Academy of Nutrition and Dietetics Evidence-Based Practice Guideline for the Management of Heart Failure in Adults

Toni Kuehneman, MS, RDN, LMNT; Mary Gregory, RDN, LDN; Desiree de Waal, MS, RDN, FAND; Patricia Davidson, DCN, RDN, LDN, FAND; Rita Frickel, MS, RDN, LMNT; Carrie King, PhD, RDN, LD; Erica Gradwell, MS, RDN; Deepa Handu, PhD, RDN

SYSTOLIC HEART FAILURE (HF) IS a rapidly growing cardiovascular disorder in the United States. About 6.5 million Americans are living with heart failure, and approximately 650,000 new cases are diagnosed each year.[1,2] The total cost of HF care in the United States exceeds $40 billion annually, with more than half of these costs spent on hospitalizations.[2] HF is the primary diagnosis in >1 million hospitalizations annually.[2] For these patients, the risk for rehospitalizations is high, with a 1-month readmission rate of 25%. Readmissions within 30 days of discharge are not reimbursed by Medicare. Nonadherence with medication and/or diet is the most common cause of these admissions.[3-6] Treatment of HF is a critical issue for the US population from both a quality-of-life and fiscal perspective.

The most common cause of HF is coronary artery disease. Other common risk factors and conditions that can lead to HF are history of myocardial infarction with damage to the heart muscle, poorly controlled hypertension, heart valve disease, alcohol and/or drug abuse, and cardiotoxicity related to cancer therapies. Some conditions or comorbidities are associated with an increased risk for HF, including diabetes, thyroid problems, metabolic syndrome, chronic kidney disease, and obesity.[2,7]

In HF, the heart enlarges, and pumping ability is weakened. An echocardiogram is the diagnostic test for HF. A left ventricular ejection fraction (LVEF) of 40% or less indicates systolic HF, which is often described as heart failure reduced ejection fraction (HF*r*EF). Symptoms of HF include fatigue, exercise intolerance, limited activities of daily living, edema, and shortness of breath.[2]

The classifications for HF are based on the American College of Cardiology Foundation (ACCF)/American Heart Association (AHA) stages and the New York Heart Association (NYHA) functional classification.[2] Comparison of ACCF/AHA stages of HF and NYHA class are provided in Figure 1. Cardiologists and other health care providers use these classifications for determining severity of the patient's symptoms and for considering a treatment plan. Symptoms of HF are managed with medications and diet.

With a weak heart, blood flow is diminished to all organs. The kidney's response to diminished blood flow is vasoconstriction, thus causing the predominant HF symptoms of edema, shortness of breath, and fatigue. Treatment for HF involves both medical and nutrition management. Most medications prescribed for HF are aimed at preventing vasoconstriction or increasing urination. Figure 2 provides a list of the common medications prescribed for patients with HF.[2]

A subset of patients with HF will continue to progress and develop severe symptoms despite optimal treatment. Many terms have been used to describe patients classified with ACCF/AHA stage D, NYHA class IV. These include end-stage HF, refractory HF, or advanced HF.[2,8,9] For the Academy of Nutrition and Dietetics (Academy) guideline for heart failure, advanced HF is used.

In the past, patients with advanced HF were referred for heart transplant in the case that they met the established criteria. While awaiting transplant, a left ventricular assist device (LVAD) was implanted. The LVAD is a mechanical pump that supports heart function and blood flow. With continued research and development, the LVAD became a smaller device easier for the patient to maintain as an outpatient. Consequently, cardiologists no longer consider a LVAD as a bridge to transplant but as destination therapy for many patients with advanced HF.[2,8,9] Registered dietitian nutritionists (RDNs) may encounter these patients in assisted living communities, cardiac rehabilitation programs, and outpatient clinics.

