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Mechanisms, outcomes, and management of heart failure-associated dysphagia: a scoping review

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ABSTRACT

Background: More than 20% of patients with heart failure (HF) experience dysphagia, or difficulty swallowing. Although a previous review identified several risk factors and highlighted the bidirectional relationship between dysphagia and sarcopenia, it focused primarily on older hospitalized adults, leaving important knowledge gaps across the broader HF population.

Methods: A scoping review was conducted using four electronic databases: PubMed, CINAHL, Embase, and Google Scholar, to identify studies involving adult patients with HF and dysphagia. No restrictions were placed on publication date, study duration, or geographical region.

Results: Thirty-six articles met the inclusion criteria. Key mechanisms of HF-associated dysphagia (HFAD) included cardiomegaly-induced esophageal compression, esophageal dysmotility, and stricture formation. HFAD was associated with adverse outcomes, including dehydration, malnutrition, aspiration, prolonged hospitalization, non-home discharge, and mortality. Reported risk factors included advanced age, systemic inflammation, poor nutritional status, reduced functional independence, female sex, polypharmacy, prolonged hospitalization, dementia, prior cardiac surgeries, and valvular heart disease. Clinical presentations ranged from sudden to gradual onset and included dysphagia, globus sensation, and hoarseness. Reported management strategies included nutritional support, swallowing rehabilitation, HF optimization, pharmacologic therapy, procedural interventions, and follow-up monitoring.

Conclusion: HFAD appears to be a common yet underrecognized comorbidity among individuals with HF and is associated with substantial adverse outcomes. Although early recognition and multidisciplinary management may be beneficial, evidence regarding optimal screening and treatment approaches remain limited. Further research is needed to establish standardized definitions, diagnostic criteria, screening approaches, and management pathways.

Introduction

The prevalence of heart failure (HF) in the United States continues to increase, posing significant public health challenges. In 2023, approximately 6 million Americans were living with HF.[1] More recent data from early 2024 estimated an increase to 6.7 million diagnosed individuals, suggesting a growing burden of this chronic condition.[2] Projections indicate that by 2030, the prevalence of HF may rise further, affecting close to 3.0% of the U.S. population.[3] The increasing prevalence of HF is accompanied by a substantial economic burden. HF-related hospitalizations incur costs estimated between $10,737 and $17,830 per admission, culminating in an annual healthcare expenditure of approximately $18 billion.[4]

Dysphagia, defined as difficulty swallowing or painful swallowing,[5] or a sensation of a lump in the throat,[6] is increasingly recognized among individuals with HF. Emerging evidence suggests that HF-associated dysphagia (HFAD), defined as dysphagia occurring in the context of HF, is prevalent among individuals with HF. In a retrospective analysis of individuals with HF enrolled in the All of Us Research Program, 20.5% experienced dysphagia.[7] Compared with those without dysphagia,

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affected individuals were more likely to be malnourished and report higher levels of fatigue, and perceived their overall health status more negatively.[7] These findings are consistent with a recent scoping review by Suzuki et al., which identified dysphagia as a common complication among hospitalized adults with HF and highlighted advanced age, systemic inflammation, poor nutritional intake, reduced functional independence, poor oral health, antipsychotic medication use, decreased tongue strength, and sarcopenia as factors associated with dysphagia development, while emphasizing the bidirectional relationship between swallowing dysfunction and sarcopenia.[8]

Although Suzuki et al. provided an important foundation for understanding dysphagia in older adults with HF, several knowledge gaps remain. Their review focused primarily on dysphagia development, associated risk factors, and the relationship between dysphagia and sarcopenia in hospitalized adults aged 60 years and older. However, less is known about HFAD across the broader adult HF population, including younger adults and those with diverse HF etiologies and clinical presentations. Moreover, the pathophysiological mechanisms, clinical presentations, adverse outcomes, and management approaches associated with HFAD have not been comprehensively synthesized within a single review.

Therefore, this scoping review synthesized evidence on the mechanisms, prevalence, risk factors, outcomes, and management of HFAD among adults aged 18 years and older. By extending the scope beyond older hospitalized populations, this review provides a broader understanding of HFAD and identifies priorities for research, clinical assessment, and multidisciplinary management.

Methods

Design

A scoping review was conducted to explore the complex and evolving relationship between HF and dysphagia. This approach enables comprehensive examination of diverse evidence, identification of knowledge gaps, and mapping of the current literature regarding dysphagia in HF. The findings of this review are intended to inform future research and clinical practice.

Search strategy

This scoping review followed the Joanna Briggs Institute (JBI) methodology and adhered to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guideline.[9] Although individual studies were appraised for methodological limitations and potential sources of bias, no formal quality assessment tool or quality scoring was applied. No protocol review was registered.

In consultation with a health sciences librarian, the search strategy incorporated Medical Subject Headings (MeSH) and key terms related to dysphagia and HF, including *"dysphagia," "deglutition," "swallow," "heart failure," "cardiac failure," cardiac insufficiency," "heart insufficiency," "heart disease," "cardiac disease," "cardiovascular diseases,"* "*progress,*" *"exacerbat*," "advanc*," "worse*,"* and *"decompensat*"*. A comprehensive search was conducted in four electronic databases: PubMed, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, and Google Scholar. The PubMed search strategy is presented below.

(((((dysphagia[Title/Abstract]) OR (deglutition[Title/Abstract])) OR (swallow*[Title/Abstract])) OR ("Deglutition Disorders"[Mesh])) AND (("Cardiovascular Diseases"[Mesh]) OR (((((((heart failure[Title/Abstract]) OR (cardiac failure[Title/Abstract])) OR (cardiac insufficiency[Title/Abstract])) OR (heart insufficiency[Title/Abstract])) OR (heart disease[Title/Abstract])) OR (cardiac disease[Title/Abstract])) OR (cardiovascular diseases[Title/Abstract]))))) AND (("Disease Progression"[Mesh]) OR ((((((disease progression[Title/Abstract]) OR (progress*[Title/Abstract])) OR (exacerbat*[Title/Abstract])) OR (advanc*[Title/Abstract])) OR (worse*[Title/Abstract])) OR (decompensat*[Title/Abstract]))))

To maximize comprehensiveness, the search was supplemented through screening of gray literature and reference lists of eligible studies. All records were imported into an EndNote reference library, where duplicate records were identified and removed before title and abstract screening.

Inclusion and exclusion criteria

Studies were eligible for inclusion if they involved adults aged 18 years or older diagnosed with HF and addressed dysphagia or swallowing-related outcomes. Given the chronic and progressive nature of HF, no restrictions were placed on publication date or study duration. No geographical limitations were applied to enhance global representation. However, because of limited translation resources, only studies published in English or accompanied by an English-language translation were included.

Selection process

The search identified 1,691 scholarly articles (Fig. 1). After duplicate removal, 1,559 articles remained for title and abstract screening. Following screening, 57 full-text articles were assessed for eligibility. Twenty-one articles were excluded after full-text review, resulting in 36 studies being included in the final synthesis.

A customized data screening and extraction form was developed and pilot-tested on ten included articles. Following pilot-testing, screening and data extraction were performed independently by at least two reviewers. Discrepancies were adjudicated by a third reviewer to ensure consistency. Findings were synthesized narratively across four domains: (1) clinical presentation and mechanisms, (2) diagnostic approaches, (3) prevalence and risk factors, and (4) outcomes and management.

