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An Evolutionary Concept Analysis in People With Heart Failure—Symptom Clusters or Symptom Cluster Profiles?

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The concept of symptom clusters in heart failure (HF) has been defined and measured inconsistently. We used Rodgers' evolutionary method to review related concepts in the HF literature. Symptom clusters and symptom cluster profiles are characterized by multiple symptoms, a synergistic relationship, and result in a myriad of poor outcomes. Researchers should carefully consider the conceptual differences underpinning symptom clusters and symptom cluster profiles and choose the appropriate concept aligned with their research questions, empirical methods, and target HF population. **Key words:** *concept analysis*, *heart failure*, *symptom*, *symptom cluster*, *symptom cluster profile*

CHRONIC HEART FAILURE (HF) is a significant public health burden; approximately 26 million people worldwide and 6 million people in the United States have HF,[1,2] a complex syndrome resulting in an array of clinical signs and symptoms caused by a functional circulatory abnormality and systemic venous congestion.[1,3] People with HF experience a range of distressing and debilitating symptoms, such as shortness of breath, fatigue, pain, sleep disturbance, and peripheral edema, which contribute to poor quality of life,[4,5] shorter cardiac event-free survival,[6,7] and functional limitations.[8] Symptoms often do not occur in isolation, but they occur in clusters,[9] the co-occurrence of 2 or 3 related symptoms that are independent of other groups of symptoms.[9,10] Compared with individual symptoms, symptom clusters often generate synergistic detrimental effects on health outcomes.[11]

During the past decades, the idea of symptom clusters was a focus of symptom and self-management research.[12,13] Identifying symptom clusters may improve clinicians', patients', and caregivers' management of complex symptoms profiles. Historically, clinicians and researchers focused on symptom clusters primarily in the specialties of psychology, psychiatry, general medicine, and cancer.[14,15] Researchers clarified that the concept of a symptom cluster in cancer was composed of a number of stable symptoms, and may be independent of other clusters,

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Statements of Significance

What is known or assumed to be true about this topic?

- Symptoms may not occur in isolation, often occurring in clusters.
- The concept of a symptom cluster in cancer was composed of stable groups of symptoms, relatively independent of other clusters, and may reveal specific underlying dimensions of symptoms.
- During the past decades, the idea of symptom clusters has been a focus of symptom and self-management research.

What this article adds:

- We clarified the concepts of symptom clusters and symptom cluster profiles and provided overarching definitions and approaches in the context of heart failure.
- The attributes (multiple symptoms, synergistic relationship, and concurrence), antecedents (classification/disease severity, etiology, comorbidities, body mass index, age, gender, insomnia, and culture), and consequences (functional status, quality of life, rehospitalization, mortality, morbidity, death-free survival, and emergency department visit) may be varied based on variable-oriented or person-oriented approaches.
- The choice of an associated concept and an empirical method should be carefully considered on the basis of the research question and the target population of the study.

revealing underlying subgroups of symptoms.[14,15] The concept of symptom clusters has gained increasing importance in relation to HF.[11] Some HF researchers used the symptom cluster definition from the cancer literature, in which the symptom clusters consists of 2 or more symptoms that occur together, but symptoms do not necessarily share the same etiology[10]; however, others have selected definitions in which there is no consensus on the number of symptoms within a cluster.[16] Two conceptual views of symptom clusters have been demonstrated in the literature: person-oriented (grouping of people) and variable-oriented (grouping of variables).[11,12]

Concepts are dynamic with regard to settings and sample. We recognized and acknowledged the fact that underlying biological pathways contribute to common symptoms in a variety of different populations.[17] However, the lack of clarity and consensus on how the concept of symptom clusters or symptom cluster profiles in HF is defined, measured, and analyzed across studies renders the concepts ambiguous as they apply to symptom management among people with HF. In addition, the conceptualization of symptom clusters needs further evaluation with emerging studies in the HF population.[18] Concept analysis is a way to demystify the concept in a particular context and illuminate its scientific uses. With conceptual clarity in the context of HF, nurses and nursing researchers can critically evaluate co-occurring symptoms and initiate interventions targeted at both symptoms within a cluster or the whole cluster, eventually improving the care for people with HF.

The purpose of this concept analysis is to explore the concept of symptom clusters to understand how the concepts have been defined, implemented, and analyzed in people with HF. Clarification of this emerging concept in HF can help future researchers strengthen the conceptual basis for building knowledge of symptom management in HF and facilitate the application into nursing research and practice.

METHODS AND SAMPLING

A basic premise of the evolutionary method of concept analysis is that a concept's

attributes depends on its discursive or nondiscursive uses.[19] Rodgers[19] originally described concept analysis as an inductive, descriptive method of inquiry used to "clarify the current status of a concept by identifying a consensus, to examine the historical or evolutionary background of the concept, and to determine areas of agreement and disagreement in the use of the concept among diverse disciplines." Rodgers' evolutionary method of concept analysis of 6 defined approaches was used for this study[19]: (1) identifying a concept of importance and its associated terms; (2) selecting a setting or sample from which to collect data; (3) collecting the data; (4) analyzing the data (inclusive of identifying key defining attributes, related terms, antecedents, and consequences relating to the concept); (5) identifying a concept exemplar; and (6) identifying the implications, hypotheses, and implications for further development of the concept.