The purpose of the updated Academy Evidence Analysis Library (EAL) guideline for HF is to summarize evidence-based nutrition therapy recommendations for HF in adults. This guideline is intended for the treatment of patients who are diagnosed with HF*r*EF and who present with symptoms; that is, ACCF/AHA stage B, C, and D/NYHA class I through IV. This guideline does not apply to patients with HF preserved ejection fraction, which refers to a diastolic heart condition.[2] The guideline does not address HF in persons with diabetes or chronic kidney disease. Nutrition care in both these comorbidities can be complex and the nutrition care for these patients is covered in the EAL guidelines for type 1 and 2 diabetes,[10,11] and chronic kidney disease management (www.andeal.org/topic.cfm?menu=5303).

This article presents recommendations using the Nutrition Care Process (NCP)[12] as a framework for practice. The recommendations include guidance on MNT and referral to an RDN for individualized nutrition care. Implementation of these recommendations

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https://doi.org/10.1016/j.jand.2018.03.004

ACCF/AHA stage	Stage description	NYHA functional class	Signs and symptoms
A	At high risk for HF but without structural heart disease or symptoms of HF	None	
B	Structural heart disease but without signs or symptoms of HF	I	No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF
C	Structural heart disease with prior or current symptoms of HF	I	No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF
		II	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in symptoms of HF
		III	Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity causes symptoms of HF
		IV	Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest
D	Refractory HF requiring specialized interventions	IV	Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest

Figure 1. Comparison of American College of Cardiology (ACCF)/American Heart Association (AHA) stages of systolic heart failure (HF) and New York Heart Association (NYHA) functional classifications.

will help facilitate evidence-based nutrition practice decisions by RDNs and other health professionals to manage HF symptoms in adults, reduce variations in practice among RDNs, and improve quality of life while taking into consideration individual preferences and personal goals.

The EAL evidence-based nutrition practice guideline for adults with HF targets the following high-priority areas for RDNs:

- MNT;
- energy;
- protein;
- sodium and fluid;
- physical activity; and
- nutrition intake and supplementation, including coenzyme Q10, iron, n-3 fatty acid, thiamin, and vitamin D.

REVIEW METHODOLOGY

In 2014, the Academy Evidence-Based Practice Committee appointed six volunteer expert workgroup members with clinical and/or research experience with HF to update the HF evidence-based nutrition practice guideline originally published in 2008. The guideline workgroup also included an Academy staff project manager and lead analyst.

Nutrition management in HF is considered a nonpharmacologic intervention.[2] Its effectiveness is seen by reduced HF signs and symptoms and improved quality of life for the patient, maintaining optimal nutritional status as evidenced by the patient's renal and biochemical results, and in quality measures (eg, reducing readmissions, length of stay, and mortality). Following the Academy's rigorous 5-step review process[13] and guideline development process for writing evidence-based nutrition practice guidelines,[14] the expert panel developed questions focusing on these outcomes in both patients with chronic HF and patients with advanced HF. The expert workgroup identified questions that addressed major nutrition treatment areas for the management of HF in adults. These areas included effectiveness of MNT, energy, protein, sodium, fluid, physical activity, and nutrition intake and supplementation. Several topics from the previous EAL heart failure guideline were considered, but it was decided that research conducted since publication of the previous project did not add to existing knowledge or strengthen current recommendations. These topics included L-arginine, folate, vitamin B-12, carnitine, and hawthorn berry and were considered to be part of the coordination of care recommendation. The update on alcohol was addressed as part of the sodium and fluid recommendation. The workgroup did not complete a systematic review on physical activity. Instead, it reviewed and chose to incorporate two external guidelines for the development of the recommendation.[2,15]

The systematic evidence review focused on adults aged 19 years and older with HF and LVEF <45% and was

