (HF-SMMI).

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the University of Iowa protocol #202307460 on 08/08/2023. Informed consent was obtained from all subjects involved in the study.

Consent for publication

This study does not contain any identifiable personal data or individual images; therefore, consent for publication is not applicable.

Availability of data and materials

The HF-SMMI data were deposited into the Zenodo repository database and are available at the following URL: https://doi.org/10.5281/zenodo.24013385.

Competing interests

The authors declare no competing interests**.**

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Authors' Contributions

NCFO, KDL, and WL conceptualized the study and drafted the methodology. NCFO and BG analyzed and interpreted the data. NCFO wrote the original draft. All authors read, edited, and approved the final manuscript.

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