Study selection

Following Preferred Reporting Items for Systematic Reviews guidelines, eligible studies were systematically identified by searching electronic databases CINAHL, PubMed, PsycINFO, Scopus, and MEDLINE in July 2022. The author (Z.W.) identified selected studies using the following selection criteria: studies representing adults (older than 18 years) with HF that were published in English as a full report, including multiple symptoms, symptom cluster, or symptom cluster profile. Studies were excluded if (1) single symptoms were analyzed; (2) data were reported without providing details of the symptoms in each cluster; (3) included people with other chronic diseases, such as diabetes or chronic obstructive pulmonary disease; (4) patients with HF in a cardiac transplant waiting list; or (5) reviews and case studies. Comprehensive key words with Medical Subject Headings (MeSH) terms were used to identify eligible studies. Relevant articles were identified (Z.W.) and discussed with another author (C.T.). In addition, reference lists of eligible studies were used to determine additional studies meeting the selection criteria. The search was limited to the English language and human subjects. No publication year limitation was set because of the incorporation of historical perspectives of the concepts.

Data extraction and analysis

We reviewed the literature to identify data relevant to the attributes of the concept as well as its contextual features such as antecedents, consequences, surrogate terms, and related concepts. As literature was obtained, we assigned each item with an identification number, providing an easier way to track the source in terms of collecting the data. We read and reread each item to identify the general tone and to gain a sense of the concept application. To clarify or generate an idea, we returned to the literature during the data collection and analysis process. All the data were appropriately organized and labeled to identify the significant aspects of the concept. To demonstrate the evolution of the concept trajectory, we started with the earliest publications to the recent publications. In the final stage, we developed a matrix to aid in comparison, pattern identification, evaluation of trends, and recurring themes across sources.

RESULTS

The Figure presents the article selection procedure based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) diagram. A total of 243 articles were identified and screened for eligibility by the authors and university librarian. After removing the duplicate articles (n = 88), 155 article abstracts were screened to verify relevance, resulting in the removal of 120 articles, which did not address either a symptom cluster or multiple symptoms in people with HF. Among the remaining 35 articles, 19 articles were excluded, including review articles (n = 3), conference papers and case studies (n = 3), patients with HF in addition to other chronic diseases (n = 5), and patients on a cardiac transplant waiting list (n = 3), and measured only individual

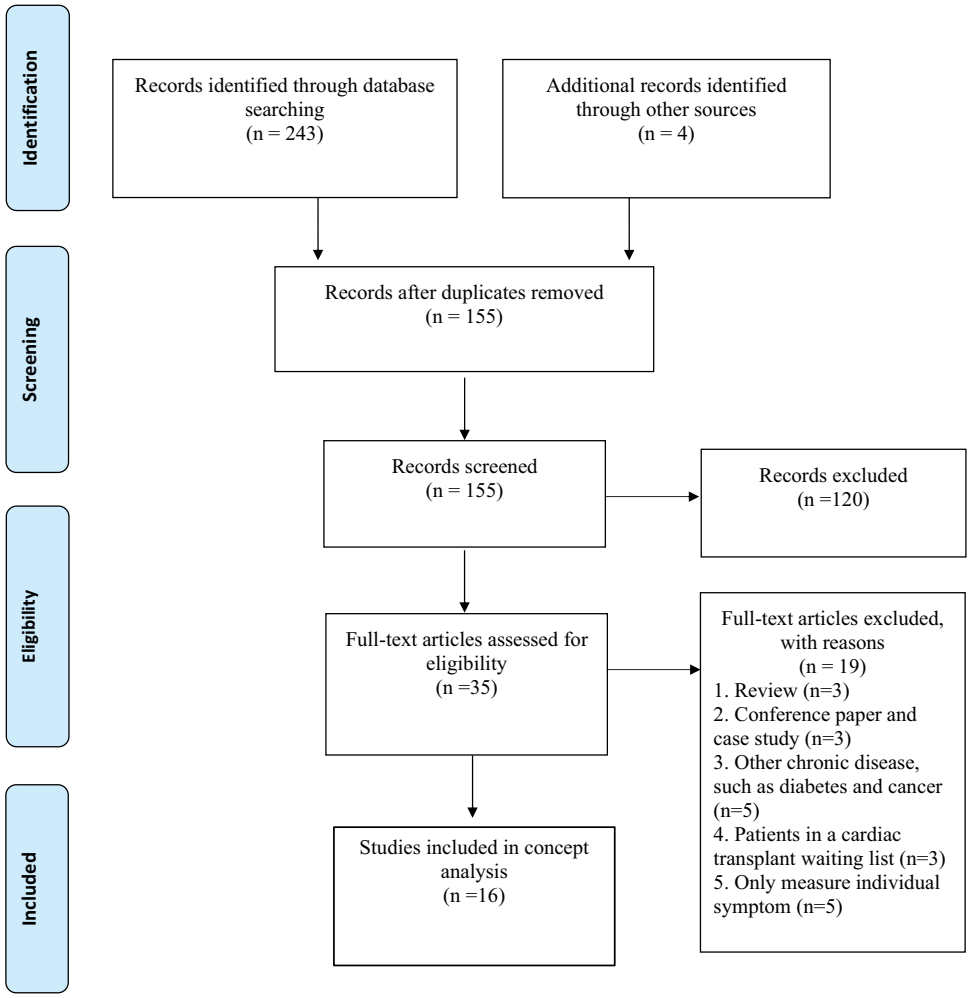

Figure. Flow diagram. This figure is available in color online (www.advancesinnursingscience.com).

symptom in patients with HF (n = 5). A total of 16 articles were included in the final analysis. The attributes, antecedents, consequences, and surrogate terms of symptom clusters and symptom cluster profiles were summarized in Table 1. The definition of symptom clusters and symptom cluster profiles, theory, and analytic approaches was summarized in Table 2.