Medication	Function	Examples	Common side effects
Angiotensin-converting enzyme inhibitor	Prevent vasoconstriction	Enalapril, lisinpril, captopril	Persistent nonproductive cough, hyperkalemia, dysgeusia, angioedema
Angiotensin receptor blocker	Prevent vasoconstriction	Irbesartan, candesartan, losartan	Hyperkalemia, hypotension, nausea, angioedema
Beta blocker	Blocks the effects of the hormone epinephrine; prevents further enlargement (remodeling) of the heart muscle	Atenolol, metoprolol, carvedilol	Xerostomia; may mask symptoms of hypoglycemia in people with diabetes
Diuretic	Increases urination by acting on the kidney to rid the body of sodium and water	Furosemide, spironolactone	Muscle cramps, dehydration, electrolyte abnormalities
Combination medication: Valsartan and sacubitril in 1 tablet	Prevents vasoconstriction; sacubitril increases levels of natriuretic peptides that naturally increase diuresis and vasodilation and inhibit fibrosis	Sacubitril/ valsartan	Hyperkalemia, hypotension, angioedema

Figure 2. Common medications specific to adult patients with systolic heart failure.

stratified into two groups: patients with chronic HF (ACCF/AHA stage A, B, and C/NYHA class I through IV) and those with advanced HF (ACCF/AHA stage D/NYHA class IV). Only studies published in peer-reviewed journals in the English language with publication dates from 2000 to 2014 were included. The workgroup considered research utilizing multiple study designs, including randomized controlled trials (RCTs), clinical-controlled trials, cohort (prospective or retrospective) studies, and at least 4 weeks or 1 month in duration. Studies reporting sample sizes <10 subjects per study group or studies with a dropout rate of 20% or greater were excluded. In addition to the criteria listed, studies on the effectiveness of MNT were required to document that the MNT was provided by an RDN using an individualized application of the NCP. A total of 46 questions were developed by the expert workgroup. Using the above-stated criteria, a search strategy for each question was developed and searches were conducted using PubMed and Cochrane database (see Figure 3). Additional studies were identified by manually searching reference lists of reviewed articles, and the ACCF/AHA 2013 HF Guideline report.[2] A total of 173 full-text articles were reviewed, of which 18 articles were included, analyzed, and rated for quality (risk of bias) by trained evidence analysts.[13] The expert workgroup and lead analyst summarized the evidence in 46 conclusion statements. Seventeen recommendations were formulated from the conclusion statements. Recommendations were rated as Strong, Fair, Weak, Consensus, or Insufficient Evidence, according to the Academy's rating scheme of recommendations, and classified as either imperative or conditional.[14] The guideline was reviewed internally and externally during May 2017. The external reviewers consisted of an interdisciplinary group of 10 health professionals who are recognized authorities in HF. The expert workgroup completed its work through regularly scheduled conference calls and shared virtual workspace.

GUIDELINE RECOMMENDATIONS

The 17 major recommendations that compose the 2017 EAL evidence-based nutrition practice guideline for the management of HF in adults (Figure 4) are based on the review and guideline development methodology developed by the Academy[13,14] and detailed above. Recommendations may vary depending on the classification of the patient as HF (NYHA functional class I through IV/AHA stage B and C) or as advanced HF (NYHA functional class IV/AHA stage D). Figure 1 includes a comparison of stages and functional class. All recommendations focus on MNT's effectiveness as indicated by reduced HF signs and symptoms and improved quality of life for the patient, maintaining optimal nutritional status as evidenced by the patient's renal and biochemical outcomes, and in quality measures (reducing readmissions, length of stay, and mortality).

MNT Effectiveness

Recommendations 1 through 3 address MNT effectiveness, duration, and frequency of encounters with an RDN:

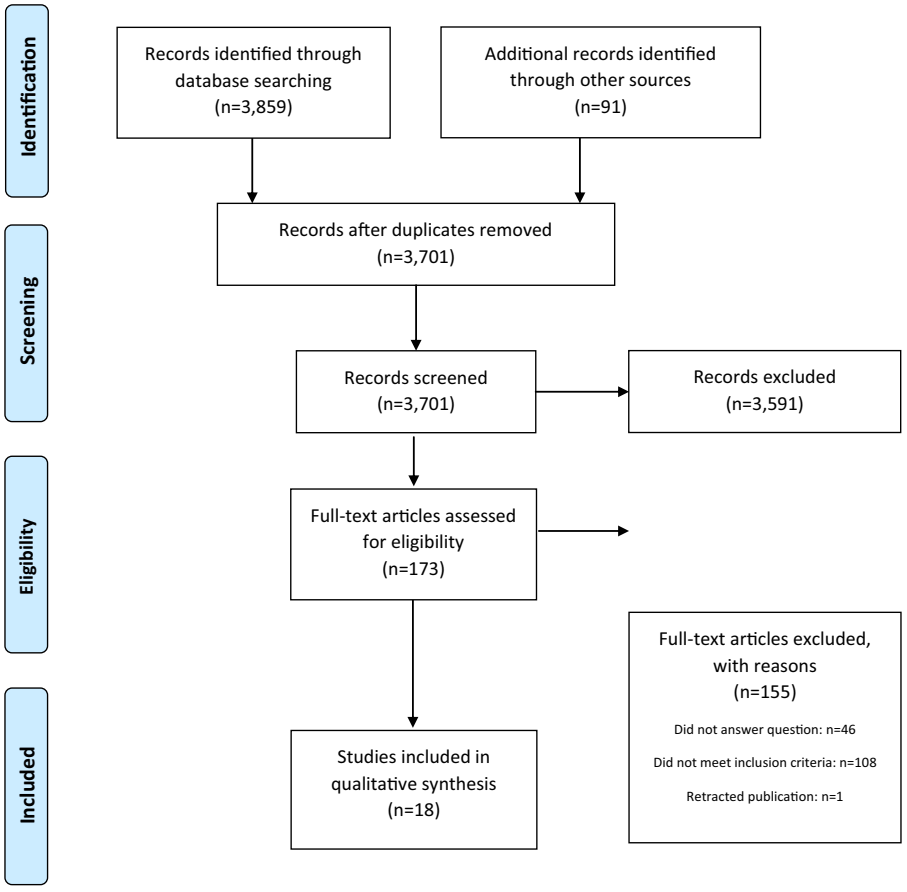

Figure 3. Preferred reporting items for systematic reviews and meta-analyses flow diagram for the Academy of Nutrition and Dietetics Evidence Analysis Library Evidence-Based systematic review for the management of heart failure in adults.

Recommendation 1

MNT in HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). For adults with HF (NYHA functional class I through IV/AHA stage B, C, and D), an RDN should provide MNT to treat HF and contributing comorbidities such as hypertension, disorders of lipid metabolism, diabetes mellitus, and obesity. Every patient with HF should have a clear, detailed, and evidence-based plan of care that ensures the achievement of guideline determined medical therapy (GDMT) goals, effective management of comorbid conditions, timely follow-up with the health care team, appropriate dietary and physical activities, and compliance with secondary prevention guidelines for cardiovascular disease. Research reports that MNT resulted in a notable decrease in sodium intake and maintenance of body weight. **Rating: Strong; Imperative.**

Evidence Reviewed. The 2013 ACCF/AHA Guideline for the Management of Heart Failure[2] reported on the need to provide nonpharmacologic treatment along with the coordinating of care for patients with chronic HF.

Recommendation 2

Frequency and Duration of MNT in HF (NYHA Functional Class I through IV/AHA Stage B and C). For adults with HF (NYHA functional class I through IV/AHA stage B and C), an RDN should provide an initial MNT encounter lasting 30 to 60 minutes, with a follow-up encounter 4 to 6 weeks later and determine whether and when additional MNT encounters are needed. Research reports that this frequency and duration of MNT resulted in a significant decrease in sodium intake, as well as maintenance of serum sodium levels and body weight. **Rating: Fair; Conditional.**

Evidence Reviewed. Two studies were included in the evidence analysis supporting these two recommendations for patients with HF (NYHA functional class I through IV/stage B and C).