Results

A total of 36 articles were included in this review, consisting of case reports (n=20), literature reviews (n=2), retrospective cohort studies (n=4), prospective cohort studies (n=5), longitudinal studies (n=3), and cross-sectional studies (n=2) (Fig. 1). The studies were conducted in Japan (n=16), the United States (n=14), Cyprus (n=1), the Czech Republic (n=1), Portugal (n=1), Bangladesh (n=1), Lebanon (n=1), and South Korea (n=1). Most case reports originated from the United States (n=13), whereas the majority of observational studies were conducted in Japan (n=15).

Synthesis of results

The included studies described clinical presentations, pathophysiological mechanisms (Fig. 2), prevalence and risk factors (Table 4), clinical outcomes, and management (Fig. 3). Identified mechanisms included cardiomegaly-induced esophageal compression, esophageal dysmotility, and esophageal stricture formation. HFAD was evaluated using diagnostic approaches, including radiographic imaging, echocardiography, esophageal manometry, endoscopy, and videofluoroscopic swallow studies. These modalities characterized structural abnormalities, swallowing function, and dysphagia-related complications. HFAD was associated with dehydration, malnutrition, aspiration, volume overload, prolonged hospitalization, non-home discharge, hospital readmissions, and increased mortality. The literature also described several management strategies aimed at reducing complications and improving swallowing function. A detailed description of the included studies is presented in Table 1, while summary findings are provided in Tables 2 and 3.

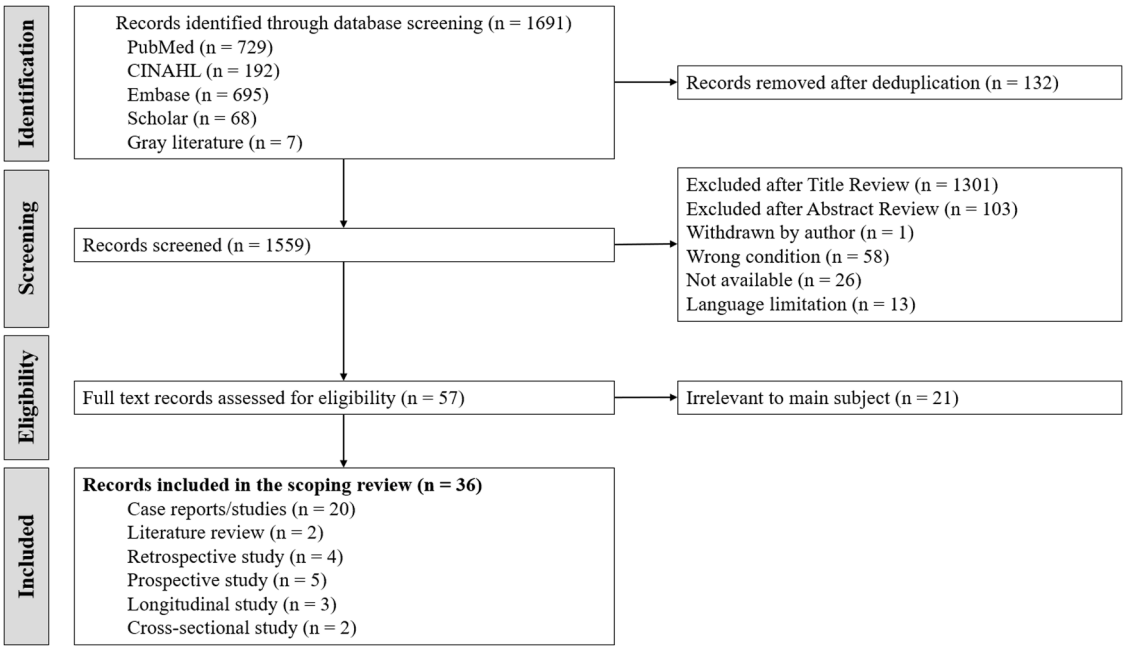

Fig. 1. PRISMA flow diagram illustrating the study selection process for the scoping review.

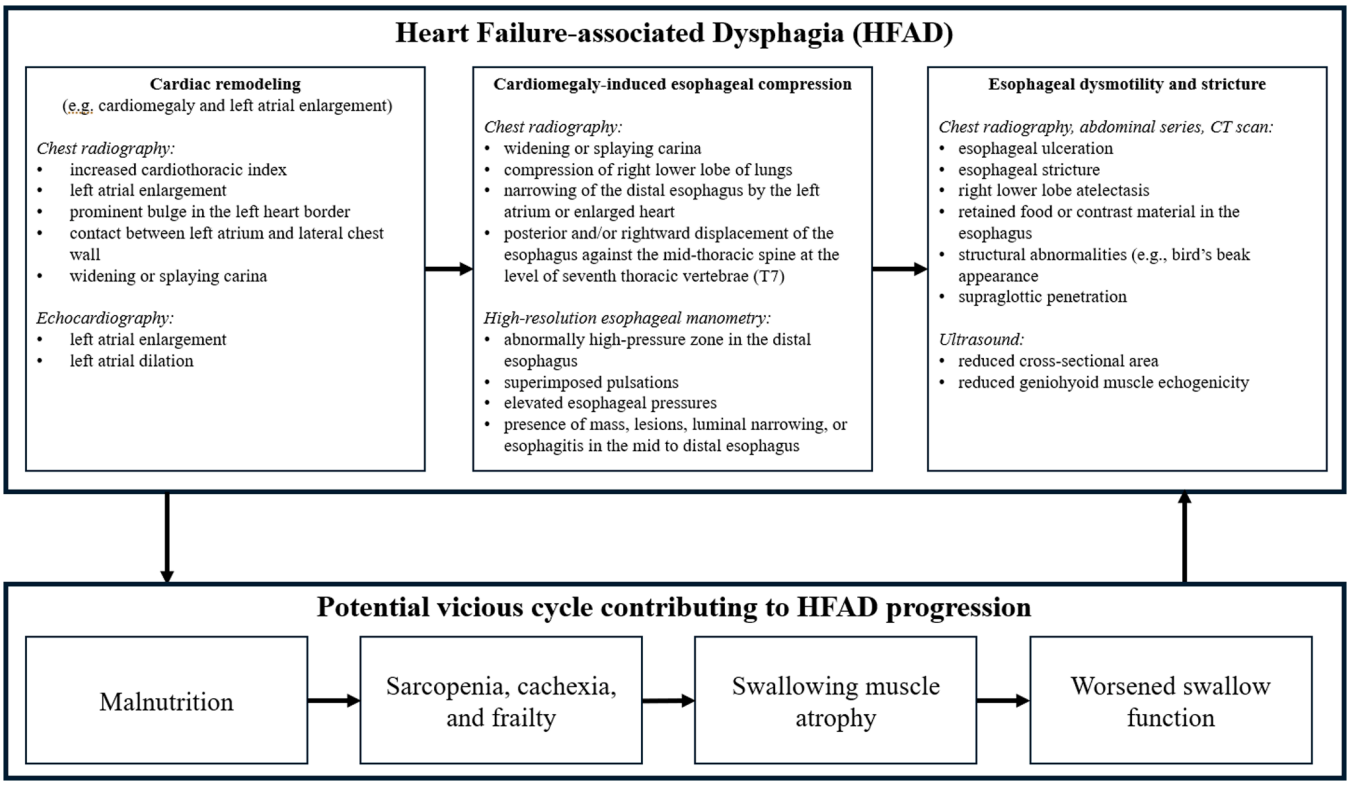

Fig. 2. Proposed pathophysiological mechanisms and vicious-cycle framework of heart failure-associated dysphagia (HFAD).