Attributes

Multiple symptoms

Of the 16 studies reviewed, 10 explicitly identify multiple physical, psychological, and cognitive symptoms as one of the attributes of a symptom cluster in HF and used a variable-oriented approach.[4,7,20-27] The physical cluster (dyspnea, fatigue, and sleep disturbances) and the emotional cluster (worrying, feeling depressed, and cognitive problems) were commonly demonstrated in people with HF.[7,22,28] To determine symptom clusters symptoms, exploratory factor analysis was the dominant method used for the variable-oriented approach. Despite the lack of a general cut point for what was considered a clinically meaningful correlation, symptom clusters were determined as 2 or more symptoms were correlated or

Table 1. Operationalization of Symptom Clusters by Included Studies

Authors (Years)	Antecedents	Attributes	Consequences	Surrogate Terms
Conley et al[29] (2023)	Chronic HF; BMI, β-blockers, insomnia severity	Two or more co-occurring symptoms were classified on the basis of similar response patterns	No report	Symptom cluster profiles; symptom groups
Hertzog et al[30] (2010)	Comorbidities; NYHA, gender, age, BMI	More than one symptom exhibits a unique pattern in certain group of patients	No report	Symptomatic group; groups of people
Herr et al[20] (2015)	NYHA; comorbidity; age; HF etiology	More than one symptom co-occurs	Functional limitation (physical activity, activities of daily living, social activities, and role performance). Mobility	Co-occurrence symptom
Huang et al[6] (2018)	NYHA; LVEF;	Share certain mechanisms	Event-free survival in terms of cardiac hospitalization; all-cause mortality	Co-occurring symptoms
Hu et al[21] (2021)	HF condition, culture	Co-occur; should be interrelated but independent of other groups of symptoms	Quality of life	Co-occurring symptoms
Jurgens et al[27] (2009)	Comorbidities; age	Multiple symptoms with difficulty to perception Multidimensional symptoms	No report	Co-occurrence symptom; concurrent symptoms
Lee et al[7] (2010)	Comorbidities; NYHA; gender; age	Two or more interrelated symptoms occur simultaneously	Cardiac event (death, rehospitalization, emergency department visit due to cardiac causes)	Co-occurrence symptom

(*continues*)

Table 1. Operationalization of Symptom Clusters by Included Studies (*Continued*)

Authors (Years)	Antecedents	Attributes	Consequences	Surrogate Terms
Moser et al[22] (2014)	Individuals with HF in different cultural background	Two or more co-occurring symptoms	No report	A core group of symptoms
Park and Johantgen[28] (2017)	Individual's cultural and personal situation	Highly related to each other	No report	Co-occurring symptoms
Park et al[31] (2019)	Comorbidities, age, sociodemographic, and clinical factors	Two or more symptoms that are related to each other and that occur together	No report	Co-occurring symptoms
Salyer et al[23] (2019)	Comorbidity, age	Symptoms must be related, co-occur, and yet be independent of other groups (clusters) of symptoms	Quality of life	Constellation symptoms; co-occurring symptoms
Sethares et al[24] (2021)	Uncertainty	Two or more symptoms that occur together	No report	Co-occurring symptoms
Sethares and Chin[25] (2021)	Gender, age	Two or more symptoms that occur together	No report	Co-occurrence symptom
Song et al[26] (2010)	Nonpreserved left ventricular systolic function LVEF ≤40%; or preserved systolic function ≥40%; age	Most related to each other	Cardiac-related rehospitalization; cardiac mobility	Coexistence; interrelated symptoms
Yu et al[4] (2016)	Advanced HF	Symptoms related to each other but do not necessarily share the same etiology; they have synergistic effect to complicate the symptom perception	Quality of life	Co-occurring symptoms
Zhang et al[5] (2016)	NHYA, HF classification	Multiple symptoms; highly correlated sets of symptoms	Quality of life	A group of symptoms

Abbreviations: BMI, body mass index; HF, heart failure; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association.

Table 2. Definition, Theory, and Analytic Approaches

Authors (Years)	Symptom Clusters Components	Symptom Cluster Definition	Symptom Cluster Definition	Theory	Analytic Approaches
Conley et al[29] (2023)	Physical (fatigue, pain, anxiety, dyspnea, sleepiness), emotional (anxiety and depression), and all-high symptom clusters (fatigue, pain, anxiety, depression, dyspnea, sleepiness)	Two or more co-occurring symptoms	Kim et al[9] (2005)	No report	Person-oriented (latent class analysis)
Hertzog et al[30] (2010)	Cluster 1 (shortness of breath with activity and fatigue); cluster 2 (highly symptomatic, experiencing shortness of breath at rest, while lying down, and at night as well as with activity, and greater symptom severity); cluster 3 (highly symptomatic, with all members having fatigue, shortness of breath at activity/rest, dizziness, bloating, swelling, and depression)	Concurrent and related symptoms	No report	No report	Person-oriented (hierarchical cluster analysis)
Herr et al[20] (2015)	Sickness behavior (anxiety, depression, daytime function, cognitive function, fatigue); discomforts of illness (shortness of breath, edema, pain), and gastrointestinal distress (appetite, hunger)	Two or three symptoms co-occur, are related but are independent of other groups of symptoms, and are related to a common source	Dodd et al[10] (2001); Kim et al[9] (2005)	Theory of unpleasant symptoms	Variable-oriented (exploratory factor analysis)

(*continues*)

Table 2. Definition, Theory, and Analytic Approaches (*Continued*)