Clinical presentations

Clinical presentations of HFAD varied considerably across the reported cases.[6,10–19] Common symptoms included painless swallowing difficulty,[12] globus sensation,[6] a feeling of a lump in the throat,[6] and hoarseness of voice.[15] Symptoms developed suddenly or gradually.[11–14,19] In some reports, HFAD occurred in the absence of shortness of breath at presentation,[10] although dyspnea subsequently developed,[11] within days of dysphagia onset.[19] In other cases, HFAD presented insidiously, beginning with difficulty swallowing solid foods and progressing to difficulty swallowing liquids.[16,17] Symptoms duration before presentation ranged from approximately two months to more than eleven months.[12–14,19] Additional symptoms reported across studies included halitosis,[14,20] nausea,[14,18] reduced appetite,[13] gastric regurgitation,[14,18] lethargy,[14] and weight loss.[13,14,17,18,21]

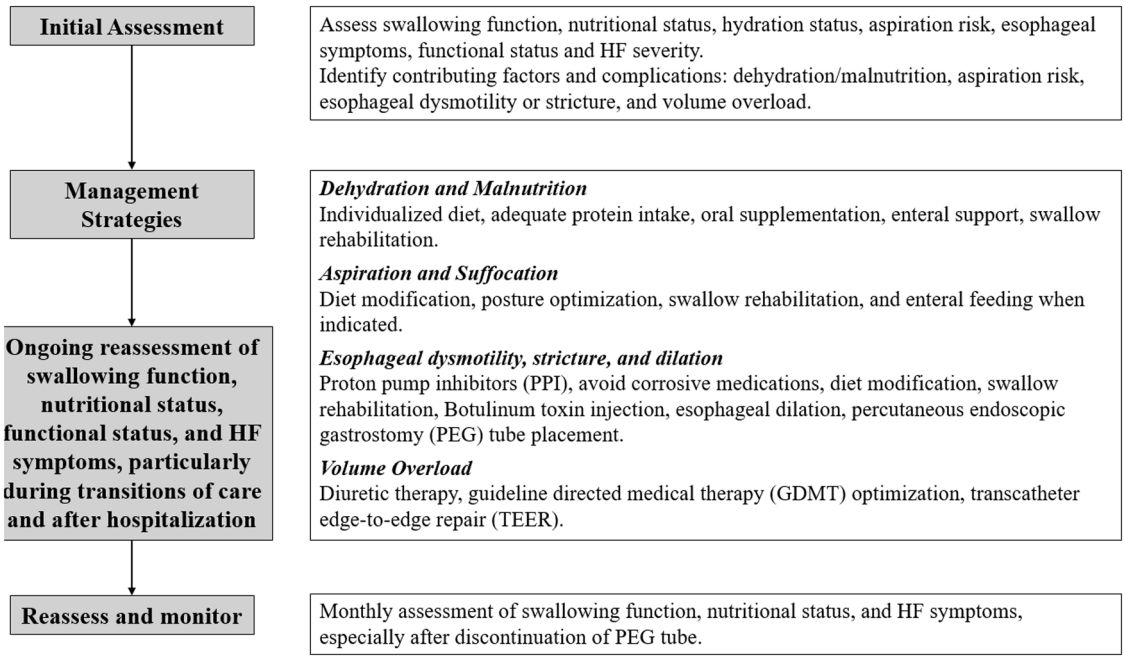

Fig. 3. Proposed multidisciplinary management framework for heart failure-associated dysphagia (HFAD).

Pathophysiological mechanisms of HFAD

HFAD may arise through multiple mechanisms related to HF pathophysiology and its associated complications. Evidence from the included studies suggests that structural cardiac remodeling, particularly cardiomegaly and left atrial enlargement, plays central role in the development of dysphagia. These anatomical changes may cause esophageal compression or displacement impairing bolus transit and swallowing function. The principal mechanisms identified in the literature included cardiomegaly-induced esophageal compression, esophageal dysmotility, and esophageal stricture formation.

Cardiomegaly-induced esophageal compression

Cardiomegaly may contribute to HFAD by exerting extrinsic pressure on the esophagus, leading to mechanical compression or displacement. Imaging studies demonstrated cardiomegaly and left atrial enlargement with displacement and compression of adjacent esophageal structures.

Findings suggestive of cardiomegaly included an increased cardiothoracic index[16] and widening or splaying of the carina.[13,22]

Echocardiographic evaluations frequently demonstrated left atrial enlargement in individuals with HFAD, regardless of whether the underlying cardiomyopathy was dilated or non-dilated.[16,19–22] Anatomically, the enlargement of the left atrium or heart displaced and compressed the esophagus[10,13,16,19,22] posteriorly and toward the right,[16] often against the mid-thoracic spine,[13] at approximately the level of the seventh thoracic vertebra.[22] In some cases, HFAD mimicked other cardiopulmonary conditions, including pulmonary embolism, highlighting the importance of considering esophageal compression in the differential diagnosis once alternative causes have been excluded.[19]

Esophageal manometry further supported the presence of mechanical compression and esophageal dysmotility.[12,22] Characteristic findings included a localized high-pressure zone within the distal esophagus,[22] superimposed pulsations, and elevated intraluminal esophageal pressures.[12] Chronic compression, even in the absence of a discrete mass lesion, or luminal obstruction, was associated with distal esophagitis[17,23] and, in some cases, the development of subepithelial lesions within the mid-esophagus.[22]

Esophageal dysmotility and stricture formation

Persistent esophageal compression resulting from cardiomegaly or left atrial enlargement may lead to esophageal dysmotility and structural abnormalities, including stricture formation. These changes can contribute to progressively worsening swallowing difficulties. Diagnostic imaging identified esophageal ulcerations and strictures.[24] Ultrasonographic assessment of the geniohyoid muscle demonstrated reduced cross-sectional area and decreased echogenicity indicating impaired muscular support for swallowing.[25]

Prevalence and risk factors

The prevalence of HFAD varied across different medical conditions. One study reported that HFAD was more common among those with chronic obstructive pulmonary disease, anemia, and cancer.[26] Surgical interventions, particularly cardiac surgery, were also associated with swallowing difficulties among individuals with HF.[27] In addition, dysphagia appeared to occur more frequently among individuals with coexisting HF and dementia, which may further complicate clinical management.[26,28,29] Conversely, no significant differences in dysphagia prevalence were observed individuals with HF and those with chronic conditions, such as metabolic syndrome or chronic kidney disease.[26] Systemic inflammation was associated with delayed dysphagia recovery and increased one-year mortality.[30]

Across studies, no consistent relationship was observed between left ventricular ejection fraction (LVEF) and HFAD.[26] Although several studies reported preserved[18,28,31] or slightly higher LVEF values among individuals with dysphagia,[28,31] findings were inconsistent, suggesting that LVEF alone is unlikely to reliably predict HFAD.[18,31]

Despite inconsistent findings regarding the relationship between LVEF and dysphagia,[26,28,29,32] the available literature suggests that HFAD appears to be an important comorbidity among individuals with HF.[26] Several reports described HFAD in association with infiltrative cardiomyopathies, giant cell myocarditis and cardiac amyloidosis.[6,15,33–36]

Mitral valve abnormalities were frequently reported among individuals with HFAD. These abnormalities included mitral regurgitation, mitral stenosis, mitral valve prolapse, and mitral annular dilation

Table 1
Study characteristics.