Authors (Years)	Symptom Clusters Components	Symptom Cluster Definition	Symptom Cluster Definition	Theory	Analytic Approaches
Huang et al[6] (2018)	Nonsevere symptom cluster (all symptoms with low severity); typical severity symptom cluster (high level of severity); atypical severity symptom cluster (low level of severity for dyspnea and fatigue, high level of severity for edema, and moderate level of severity for all other symptoms)	Multiple symptoms that are related to each other and that are experienced simultaneously	Aktas et al[15] (2010)	No report	Person-oriented (cluster analysis)
Hu et al[21] (2021)	Fatigue (lack of energy, sleep difficulties, lack of appetite), dyspneic (waking up breathless at night, difficulty breathing when lying flat, shortness of breath), discomfort (sleepiness, dry mouth, sweating), congestive (cough, swollen legs or ankles, bloating, nausea, abnormal urination), ischemic (dizziness, palpitations, chest pain), and emotional (nervousness, anxiety, sadness)	Two or three symptoms co-occur, are related but are independent of other groups of symptoms, and are related to a common source	Dodd et al[10] (2001); Kim et al[9] (2005)	Theory of Unpleasant Symptoms	Variable-oriented (exploratory factor analysis)
Jurgens et al[27] (2009)	Acute volume overload (shortness of breath, tired, sleeping difficult at night); emotional (depressed, worry, difficulty to concentrate); chronic volume overload (swelling, need to rest, dyspnea)	No report	No report	Theory of Unpleasant Symptoms	Variable-oriented (exploratory factor analysis)

(*continues*)

Table 2. Definition, Theory, and Analytic Approaches (*Continued*)

Authors (Years)	Symptom Clusters Components	Symptom Cluster Definition	Symptom Cluster Definition	Theory	Analytic Approaches
Lee et al[7] (2010)	Physical cluster (dyspnea, fatigue, sleep disturbances); emotional cluster (worrying, feeling depressed, and cognitive problems)	Two or more interrelated symptoms occurring together	Kim et al[9] (2005)	No report	Variable-oriented (hierarchical cluster analysis)
Moser et al[22] (2014)	Physical cluster (dyspnea, difficulty in walking, increased need to rest, low energy); emotional cluster (sleep difficulties, worrying, feeling depressed, cognitive problems)	Two or more co-occurring symptoms. Although symptoms within a cluster are strongly related, they do not necessarily share a common etiology	Miaskowski et al[16] (2007)	No report	Variable-oriented (hierarchical cluster analysis)
Park and Johantgen[28] (2017)	Physical cluster (edema, fatigue/increased need to rest, fatigue/low energy, shortness of breath, sleep difficulties); psychological cluster (worrying, feeling depressed, cognitive problems)	Two or more symptoms that are related to each other and that occur together	Kim et al[9] (2005)	No report	Person-oriented (Latent class analysis)
Park et al[31] (2019)	Cluster 1 (low distress); cluster 2 (physical distress); cluster 3 (psychological distress); and cluster 4 (high distress)	Two or more symptoms that are related to each other and that occur together	Kim et al[9] (2005)	No report	Person-oriented (latent class analysis)

(*continues*)

Table 2. Definition, Theory, and Analytic Approaches (*Continued*)

Authors (Years)	Symptom Clusters Components	Symptom Cluster Definition	Symptom Cluster Definition	Theory	Analytic Approaches
Salyer et al[23] (2019)	Sickness behavior cluster (anxiety, depressive symptoms, daytime sleepiness, cognitive function, fatigue); gastrointestinal disturbance (appetite, hunger); discomforts of illness cluster (shortness of breath, edema, pain)	Two or more symptoms that occur together that may or may not have the same etiology	Dodd et al[10] (2001); Kim et al[9] (2005)	Theory of Unpleasant Symptoms	Variable-oriented (principal components analysis)
Sethares et al[24] (2021)	Cluster 1 (cough, palpitations, chest pain, and nausea); cluster 2 (shortness of breath, difficulty breathing, orthopnea, paroxysmal nocturnal dyspnea, decreased activity due to breathing, fatigue, tiredness, difficulty dressing, and waking at night to urinate); and cluster 3 (weight gain, edema, tight shoes, and tight clothes)	Two or more symptoms that occur together that may or may not have the same etiology	Dodd et al[10] (2001)	No report	Variable-oriented (hierarchical agglomerative clustering analysis)

(*continues*)

Table 2. Definition, Theory, and Analytic Approaches (*Continued*)

Authors (Years)	Symptom Clusters Components	Symptom Cluster Definition	Symptom Cluster Definition	Theory	Analytic Approaches
Sethares and Chin[25] (2021)	Cardiac cluster (cough, decreased appetite, palpitations, chest pain, and nausea); shortness of breath cluster (dyspnea, breath hard, orthopnea, paroxysmal nocturnal dyspnea, dyspnea on exertion, need to rest, fatigue, difficulty dressing, and a need to wake night to urinate); edema cluster (weight gain, tight clothes, tight shoes, and edema)	Two or more symptoms that occur together that may or may not have the same etiology	Dodd et al[10] (2001)	No report	Variable-oriented (hierarchical agglomerative clustering analysis)
Song et al[26] (2010)	Dyspneic symptom cluster (shortness of breath, difficulty breathing when lying flat, waking up breathless at night); and weary symptom cluster (lack of energy, lack of appetite, and difficulty sleeping)	No report	No report	No report	Variable-oriented (hierarchical agglomerative clustering analysis)
Yu et al[4] (2016)	Distress cluster (shortness of breath, anxiety, and depression); decondition cluster (fatigue, drowsiness, nausea, and reduced appetite); and discomfort cluster (pain, sense of generalized discomfort)	Constellation of two or more co-occurring symptoms that relate to each other but which do not necessarily share the same etiology	Dodd et al[10] (2001)	No report	Variable-oriented (exploratory factor analysis)

(*continues*)

Table 2. Definition, Theory, and Analytic Approaches (*Continued*)

Authors (Years)	Symptom Clusters Components	Symptom Cluster Definition	Symptom Cluster Definition	Theory	Analytic Approaches
Zhang et al[5] (2016)	Breathlessness cluster (fatigue on daily activities, breathless limiting normal daily activities, and reduced ability to pursue hobbies); psychological distress cluster (stress, depression, and anxiety); sleep quality cluster, insomnia, waking, and lack of refreshing sleep; frailty cluster (eating less food, finding going places away from home difficult, and need to stays in hospital); cognitive/ psychomotor impairment cluster (loss of memory, falls, dizziness, and muscles); respiratory symptoms cluster (cough, wheeze, and breathless at night); and chest pain cluster (chest pain at rest, chest pain at daily activity)	Highly correlated sets of symptoms	No report	No report	Variable-oriented (exploratory factor analysis)

shared higher variances with other symptoms in people with HF. Other studies used hierarchical agglomerative clustering techniques to identify symptom clusters based on the similarity of symptoms within clusters while maximizing dissimilarity between clusters.[7,22,24,25]