Author (Year) Country	Study Design	Sample (n) Participants	Statistical Analysis	Outcome
Alaws et al. (2024) USA	Case report	1	Not applicable	Volume overload Prolonged hospitalization/ readmission Mortality
Alur et al. (2023) USA	Case report	1	Not applicable	Volume overload
Ashraf et al., (2016) USA	Case report	1	Not applicable	Aspiration/suffocation Esophageal dysmotility/ stricture formation Mortality
Avalos et al. (2022) USA	Case report	1	Not applicable	Volume overload Prolonged hospitalization/ readmission
Eliliwi et al. (2020) USA	Case report	1	Not applicable	Volume overload Prolonged hospitalization/ readmission Mortality
Euell et al. (2024) USA	Case report	1	Not applicable	Volume overload Prolonged hospitalization/ readmission Mortality
Gajanana et al. (2016) USA	Case report	1	Not applicable	Volume overload Malnutrition/dehydration
King et al. (2022) USA	Case report	1	Not applicable	Malnutrition/dehydration
Leonidou et al. (2023) Cyprus	Case report	1	Not applicable	Volume overload
Maesaka et al. (2018) Japan	Case report	1	Not applicable	Aspiration/suffocation Esophageal dysmotility/ stricture formation
Mates et al. (1998) Czech Republic	Case report	1	Not applicable	Aspiration/suffocation Esophageal dysmotility/ stricture formation
Mathew et al. (2020) USA	Case report	1	Not applicable	Dehydration/malnutrition Aspiration/suffocation Esophageal dysmotility/ stricture formation Volume overload Mortality
Matta et al. (2020) Lebanon	Case report	1	Not applicable	Aspiration/suffocation Volume overload
Montasir et al. (2020) Bangladesh	Case report	1	Not applicable	Volume overload
Morgado et al. (2021) Portugal	Case report	1	Not applicable	Volume overload Prolonged hospitalization/ readmission
Mouawad et al. (2017) USA	Case report	1	Not applicable	Malnutrition/dehydration Aspiration/suffocation. Esophageal dysmotility/ stricture formation
Park et al. (2022) South Korea	Case report	1	Not applicable	Malnutrition/dehydration Aspiration/suffocation Volume overload
Sedarat et al. (2006) USA	Case report	1	Not applicable	Aspiration/suffocation Malnutrition/dehydration Esophageal dysmotility/ stricture formation
Stefanescu (2015) USA	Case report	1	Not applicable	Aspiration/suffocation Volume overload
Trivedi et al. (2018) USA	Case report	1	Not applicable	Malnutrition/dehydration Aspiration/suffocation Esophageal dysmotility/ stricture formation Mortality

(*continued on next page*)

Table 1 (*continued*)

Author (Year) Country	Study Design	Sample (n) Participants	Statistical Analysis	Outcome
Matsuo et al. (2020) Japan	Prospective cohort study	149 Hospitalized HF patients	Univariate and multivariate logistic regression	Discharge to non-home setting
Matsuo et al. (2021) Japan	Literature review	Not reported	Not applicable	Malnutrition/dehydration Aspiration/suffocation Mortality
Matsuo et al. (2021) Japan	Prospective cohort study	184 Hospitalized HF patients	Multivariate analysis	Mortality
Matsuo et al. (2021) Japan	Prospective cohort study	203 Hospitalized HF patients with dysphagia before hospitalization, requirement of artificial respiratory management, requirement of cardiac catheter treatment including revascularization, or severe cardiac symptoms (cardiac shock).	Multivariate analysis	Prolonged hospitalization/ readmission Discharge to non-home setting,
Matsuo et al. (2022) Japan	Literature review	Not reported	Not applicable	Malnutrition/dehydration Aspiration/suffocation Discharge to non-home setting
Matsuo et al. (2023) Japan	Prospective cohort study	203 Hospitalized HF patients during study period	Univariate and multivariate analysis	Aspiration/suffocation
Matsuo et al. (2024) Japan	Retrospective cohort study	131 65 years and older without dysphagia with FILS score or 9 or greater before admission	Cox proportional hazards model	Malnutrition/dehydration
Robison et al. (2023) USA	Retrospective cohort study	29,591 Antipsychotic-naïve Veterans hospitalized with HF	Bivariate analysis	Aspiration/suffocation
Yokota et al. (2016) Japan	Cross-sectional study	105 20 years and older, acute HF exacerbation	Unpaired two-tailed t-tests, Chi-square tests, logistic regression analysis, univariate analysis	Volume overload Malnutrition/dehydration Aspiration/suffocation Prolonged hospitalization/ readmission
Yokota et al. (2019) Japan	Longitudinal study	327 Hospitalized HF patients	Logistic regression, multivariate analysis	Volume overload Malnutrition/dehydration Aspiration/suffocation Prolonged hospitalization/ readmission
Yokota et al. (2019) Japan	Longitudinal study	286 Hospitalized HF patients age 20 years and older	Multivariate analysis	Discharge to non-home setting
Yokota et al. (2020) Japan	Longitudinal design	311 Hospitalized HF patients	Propensity score matching, multivariate analysis	Prolonged hospitalization/ readmission
Yokota et al. (2021) Japan	Prospective cohort study	224 Hospitalized HF patients who had cardiac rehabilitation.	Multivariable logistic regression	Malnutrition/dehydration Discharge to non-home setting
Yokota et al. (2022) Japan	Retrospective cohort study	111 HF diagnosis, cardiac rehabilitation during hospitalization, and onset of oral intake impairment following hospital admission	Linear regression	Malnutrition/dehydration Discharge to non-home setting
Yokota et al. (2023) Japan	Retrospective cohort study	360 Admitted HF patients aged 65 years and older, cardiac evaluation or rehabilitation during hospitalization.	Bivariate analysis, propensity score matching	Malnutrition/dehydration Aspiration/suffocation Prolonged hospitalization/ readmission Discharge to non-home settings
Yokota et al. (2023) Japan	Retrospective cohort study	146 Admitted HF patients aged 65 years and older, cardiac evaluation or rehabilitation during hospitalization	Two-wave cross-lagged mediation model	Malnutrition/dehydration Aspiration/suffocation Discharge to non-home settings

Note: FILS = Food Intake Level Scale; HF = heart failure

or calcification.[10,13,16,19,21] Importantly, HFAD persisted in some cases despite successful mechanical mitral valve replacement and normal prosthetic valve function.[13] Tricuspid regurgitation, commonly secondary to annular dilation, was also reported.[16]

Advanced age was one of the most consistently reported risk factors for HFAD,[20,28,31,37] with prevalence reaching 86% among adults older than 75 years.[28] Although older adults represented most HFAD cases, younger individuals, particularly those with giant cell myocarditis, were also affected and presented with globus sensation.[6]

Findings regarding sex-based differences have been inconsistent. Earlier studies reported no significant differences between men and women,[26] whereas more recent research evidence suggested a higher prevalence of HFAD among females.[29] Emerging evidence also identified body weight and body mass index as potential risk factors,[31] although height was not a significantly associated with HFAD.[26] These associations remain incompletely understood and warrant further examination.

Oral health status emerged as another important risk factor for HFAD, particularly among older adults with reduced functional capacity.[38] Poor oral health was associated with impaired swallowing function and delayed recovery from HFAD.[38] Denture use was also associated with greater symptom burden than non-wearers.[26] These

Table 2
Summary of case study/report articles.

Author (Year) Country	Risk of Bias	Case Details	Assessment Findings	Interventions	Outcomes
Alaws et al. (2024) USA	Low	58-year-old woman with multiple myeloma and systemic amyloidosis	Echocardiography and gastric biopsy: consistent with systemic amyloidosis.	None reported	Rapid deterioration, cardiac arrhythmias, and cardiac arrest resulted in death.
Alur et al. (2023) USA	Low	96-year-old man with hypertension, coronary artery disease, HFpEF, chronic kidney disease	Sudden dysphagia to solids and liquids with new oxygen requirements. CT showed left atrial enlargement compressing the esophagus. Echocardiography showed preserved LVEF and biatrial enlargement	Intravenous diuresis	Dysphagia resolved after three days of intravenous diuresis.
Ashraf et al., (2016) USA	Low	63-year-old African American woman with severe nonischemic cardiomyopathy (LVEF 8%), prior mitral valve surgery, atrial fibrillation	Progressive dysphagia from with solids to liquids with 10-lb weight loss in 2 months. EGD showed esophagitis without obstruction or luminal narrowing.	Esophageal dilation; HF directed medical therapy	Dysphagia did not improve after esophageal dilation.
Avalos et al. (2022) USA	Low	64-year-old woman with breast cancer in remission	Readmitted with dysphagia, weight loss, and worsening HF. Echocardiography showed granular myocardium and ventricular hypertrophy. Renal biopsy confirmed amyloidosis.	Intravenous diuresis	Improved HF symptoms.
Eliliwi et al. (2020) USA	Low	64-year-old man with prior prostate cancer and myocardial infarction	Progressive oropharyngeal dysphagia confirmed by VFSS. Autopsy demonstrated systemic amyloidosis.	Thoracentesis	Bradycardia progressed to pulseless electrical activity arrest and death.
Euell et al. (2024) USA	Low	32-year-old man with Celiac disease and recent viral illness	Dysphagia, confusion, and cardiogenic shock. Echocardiography showed LVEF 20%; biopsy confirmed giant cell myocarditis	Mechanical circulatory support (IABP, VA-ECMO, Impella) and heart transplantation	Discharged after heart transplantation.
Gajanana et al. (2016) USA	Low	65-year-old woman with atrial fibrillation and prior mechanical mitral valve replacement	Dysphagia, weight loss, and anorexia. Imaging demonstrated massive left atrial enlargement with esophageal compression and cardiomegaly	Not reported.	Not reported.
King et al. (2022) USA	Low	50-year-old woman with nonischemic cardiomyopathy, atrial fibrillation/flutter, and systemic sclerosis	Progressive solid-food dysphagia and worsening dyspnea. PET CT demonstrated myocardial inflammation consistent with systemic sclerosis.	Not reported.	Not reported.
Leonidou et al. (2023) Cyprus	Low	78-year-old man with chronic atrial fibrillation and severe mitral regurgitation	Progressive solid-to-liquid dysphagia and hoarseness. Imaging demonstrated left atrial enlargement with esophagus compression and cardiac chamber dilation	Optimization of HF therapy	Improved quality of life, functional status, and physical capacity; referred for percutaneous mitral valve repair
Mates et al. (1998) Czech Republic	Low	43-year-old man with recurrent aspiration pneumonia secondary to achalasia	Echocardiography demonstrated a markedly dilated esophagus causing left atrial and left ventricular compression.	Repeated esophageal dilations and removal retained esophageal contents.	Cardiac compression resolved; patient subsequently died from aspiration-related septic shock
Maesaka et al. (2018) Japan	Low	44-year-old woman with giant cell myocarditis, hypertrophic cardiomyopathy, atrial fibrillation, and recurrent HF hospitalization	Odynophagia and dysphagia. *Endoscopy* revealed a deep esophageal ulcer. CT showed left atrial enlargement compressing the esophagus with retained medication	Proton pump inhibitors, soft diet, endoscopic balloon dilation	Swallowing function recovered without ulcer recurrence.
Mathew et al. (2020) USA	Low	71-year-old man with dilated cardiomyopathy and congestive HF	Worsening respiratory symptoms, CT and barium swallow study demonstrated proximal esophageal dilation and compression of the mid and distal esophagus by an enlarged heart.	PEG placement and optimization of HF management	Swallowing function and respiratory symptoms improved, allowing PEG removal and resumption of oral intake. Loss to follow-up was associated with recurrent aspiration, septic shock, and death two years later.
Matta et al. (2020) Lebanon	Low	76-year-old man with dilated cardiomyopathy and coronary artery disease	Progressive solid to liquid dysphagia for 11 months. CT demonstrated giant left atrial enlargement compressing the mid esophagus. Symptoms consistently worsened with congestion and improved with diuresis	Diuresis and surgical atriotomy	Euvolemia was achieved and swallowing function improved.
Montasir et al. (2020) Bangladesh	Low	40-year-old man with mitral stenosis	Progressive dysphagia over 6 months. Imaging demonstrated marked left atrial enlargement causing esophagus compression, severe mitral stenosis, and elevated pulmonary artery pressure	Not reported.	Not reported.
Morgado et al. (2021) Portugal	Low	64-year-old man with hypertension, dyslipidemia, obesity, familial amyloidotic polyneuropathy	Cardiac evaluation demonstrated transthyretin amyloidosis with cardiac involvement cardiac involvement and ventricular tachycardia despite absence of obstructive coronary artery disease	Intensification of diuretic therapy	Developed complete atrioventricular block requiring dual-chamber pacemaker implantation; continued functional decline.

(*continued on next page*)

Table 2 (*continued*)

Author (Year) Country	Risk of Bias	Case Details	Assessment Findings	Interventions	Outcomes
Mouawad et al. (2017) USA	Low	82-year-old man with ischemic cardiomyopathy, atrial fibrillation, hypertension, hyperlipidemia, cerebrovascular accident, and abdominal aortic aneurysm.	Chronic progressive solid-to-liquid dysphagia. Barium swallow demonstrated a distal "*bird beak*" appearance, and CT showed compression of the distal esophagus by a thoracoabdominal aneurysm.	Serial esophageal dilations and PEG placement	Not reported.
Park et al. (2022) South Korea	Low	74-year-old woman with mitral stenosis, aortic stenosis, and prior cerebrovascular disease	Videofluoroscopic swallow study showed supraglottic penetration and extrinsic esophageal compression. CT and echocardiography confirmed left atrial enlargement compressing the esophagus	Thickened liquids, texture-modified diet, positioning strategies, and diuretic therapy	Reduced aspiration risk, decreased esophageal residue, and reduced atrial size.
Sedarat et al. (2006) USA	Low	81-year-old woman with new-onset HF	Barium swallow demonstrated achalasia with marked esophagus dilation. Imaging showed pulmonary edema and left atrial compression caused by retained esophageal contents	Nasogastric tube and botulinum toxin injection	Symptom remission for up to 18 months.
Stefanescu (2015) USA	Low	60-year-old man with Hypertension and chronic neurologic disease	Progressive dysphagia and hoarseness. Cardiac imaging and fat pad biopsy confirmed amyloid light-chain amyloidosis with severe biventricular involvement	Diuresis and chemotherapy (bortezomib and prednisone)	Improved dysphagia and HF-related symptoms.
Trivedi et al. (2018) USA	Low	80-year-old man with coronary artery disease, thoracic aortic aneurysm, and systolic HF	Progressive dysphagia predominantly affecting solids. Barium swallow demonstrated distal esophagus narrowing due to compression from cardiomegaly and calcified thoracic aorta	Dietary modification or surgical intervention depending on severity	Died from hemorrhagic shock secondary to unrelated complications.