Six studies used person-oriented statistical approaches to identifying subgroups of people who shared multiple similar symptoms to determine symptom cluster profiles.[6,7,28-31] Latent class analysis (LCA) is a categorical person-oriented method often used by researchers to determine symptom cluster profiles in people with HF. In addition, LCA is a data-driven approach, which indicates that a priori hypotheses are not required. Regardless of variable-oriented or person-oriented approaches, multiple symptoms are considered an attribute of symptom clusters or symptom cluster profiles. Most included studies examined at least 2 symptoms, yet only a few authors included 2 symptoms within a symptom cluster.[20,29,30] No author described clusters composed of only 1 symptom in a cluster.

Synergistic relationship

The relationships among symptoms within symptom clusters or symptom cluster profiles are synergistic among people with HF. Synergistic effects are developed by the complicated interactions of direct and indirect effects between symptoms. Researchers often described synergistic effects as the co-occurrence of 2 or 3 symptoms, in which symptoms were highly related to or similar to each other but independent of other groups of symptoms. One study determined that fatigue, dyspnea, depression, daytime sleepiness, and cognitive function had the highest correlations among 10 symptoms and had the tendency to become a symptom cluster.[20] The correlation was initiated with each symptom as a separate group and successively merged 2 or more symptoms into a larger cluster. Another study used a pattern matrix where a higher loading indicated a higher shared variance with other symptoms.[27] This study identified 3 symptom clusters that explained a total of 68.1% variance of symptoms' impact, among which the acute volume overload cluster explained the highest variance (45%) compared with the other 2 symptom clusters. Four studies combined symptoms into consecutively larger clusters based on their similarity while maximizing dissimilarity between clusters in patients with HF.[22,24-26]

The synergistic relationship between 2 or more symptoms within a cluster profile should have a combined effect that is greater than arithmetically adding the symptoms on their own. The person-oriented approach often simultaneously included 1 or more identical symptoms in several symptom cluster profiles.[6,28-31] One recent study used LCA to identify 3 daytime symptom cluster profiles, in which multiple symptoms appeared in 3 symptom clusters simultaneously, such as anxiety and depression occurring in emotional and all-high symptom clusters concurrently.[29] Other person-oriented studies used latent profile analysis, a finite mixture model, to identify related subgroups (latent classes) with similar responses to symptoms.[28,31] Psychical and psychological symptoms were frequently observed in different symptom cluster profiles. The relationships of symptoms across clusters or cluster profiles in HF need to be independent regardless person- or variable-oriented approach, otherwise clustered symptoms or clustered symptom profiles cannot be determined. The variable-oriented approach is likely to have 1 symptom occurring in a single cluster at a time. In contrast, the person-oriented approach is likely to encompass 1 or more symptoms in several symptom cluster profiles simultaneously.

Concurrence

Two or more symptoms that occur simultaneously or concomitantly can be regarded as attributes. Four studies were guided by the Theory of Unpleasant Symptoms (TUS),

in which concurrence refers to symptoms occurring together, such as the occurrence of dyspnea, fatigue, and edema.[16,20,21,27] The HF literature defined a symptom cluster as 2 or more concurrent symptoms according to 3 classic references (Table 2).[9,10,32] In addition to these definitions, most studies did not explicitly demonstrate how symptoms within a cluster co-occur among people with HF. With limited studies verifying that clustered symptoms or clustered individuals with HF occurred at a given time, this attribute may be overrated because of unclear descriptions of how concurrently or simultaneously these symptoms were presented in a cluster or a cluster profile. In addition, the stability of symptom clusters or symptom cluster profiles is still not explored in the HF field.

Antecedents

Antecedents of symptom clusters and symptom cluster profiles include HF classification/disease severity, etiology, comorbidities, body mass index (BMI), sleep/insomnia, culture, age, and gender (Table 1). Four studies used the TUS,[33] a middle-range theory, to provide a structured and comprehensive way to understand the antecedents of symptom clusters in HF coordinated with the antecedents of TUS, including physiologic, psychologic, and situational factors.

The New York Heart Association (NYHA) functional classification, a simple way to classify HF based on the severity of symptoms, can be regarded as an antecedent for symptom clusters and symptom cluster profiles among people with HF.[5-7,20,30] One study demonstrated that higher NYHA III-IV stages have a greater impact on the physical distress cluster compared with patients with NYHA I-II.[7] Etiology can be regarded as an antecedent of symptom clusters in HF. Common etiology within a symptom cluster in HF was addressed in 4 studies.[6,20,21,23] Symptoms within a cluster could share a common etiology due to certain pathophysiological mechanisms, which was drawn from the definition of symptom cluster in cancer.[9,10] In other words, symptoms within a cluster in HF may share a common set of causes.[20,21,23] Other researchers argued that complex and multiple etiologies could exist when HF has progressed to an advanced stage.[4] Fatigue had been found to cluster with other debilitating symptoms (eg, nausea, drowsiness, and reduced appetite) in people with advanced HF.[22,27] Having a complex etiology supports that symptom clusters and symptom cluster profiles may be more predictive of diverse outcomes than single symptoms.[22] Despite researchers having adapted various definitions of a symptom cluster, etiology has not achieved consensus in the HF literature due to the absence of research targeting on etiology.

Gender is also an antecedent of symptom clusters and symptom cluster profiles in HF.[7,25,30] Female individuals with HF were likely to report physical distress symptom clusters than males.[7] Two studies also found similar results that gender differences exist in the symptom cluster experience among people with HF.[25,30] Eight studies revealed that age could be an antecedent of symptom clusters and symptom cluster profiles in HF.[7,23-27,30,31] Older people with HF may have more difficulty recognizing subtle symptoms due to reduced physical activity, which can contribute to a more challenging and distressing symptom cluster.[27] Another study demonstrated a contradictory result that younger adults with HF were more likely to express fewer symptoms than older adults.[24] However, younger adults with HF may experience higher psychological/emotional symptom profile than older adults.[7]

Comorbidities, often including hypertension, coronary artery disease, diabetes, chronic lung disease, and atrial fibrillation, were identified as an antecedent.[20,27,30,31] Four studies stated that diabetes was a significant predictor for the emotional symptom clusters.[20,23,27,31] People with HF may not be capable of attributing a symptom to HF because of the presence of comorbid illness, leading to delay in managing symptoms and

seeking proper medical care. Differentiating the origin of symptoms in the presence of comorbidities is challenging. For example, dyspnea, the most common distressing symptom experienced by people with HF, is often clustered with waking up breathless at night and difficulty breathing when lying flat; however, for people with both HF and chronic lung disease, it may be difficult for themselves and clinicians to determine the source of symptoms.[26]

Body mass index might be an antecedent of symptom cluster profiles in people with HF.[29,30] One study demonstrated that all-high symptom cluster profiles, including fatigue, pain, anxiety, depression, dyspnea, and sleepiness, had a higher odds of having a higher BMI than other symptom cluster profiles.[29] Another study also described a similar result that BMI was higher in symptom cluster profiles that were highly symptomatic compared with a symptom cluster profile characterized by few symptoms.[30] Sleep or insomnia can be an antecedent for symptom cluster profiles among people in HF and is associated with individual daytime symptoms. One study found that people in the all-high symptom cluster profile, compared with those in physical and emotional symptom cluster profiles, had higher odds of having more severe insomnia.[29]

Three studies reported that cultural factors might influence symptom clusters in HF and may be an antecedent.[21,22,28] Beliefs and norms within a culture play a role in making decisions about which phenomena should be considered as symptoms of an illness. As the study indicated, individuals with Asian cultural backgrounds were less likely to present distress clusters than those with a Western cultural background.[28] A likely explanation was that individuals with HF from Asian cultures often tried to normalize symptoms so as not to cause worry to families, based on Taoism and Confucianism, in which stoicism is highly valued prohibiting the expression of fear, anxiety, and sadness.

Consequences

The consequences of symptom clusters and symptom cluster profiles were identified across the studies involving several aspects of HF outcomes, including functional status,[20] quality of life,[4,5,21] cardiac event-free survival, morbidity, and mortality.[6,7,26] Symptom clusters can interfere with HF functional outcomes, contributing to functional limitation in activities, such as walking several blocks, climbing stairs, kneeling or stooping, pushing a vacuum cleaner, and lifting or carrying groceries.[20] The interaction of some specific symptom clusters (sickness behaviors and discomforts of illness symptom clusters) was independently associated with functional limitation, meaning functional limitation was more sensitive to detection when these symptom clusters presented.[20]

Symptom clusters could also worsen the health-related quality of life in people with HF.[4,5] Deconditioning, discomfort, and distressing symptom clusters independently predicted quality of life in people with advanced HF.[4,5] In addition, the distressing symptom cluster (depression, anxiety, and shortness of breath) was found to be the most noticeable and predictive cluster on quality of life. The dyspneic symptom cluster independently predicted cardiac death-free survival after controlling for various clinical covariates. In contrast, the weary symptom cluster (lack of energy, lack of appetite, and difficulty sleeping) independently predicted cardiac rehospitalization-free survival after controlling for the same clinical variables.[26] Another study has shown that emotional/cognitive symptom cluster can also independently predict cardiac event-free survival.[7]

Surrogate and related concepts

Researchers applied various terms for the same phenomena in people with HF (Table 1). "Co-occurring symptoms": "concurrent symptoms" are terms that are commonly used as a synonym for symptom clusters and symptom cluster profiles

in HF, which successfully communicate the attributes of multiple symptoms and concurrence.[4,6,7,20,21,23-25,27-29,31] Some researchers also used the terms: "group," "constellation," "grouped symptoms/symptom groups," or "groups of people" to describe symptom clusters or symptom cluster profiles in people with HF.[5,22,23] These terms convey a relatively independent relationship within and across clusters and cluster profiles.

We argue that future studies should use consistent terms for conceptual clarity. For example, researchers who intend to cluster symptoms should use the term "symptom clusters"; and researchers who intend to group people with similar symptoms should use the term "symptom cluster profiles." The choice of an associated term and an empirical method should be carefully considered on the basis of the research question and the target population of the study.

Clarifying the concepts in HF

The authors arrived at the following definitions throughout this concept analysis for people with HF:

Symptom clusters: Two or more symptoms that are related to or occur together, often generated by variable-oriented approaches.

Symptom cluster profiles: Subgroups of people who experience 2 or more symptoms, often generated by person-oriented approaches.

The relationships among symptoms within a cluster or cluster profile are synergistic rather than causal. A symptom cluster or a symptom cluster profile may be independent of other clusters or cluster profiles, reflecting multidimensions of underlying symptoms but may or may not consist of a stable group of symptoms or symptom profiles over time. Relationships among symptoms within a cluster or a cluster profile should be stronger than relationships among symptoms across different clusters or cluster profiles. To compare and distinguish symptom clusters and symptom cluster profiles in people with HF, a constructed exemplar is provided in Table 3. These 2 examples highlight that even when people with HF experience similar symptoms, the approach to recognizing and managing those symptoms can vary greatly.