Abbreviations: AL=amyloid light chain; CRT-D=cardiac resynchronization therapy with defibrillator; CT=Computed Tomography; EF=ejection fraction; EGD=esophagogastroduodenoscopy; FDG=fluorodeoxyglucose; HF=heart failure; HFpEF=heart failure with preserved ejection fraction; IABP=intra-aortic balloon pump; LA=left atrium; LV=left ventricle; LVEF=left ventricular ejection fraction; NGT=nasogastric tube; PEG=percutaneous endoscopic gastrostomy; PPM=permanent pacemaker; S/P=status post; TTR=transthyretin; VA-ECMO=veno-arterial extracorporeal membrane oxygenation; Val30Met=Valine 30 Methionine; VFSS=Videofluoroscopic swallow study

findings suggest that poor oral health may contribute to both the development and persistence of HFAD. Interestingly, one study reported a lower prevalence of dysphagia among individuals with a history of smoking; however, the underlying mechanism remains unclear, and this finding should be interpreted cautiously.[26]

Pharmacologic factors were also associated with HFAD. Antipsychotic medications and polypharmacy were identified as potential contributors to dysphagia risk.[38,39] Hospitalized individuals with HF who received antipsychotic medications experienced a 1.9-fold higher risk of HFAD compared with those who did not receive these medications (26.2% vs. 12.7%).[39] Dysphagia prevalence varied according to antipsychotic class, occurring in 24.6% of individuals receiving atypical antipsychotics and 23.1% of those receiving typical agents.[39] The concurrent use of both classes was associated with the elevated prevalence of HFAD (33.8%).[39] Additionally, prolonged hospitalization and extended bedrest were associated with worsening swallowing function and a greater risk of HFAD.[24,39]

Clinical outcomes and management

HFAD was associated with a broad range of adverse outcomes. Reported management approaches focused on safe swallowing, complication prevention, HF optimization, and recovery (Fig. 3). Common interventions included swallowing rehabilitation, nutritional support, dietary modification, enteral feeding when indicated, and structured follow up. However, evidence supporting these interventions remains limited and derives largely from observational studies and case reports.

Dehydration and malnutrition

Dehydration was reported among individuals with HFAD and was characterized by findings such as dry mucous membranes[23] and hypotension.[17] Because fluid restriction is often necessary in HF,[20] maintaining adequate hydration while preserving swallowing safety may be challenging.[40] One study reported no difference in time to resumption of oral liquid intake between individuals with and without HFAD.[31]

Malnutrition was frequently associated with HFAD.[18,20,27,28,32] Reduced oral intake, appetite, and dietary variety[18,27,40] were associated with poorer nutritional status[27] and undernutrition.[18,20,27,28,32] Consequences included weight loss,[28] lower body mass index,[18,28] muscle wasting,[18,32] reduced handgrip strength[26] and cachexia,[13] all of which impaired recovery and reduced exercise tolerance.[27] Higher Controlling Nutritional Status scores were also associated with increased morbidity and mortality.[28,31] These findings highlight the close relationship between swallowing dysfunction and nutritional decline.

Aspiration and suffocation risks

Aspiration and airway compromise were among the most commonly reported complications of HFAD. Dysphagia was associated with recurrent aspiration, airway obstruction, pneumonia, and pulmonary infections.[18,41,42] Screening tools included the Repetitive Saliva Swallowing Test,[43] the Water Swallowing Test,[28,43] the Revised Saliva Swallowing Test,[26,28] and the Functional Oral Intake Scale.[20,28,43] Diagnostic evaluation commonly involved chest radiography, computed tomography, esophagogastroduodenoscopy, and videofluoroscopic swallow studies.[12–14,22,23,41] Structural abnormalities included distal esophageal compression,[12,41] barium retention,[22] supraglottic penetration,[22,23] and the characteristic "bird's beak" appearance[14,23,41]

Esophageal dysmotility, stricture, and dilation

Persistent esophageal compression may contribute to dysmotility,

Table 3
Summary of research articles.

Author (Year) Country	Risk of Bias	Methodology, Sample Size, Participants	Major Findings	Conclusions
Matsuo et al. (2020) Japan	Low	Prospective study n=149 Hospitalized patients with HF	Dysphagia was presented in 32.9% of participants at admission and 9.4% after HF stabilization. Participants with dysphagia were older and had poorer nutritional status, muscle strength, physical function, cognitive function, and longer hospital stays.	Dysphagia was independently associated with poorer physical function and reduced recovery during cardiac rehabilitation.
Matsuo et al. (2021) Japan	Low	Literature review	Limited direct evidence linked HF, dysphagia, and sarcopenia. Sarcopenia, cachexic, and reduced oral intake may contribute to dysphagia.	Dysphagia may contribute to malnutrition, dehydration, aspiration, and mortality in HF.
Matsuo et al. (2021) Japan	Low	Prospective study n=184 Hospitalized patients with HF	High systemic inflammation was associated with poorer swallowing function, lower physical function, and reduced nutritional indicators at admission and discharge.	High-grade systemic inflammation was associated with delayed dysphagia recovery, reduced functional recovery, and increased 1-year mortality.
Matsuo et al. (2021) Japan	Low	Prospective study n=203 Patients with HF without dysphagia before hospitalization	Dysphagia developed in 23.4% of participants during hospitalization. Incident dysphagia was associated with older age, poor nutritional status, reduced physical and cognitive function, longer hospitalization, and higher mortality. Readmission rates were not different significantly.	Hospital-acquired dysphagia was independently associated with poorer functional recovery and increased 1-year mortality, but not hospital readmission.
Matsuo et al. (2022) Japan	Low	Literature review	Dysphagia is common among older adults with HF and may adversely affect outcomes. Several medications may worsen or improve swallowing function.	Evidence regarding HF-associated dysphagia remains limited.
Matsuo et al. (2023) Japan	Low	Prospective study n=203 Patients hospitalized for HF during study period	Poor oral health independently predicts incidence of dysphagia and poor swallowing outcomes.	Poor oral health was associated with dysphagia development and reduced swallowing recovery.
Matsuo et al. (2024) Japan	Low	Retrospective study n= 131 Adults 65 years and older without dysphagia, FILS score of 9 or greater before admission	Dysphagia was present in 33% of patients at admission and 18% at discharge. Patients with sarcopenia and nutritional risk had poorer swallowing function and geniohyoid muscle characteristics.	Sarcopenia and nutritional risk were associated with dysphagia in older adults with HF.
Robison et al. (2023) USA	Moderate	Retrospective study n=29,591 Antipsychotic-naïve Veterans hospitalized with HF	Dysphagia occurred in 14% of hospitalized veterans with HF. Antipsychotic use was associated with 1.9-fold higher risk of dysphagia. Risk increased with cumulative antipsychotic exposure.	Antipsychotic use was associated with increased dysphagia risk among hospitalized older Veterans with HF.
Yokota et al. (2016) Japan	Moderate	Cross-sectional study n=105 Adults 20 years and older with acute HF exacerbation	Dysphagia was present in 36.1% of participants with acute HF. Dysphagia was associated with poorer nutritional, functional, and cognitive status and greater HF severity	Mini Mental Status Exam, transthyretin, and Barthel Index scores independent predicted dysphagia.
Yokota et al. (2019) Japan	Low	Longitudinal study n=327 Hospitalized patients with HF	Dysphagia was associated with poorer nutritional status, reduced physical and cognitive function, longer hospitalization, higher mortality, and lower rates of home discharge.	Dysphagia severity independently predicted adverse clinical outcomes.
Yokota et al. (2019) Japan	Low	Longitudinal design n=286 Hospitalized patients aged 20 years and older with HF	Dysphagia was more prevalent among individuals discharged to rehabilitation or long-term care facilities. Lower FOIS scores were associated with non-home discharge.	Dysphagia was independently associated with non-home discharge.
Yokota et al. (2020) Japan	Low	Longitudinal design n=311 Hospitalized patients with HF	Dysphagia was present in 32.7% of patients at admission. Dysphagia was associated with poor nutritional, physical, and cognitive status and higher mortality.	Dysphagia independently predicted worse short-term outcomes, including in-hospital mortality, prolonged hospitalization, and non-home discharge.
Yokota et al. (2021) Japan	Low	Prospective study n=224 Hospitalized patients with HF who had cardiac rehabilitation.	Dysphagia developed in 20.5% of patients during hospitalization. Dysphagia and malnutrition were associated with greater dependence in activities of daily living at discharge.	Dysphagia and malnutrition were associated with reduced functional independence at discharge.
Yokota et al. (2022) Japan	Low	Retrospective study n=111 HF diagnosis, cardiac rehabilitation during hospitalization, and onset of oral intake impairment following hospital admission	Oral intake improved in 59% of patients at discharge. Poorer swallowing function was associated with lower nutritional, physical, and cognitive performance measures.	Maximum tongue pressure, physical performance, and nutritional status were associated with oral intake recovery.
Yokota et al. (2023) Japan	Low	Retrospective study n=360 Patients aged 65 years and older who were admitted for HF and had cardiac	Hospital-acquired disability occurred in 38.1% of participants at discharge. Dysphagia was associated with poorer swallowing function, lower physical	Dysphagia at rehabilitation initiation independently predicted hospital-acquired disability.