DISCUSSION

This is the first article to clarify the concepts of symptom clusters and symptom cluster profiles in the context of HF. We arrived at the definitions of symptom clusters and symptom cluster profiles in HF by building the concepts based on the definition of symptom clusters in cancer. Choosing between symptom clusters and symptom cluster profiles should be aligned with research questions, empirical methods, and targeted HF population. More precise etiologies of symptom clusters are possible in the future through the identification of symptom clusters or symptom cluster profiles in HF. Although only 2 articles included objective signs in addition to subjective symptoms,[24,25] the meaning of symptom clusters and symptom cluster profiles in HF should also be broadened in the future, encompassing a broader spectrum of cardiac signs and symptoms, reflecting existing definitions of HF, that is, a recognizable cluster of symptoms.

The surrogate and related concepts of symptom clusters and symptom cluster profiles in HF have similarities with the concept of symptom clusters in patients with cancer.[9] However, symptom clusters in the context of cancer were identified as "symptom experience," "symptom factors," and "symptom dimensions."[9] Other surrogate terms of symptom clusters within the cancer literature regarding general medicine and psychology/psychiatry were "syndromes" or "subsyndromes." They focused on the function of the symptom clusters characterized with 1 or more subtypes of disease. However, these terms have been argued to be an inappropriate surrogate term for symptom clusters.[9] The possible explanation is that the terms do not explain the nature of a

Table 3. Symptom Clusters and Symptom Cluster Profiles Exemplar

Exemplar
Mrs A, a woman in her sixties, was diagnosed with heart failure (NYHA III) 1 y ago. Since then, she has experienced a range of symptoms, including dyspnea, fatigue, pain, sleep disturbances, depressive symptoms, and anxiety. She noticed that some symptoms often occur simultaneously, such as dyspnea, fatigue, and sleep disturbance. She told her health care provider about those co-occurring symptoms, and the health care provider noticed that she had 3 ED visits whenever she reported dyspnea, fatigue, and sleep disturbance. The health care provider looked up literature and told Mrs A that those co-occurring symptoms were called "symptom clusters." The health care provider started to treat these co-occurring symptoms in a cluster to reduce her frequent ED visit.
Mr B, Mr C, and Mrs D, who were diagnosed with heart failure years ago, experienced the same symptoms as Mrs A. They know each other because they live in the same community, and they organized a heart failure support group. During their monthly meeting, they noticed that their symptoms shared a similar pattern. They have experienced similar co-occurring symptoms, such as fatigue, dyspnea, sleepiness, pain, anxiety, and depression, which often results in hospitalization. They talked to other people in the heart failure support group and found that 1 group of people had experienced physical symptoms only (fatigue, pain, dyspnea, and sleepiness), and another group of people had experienced psychological symptoms only (depressive symptoms, worrying, and anxiety). Different groups of people experience distinct symptoms pattern and are associated with different cardiac events. A research team joined this heart failure support group and implemented intervention, aiming to alleviate their symptom burden. This research team found significant improvement among individuals with physical symptom cluster profiles and small to moderate effects on individuals with psychological symptom cluster profiles.

Abbreviation: ED, emergency department.

symptom cluster, such as multiple dimensions and concurrent symptoms. The related concepts are mostly identified in the context of analytic techniques as they reduce dimensions of multiple symptoms to independent symptom groups or individual groups. Of note, none of the surrogate terms of symptom clusters in HF or cancer demonstrate the etiology component.

Although we stressed the magnitude of the correlation between multiple symptoms within a cluster regarding the variable-oriented method, there appears to be no general agreement on the threshold. In contrast to variable-oriented, the person-oriented approach tends to cluster persons who share similar symptoms within a cluster but differ from one another across different clusters. Before conducting the latent class or agglomerative analysis, researchers need to determine the number of clusters to obtain a deeper understanding of the data. No literature discussed incorporating statistical approaches into real symptom experiences for people with HF. Statistically, symptom clusters or symptom cluster profiles can be influenced by many contributing factors, including which symptoms are assessed, how they are measured, what their prevalence is in the selected sample, sample size, and composition of the sample.

Symptoms are multidimensional (eg, timing, intensity, quality, and distress), and researchers should consider and determine which dimension of symptoms is relevant to their research questions and select and choose the appropriate measure accordingly. To guide symptom clusters or symptom cluster profiles research, adopting a theoretical framework into the study design is necessary; however, only 4 included studies in this review used a conceptual framework and they all used the TUS. Future researchers aiming to examine symptom clusters or

symptom cluster profiles should incorporate a theoretical framework into their study design. Theoretical frameworks such as the TUS and the National Institutes of Health Symptom Science Model (NIH-SSM) contribute to a rigorous study structure and reveal the complex symptom experience.[33,34] Adopting theoretical frameworks into study designs could help researchers identify as many influencing factors as possible, such as physiologic, psychologic, and situational factors, and guide researchers to what extent these influencing factors could predict symptom clusters/symptom cluster profiles as well as how symptom clusters/symptom cluster profiles and influencing factors impact the outcome variables (eg, quality of life, functional status, hospitalization/readmission).

Symptoms may frequently appear to cluster clinically but do not cluster consistently with analytic approaches.[14] Researchers must clarify what they consider to be clinically meaningful in symptom clusters or symptom cluster profiles with regard to symptom selection during the study design phase. For example, some researchers have preselected symptoms for specific symptom clusters in patients with cancer.[9] It is important to cooperate with nurses in the clinical setting who routinely work with people with HF to justify the rationale for selecting the symptoms, based on both clinical experience and research evidence. The phenomenon of symptom clusters or symptom cluster profiles in HF may partially represent interrelationships of symptoms. Clinicians should explore the influence of symptoms on each other and choose symptom treatment accordingly.