(*continued on next page*)

Table 3 (*continued*)

Author (Year) Country	Risk of Bias	Methodology, Sample Size, Participants	Major Findings	Conclusions
		evaluation or rehabilitation during hospitalization.	performance, greater nutritional risk, and higher rates of hospital-acquired disability.	
Yokota et al. (2023) Japan	Low	Cross sectional study n=146 Patients aged 65 years and older who were admitted for HF and had cardiac evaluation or rehabilitation during hospitalization	Physical performance was positively associated with maximum tongue pressure and swallowing function.	Better physical performance was associated with improved swallowing function through its effect on maximum tongue pressure.

Abbreviations: HF=heart failure; FILS=Food Intake Level Scale; FOIS=Functional Oral Intake Score

Table 4
Risk factors and adverse outcomes of heart failure-associated dysphagia.

Risk Factors
Advanced age
Female sex
Reduced functional independence
Sarcopenia and tongue strength
Polypharmacy
Antipsychotic medication use
Prolonged hospitalization and bedrest
Prior cardiac surgeries
Systemic inflammation
Infiltrative cardiomyopathies (e.g., giant cell myocarditis, amyloidosis)
Valvular heart disease (e.g. mitral regurgitation, mitral stenosis, mitral valve prolapse, tricuspid regurgitation, annular dilation, annular calcification)
Mechanical prosthetic valves
Dementia
Poor oral Health
Adverse Outcomes
Dehydration
Malnutrition
Aspiration and suffocation
Volume overload
Hospital readmission
Prolonged hospitalization
Non-home discharge (rehabilitation or long-term care facilities)
Frailty and functional decline
Increased mortality

ulceration, and stricture formation. Conservative management included proton pump inhibitors, avoidance of mucosal injury, and dietary modification.[24] In select patients, more invasive interventions, including botulinum toxin injection,[23] esophageal dilation,[24,42] and percutaneous endoscopic gastrostomy placement,[41] were described in selected cases involving severe structural abnormalities, aspiration risk, or inability to maintain adequate oral intake. Evidence supporting these interventions remains limited.

Volume overload

Several reports described an association between HFAD and manifestations of volume overload. Individuals with HFAD generally exhibited more severe HF symptoms[23,41,42] and findings of congestion, including pulmonary edema,[14,23] elevated pulmonary pressures,[21] and jugular vein distention.[13,17,23] Several reports described improvements in dysphagia following diuretic therapy.[10,16,19,22] However, the extent and durability of these effects remain insufficiently characterized.

Readmission rate and length of hospital stay

HFAD was associated with adverse outcomes, including prolonged hospitalization and greater clinical complexity during HF episodes.[26,28] Individuals with HFAD generally had higher N-terminal-pro-B-type natriuretic peptide levels and poorer functional status.[26,31,43] Between 24% and 33% of hospitalized individuals with HF developed HFAD,[18,25] and 9.4% to 18% remained dysphagic at discharge.[25,32] Prolonged hospitalization was consistently associated with HFAD and poorer functional outcomes.[18,20,28,31,32,39]

One study reported that although antipsychotic exposure was associated with increased HFAD prevalence during acute hospitalization, the prevalence of dysphagia decreased following transfer to skilled nursing facilities, with rates dropping to 4.5%.[39] Although HFAD was associated with functional decline and prolonged hospitalization, evidence regarding its relationship with hospital readmission remains inconsistent, as HFAD was not consistently associated with increased one-year readmission rates,[18] highlighting the need for additional prospective research to clarify the long-term clinical impact of HFAD.

Discharge to non-home settings

Several studies reported as association between HFAD and discharge to non-home settings, including long-term institutions and rehabilitation facilities.[20,28,29,43,44] A Functional Oral Intake Scale score of <5 was an independent predictor of poor physical function and institutional discharge in one study.[28] In another cohort, 38.1% of individuals developed hospital-acquired disability, and approximately half experienced new deficits in activities of daily living by discharge, including difficulties with stair climbing, dressing, and transfers.[31]

Individuals with HFAD generally exhibited poorer physical performance than those without dysphagia. Reported findings included lower handgrip strength,[31,44] diminished Barthel Index scores,[29,31,32,44] worse New York Heart Association functional class, and shorter walking distances before and after hospitalization.[26,28,31,32] Reduced resting energy

expenditure was also observed among some individuals with HFAD despite preserved nutritional status, suggesting potential alterations in metabolic function.[32]

Frailty was frequently reported among individuals with HFAD.[18,23,31,44] Measures associated with frailty included lower Short Physical Performance Battery scores and reduced knee extension strength.[31] Functional assessments, such as the Modified Barthel Index and Modified Self-Assessment Scale also demonstrated poor mobility, self-care capacity, and elf-reported health status among individuals with dysphagia.[26,31] Several studies suggested that recovery of physical function may be prolonged, with some individuals continuing to experience impairments of up to 18 months after hospital discharge.[18,23,31]

Cognitive impairment was also associated with discharge outcomes.[26,31,44] Individuals with HFAD often demonstrated lower Mini-Mental State Examination scores at the initiation of rehabilitation, and poorer cognitive performance was associated with a greater likelihood of institutionalization.[18,26,32] Collectively, these findings suggest that HFAD commonly coexists with frailty, functional limitations, and cognitive impairment, factors likely to influence discharge planning and post-acute care needs.

Mortality

Several studies reported association between HFAD and increased mortality during hospitalization and within the first-year post-discharge.[20,28] HFAD was associated with increased in-hospital and one-year mortality. Potential contributors included recurrent aspiration-related complications,[42] malnutrition,[18] sarcopenia,[18] frailty,[26,28] and functional decline.[26,28]

Discussion

This scoping review synthesized evidence on HFAD mechanisms, clinical presentations, risk factors, outcomes, and management among adults aged 18 years and older. Across the 36 included articles, HFAD emerged as a multifactorial condition that extends beyond swallowing dysfunction alone and appears to be associated with adverse nutritional, functional, and clinical outcomes. Available evidence suggests that HFAD management may require a multidisciplinary approach integrating HF optimization, nutritional support, and swallowing rehabilitation.

Our findings are broadly consistent with those of Suzuki et al.,[8] with nine studies included in both reviews. However, several important distinctions exist. Suzuki et al. focused primarily on hospitalized adults aged 60 years and older and emphasized dysphagia development, associated risk factors, and the relationship between dysphagia and sarcopenia. In contrast, the present review included adults aged 18 years and older, incorporated a broader range of populations and clinical settings, and synthesized evidence regarding pathophysiological mechanisms, clinical presentations, adverse outcomes, and management strategies associated with HFAD. As a result, this review provides a broader framework for understanding HFAD across the adult HF population. Importantly, only nine of the 36 studies included in the present review overlapped with those included by Suzuki et al., further supporting the added scope of the current synthesis.

Consistent with Suzuki et al., advanced age, poor oral health, and antipsychotic medication exposure – were frequently associated with HFAD. Additional risk factors as risk factors identified in this review included female sex, polypharmacy, prolonged hospitalization, dementia, prior cardiac surgery, infiltrative cardiomyopathies, and valvular heart disease, further supporting the multifactorial nature of HFAD.

Suzuki et al. also highlighted the relationship between dysphagia and sarcopenia in older adults with HF,[8] the progressive decline in muscle mass and function.[45] Our review expands this framework by suggesting that swallowing dysfunction occurs within a broader clinical context involving malnutrition, muscle loss, frailty, functional decline, and HF progression. Rather than a simple bidirectional relationship between dysphagia and sarcopenia, the available evidence suggests a more complex vicious cycle involving multiple interrelated physiological and functional processes. This conceptual framework may explain the diverse outcomes associated with HFAD and provides a foundation for future mechanistic research.

HFAD appears to arise through cardiovascular, neuromuscular, nutritional, and gastrointestinal pathways. This heterogeneity likely contributes to variability in clinical presentation and underscores the need for individualized assessment.

A key distinction from Suzuki et al. is the inclusion of management strategies. Although evidence remains limited, the available literature suggests that HFAD management may require multidisciplinary approach combining HF optimization, nutritional support, swallowing rehabilitation, and ongoing follow-up. However, no standardized management pathway currently exists, highlighting an important area for future research.

The lower prevalence of dysphagia observed among smokers was an unexpected finding. Given the established harms of smoking and potential for residual confounding, this should be interpreted cautiously and requires further investigation.

Collectively, these findings suggest that HFAD may represent an indicator of broader clinical vulnerability among individuals with HF. However, substantial knowledge gaps remain regarding its pathophysiology, diagnosis, management, and clinical and economic impacts. Future research should prioritize standardized definitions and diagnostic criteria, objective assessments of swallowing function, diverse patient populations, and prospective evaluation of multidisciplinary interventions to support evidence-based approaches for HFAD prevention and management.

Limitations, implications, and future directions

Several important limitations should be considered when interpreting the findings of this scoping review.

First, much of the available evidence consists of case reports and small observational studies. Although these studies provide valuable clinical insights and help identify emerging patterns, they are inherently limited in their ability to establish causality, quantify risk, or support broader generalization. Consequently, many findings should be regarded as exploratory and hypothesis-generating rather than definitive.

Second, as noted by Suzuki and colleagues (2025),[8] overlap in participant populations across several studies may have reduced the independence of findings and contributed to potential duplication of data. Such overlap complicates the interpretation of the evidence and highlights the need for larger studies involving independent and more diverse cohorts.

Third, the existing base remains geographically concentrated in Japan and is characterized by substantial heterogeneity in study design, patient populations, dysphagia assessment methods, and functional evaluation measures. Restricting inclusion to English-language publications or studies with available English translations may have further limited the evidence base. In addition, subclinical or mild swallowing dysfunction may have been underrecognized, potentially resulting in underestimation of HFAD prevalence and burden.

A major challenge identified across studies is the absence of standardized definitions, screening tools, and diagnostic criteria specific to HFAD. This limitation hinders comparisons across studies, impedes accurate case identification, and complicates evaluation of preventive and therapeutic interventions.

Despite these limitations, this review extends the existing literature by synthesizing evidence across a broader adult HF population than previous reviews and by integrating current knowledge regarding HFAD mechanisms, clinical presentations, outcomes, and management approaches. Future research should prioritize the development and validation of standardized diagnostic algorithms, prospective studies

evaluating proposed mechanistic pathways, and rigorous assessment of multidisciplinary interventions. Emerging technologies, including wearable swallowing monitors and other sensor-based approaches, may facilitate objective, real-time assessment of swallowing function. However, their clinical utility, reliability, cost-effectiveness, and patient acceptability remain to be established.

Conclusion

In summary, HFAD appears to be a relatively common yet underrecognized comorbidity among individuals with HF. This scoping review identified multiple mechanisms that may contribute to HFAD, including cardiomegaly-induced esophageal compression, esophageal dysmotility, and structural esophageal abnormalities. Across the literature, HFAD was associated with adverse outcomes such as malnutrition, frailty, functional decline, prolonged hospitalization, non-home discharge, and mortality. Available evidence suggests that multidisciplinary management approaches involving optimization of HF status, nutritional support, swallowing rehabilitation, and ongoing surveillance may be beneficial in selected patients. The finding also suggests a potentially reinforcing cycle involving dysphagia, malnutrition, sarcopenia, and functional decline that may contribute to adverse clinical outcomes. However, available evidence remains limited by heterogenous study designs, predominance of observational and case-based reports, and the absence of standardized diagnostic criteria. While assessment of swallowing function may be beneficial in selected individuals with HF, additional prospective research is needed before routine screening recommendations can be established. Future research should prioritize the development of consensus definitions, validation of diagnostic approaches, mechanistic studies, and evaluation of multidisciplinary interventions. Such efforts are needed to improve recognition of HFAD and support evidence-based strategies for its prevention and management.

Ethics declaration

This scoping review did not involve human participants, animals, or unpublished primary data; therefore, ethical approval and informed consent were not required.

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CRediT authorship contribution statement

Juvel-Lou P. Velasco: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Sherry Cazares:** Writing – original draft, Investigation, Formal analysis. **Ke Luo:** Investigation, Formal analysis. **Shu-Fen Wung:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no conflicts of interest.

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Data availability

No new data were generated or analyzed during this scoping review. All data supporting the findings are derived from previously published studies were cited within this article. Therefore, data sharing is not applicable.

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