The attribute of multiple symptoms was partly consistent with the findings of symptom clusters in patients with cancer.[9,14] Person-oriented approaches, such as LCA, have been successfully applied to determine symptom cluster profiles in a diverse population.[35,36] However, LCA has been overlooked by researchers in the area of HF symptom cluster profiles as it is not only applicable for determining symptom clusters at a one-time point but also suitable for exploring symptom cluster membership over time.[37] The stability of symptom clusters or symptom cluster profiles in HF has not been explored, which was a critical attribute in patients with cancer.[9] The stability of symptom clusters or symptom cluster profiles in HF is a necessary component to consider for future research. Symptom clusters in cancer addressed the issue of cluster stability by identifying "core" or "sentinel" symptoms that endured over time.[9] Sentinel or core symptoms within a cluster can serve as an indicator or marker of the presence of a symptom cluster and thus can help assess other related symptoms in the same cluster.[14] Further longitudinal research is warranted in HF, defining the stability of symptom clusters or symptom cluster profiles and how membership changes at different time points. With more HF studies being conducted, researchers may use certain sentinel symptoms as an indicator to further assess other symptoms in the same cluster or cluster profile.

A common etiology of symptom clusters in people with HF was not been revealed, but the cancer literature has consistently suggested the possibility of the common etiology in a cluster as symptoms may vary and contribute to the reasonable assumption that these symptoms may share a common etiology. It is difficult to draw concrete conclusions on etiology due to limited HF studies. As an end-stage disease with complicated comorbidities, HF can cause diverse symptoms from various etiologies. More research is needed to explore the etiological mechanisms or biologic pathways underlying the symptom clusters or symptom cluster profiles in HF, including behavior/psychosocial factors, biomarkers, genetics, and epigenetics. The antecedents are somewhat consistent with the concept of symptom clusters in patients with cancer in nursing; however, it is not consistent with medicine or psychology.[9] Nevertheless, all disciplines in cancer considered that physiological, psychological, and situational factors were necessary for the presence

of a symptom cluster, which could be explained by the TUS.[33] Further studies should investigate both disease and treatment symptom clusters or symptom cluster profiles as treatment-related or illness-related symptoms could appear and group differently in the HF trajectory.

Quality of life is a common performance measured as a consequence of symptom clusters or symptom cluster profiles in people with HF. The presence of symptom clusters or symptom cluster profiles in people with HF may result in poor quality of life, which is consistent with symptom clusters in patients with cancer,[38] leg ulcers,[39] and people with multiple sclerosis.[40] People with HF have identified symptom management as a major priority, with over a quarter of them expressing their willingness to sacrifice almost all of their remaining time to feel better and experience an improved quality of life.[41] However, managing symptom clusters or symptom cluster profiles for people with HF can be challenging and it presents with several systematic disadvantages that can impact their health-related quality of life, including lack of awareness and education, limited access to health care (rural or remote areas), socioeconomic factors (low-income, marginalized communities), and cultural barriers.[21]

The unique challenges and symptoms experienced by the underrepresented population have been recognized in 3 studies, in which participants from cultural minority groups influenced the presentation of symptom clusters in people with HF. In contrast to Western culture, where revealing distress to others is considered acceptable, Asian cultures have been characterized as placing greater emphasis on emotional control and discouraging the open expression of emotions.[21] By assessing socioeconomic factors and recognizing culture as an antecedent for the symptom clusters in people with HF, health care providers can help prevent patients' exacerbations and hospitalizations, reducing health care costs, and improving patient satisfaction. This approach can be especially impactful for people with HF from disadvantaged or underserved communities, who may face greater barriers to accessing optimal health care and may be at a higher risk for poor quality of life. Health care providers can provide a more accurate diagnosis for people with HF, which can lead to more targeted interventions, promoting health equity, and addressing underlying health disparities for people from marginalized communities.

This concept analysis found that symptom clusters or symptom cluster profiles in HF are limited to quantitative studies. Symptom clusters in people with cancer have been studied using qualitative or mixed-methods approaches, which provided more comprehensive evidence to support real symptom clusters' experience based on participants' narratives.[42] Although causal relationships cannot be determined from qualitative studies, a qualitative or mixed-methods study still can offer conceptual evidence for symptom clusters or symptom cluster profiles in HF. To strengthen and advance the symptom cluster and symptom cluster profile research in HF, more qualitative studies are needed to explore the experience from the perspective of individuals, as well as their informal caregivers.[43] Future research could be expanded on biobehavioral mechanisms attempting to strengthen evidence-based strategies for managing symptom clusters and symptom cluster profiles in people with HF.

Limitation

No exemplar inclusive of all the mentioned attributes was found in the literature due to the small sample size of available studies. A larger sample may be needed before it is possible to achieve a consensus in the use, and thus definitions, of symptom clusters and symptom cluster profiles concepts. In addition, this review was incapable of identifying articles from other disciplines, such as medicine or psychology, which generated limited discipline representation since all the included studies were drawn from nursing literature.

CONCLUSION

We analyzed and clarified the concepts of symptom clusters and symptom cluster profiles in HF and provided overarching definitions and approaches for exploring and examining symptom clusters or symptom cluster profiles among people with HF for new insights, contributing to the science and theoretical development. Rodgers' evolutionary method of concept analysis served as the framework for reviewing the literature. The attributes (multiple symptoms, synergistic relationship, and concurrence), antecedents (classification/disease severity, etiology, comorbidities, BMI, age, gender, insomnia, and culture), and consequences (functional status, quality of life, rehospitalization, mortality, morbidity, death-free survival, and emergency department visit) may be varied based on variable-oriented or person-oriented approaches. An increased understanding of the characteristics of symptom clusters and symptom cluster profiles in people with HF may contribute to developing a more effective and timely symptom intervention.

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