Research reported a significant decrease in sodium intake in the dietitian education group who received two 30- to 45-minute sessions of individualized nutrition counseling appointments with an RDN, 4 to 6 weeks apart, compared with the usual care group who received only a self-help educational package. Serum sodium levels were maintained within normal range before and after the trial in both groups. No significant differences were observed in quality of life or body weight between the two groups.[4,16]

No studies were identified concerning the effect of MNT on renal function labs and quality measures (readmission rate, length of stay, and mortality) in HF.

Recommendation	Rating (classification)
Recommendation 1: Effectiveness of MNT[a]	
For adults with heart failure (NYHA[b] functional class I-IV/AHA[c] stage B, C, and D), the RDN[d] should provide MNT to treat heart failure and contributing comorbidities, such as hypertension, disorders of lipid metabolism, diabetes mellitus, and obesity. Every patient with heart failure should have a clear, detailed, and evidence-based plan of care that ensures the achievement of guideline-determined medical therapy GDMT[e] goals, effective management of comorbid conditions, timely follow-up with the health care team, appropriate dietary and physical activities, and compliance with secondary prevention guidelines for cardiovascular disease. Research reports that MNT resulted in a significant decrease in sodium intake and maintenance of body weight.	Strong (imperative)
Recommendation 2: Frequency and duration of MNT	
For adults with heart failure (NYHA class I-IV/AHA stages B and C), the RDN should provide an initial MNT encounter lasting 30-60 min, with a follow-up encounter 4-6 wk later, and determine whether and when additional MNT encounters are needed. Research reports that this frequency and duration of MNT resulted in a significant decrease in sodium intake, as well as maintenance of serum sodium levels and body weight.	Fair (conditional)
Recommendation 3: Frequency and duration of MNT	
For adults with advanced heart failure (NYHA functional class IV/AHA stage D), the RDN should provide an initial MNT encounter and additional follow-up encounters as often as every 2 wk. Research reports that this frequency and duration of MNT resulted in increased exercise tolerance, higher physical component scores on quality of life measures, decreased anxiety, as well as maintenance of body weight.	Fair (conditional)
Recommendation 4: Nutrition assessment	
The RDN should assess the following in adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D) to formulate the nutrition care plan: assess NYHA functional classification, biochemical data, medical tests and medication use; nutrition-focused physical findings; and client food and related history.	Strong (imperative)
Recommendation 5: Assessing energy needs	
If indirect calorimetry is available, the RDN should use a measured RMR[f], which is then multiplied by a physical activity factor to estimate total energy needs in adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D). Measurement of RMR using indirect calorimetry is more accurate than estimating RMR rate using predictive equations.	Consensus (conditional)
Recommendation 6: Assessing energy needs	
If indirect calorimetry is not available, the RDN should use 22 kcal/kg actual body weight (for normally nourished patients) to 24 kcal/kg actual body weight (for malnourished patients) to estimate RMR, which is then multiplied by a physical activity factor to estimate total energy needs in adults with heart failure (NYHA functional class I-IV/AHA stages B and C). In these patients, measured RMR ranged from 22 kcal/kg actual body weight in normally nourished patients to 24 kcal/kg actual body weight in malnourished patients.	Fair (conditional)
Recommendation 7: Assessing energy needs	
If indirect calorimetry is not available, the RDN should use 18 kcal/kg actual body weight to estimate RMR, which is then multiplied by a physical activity factor to estimate total energy needs in adults with advanced heart failure (NYHA functional class IV/AHA stage D). In these patients, the average measured RMR using indirect calorimetry was 1, 610 kcal/d (17.69 kcal/kg actual body weight).	Consensus (conditional)

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Figure 4. Recommendations of the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based nutrition practice guideline for the management of systolic heart failure (HFrEF) in adults.

Recommendation	Rating (classification)
Recommendation 8: Assessing energy needs	
The RDN should multiply the RMR (measured or estimated) by 1 of the following physical activity factors to estimate total energy needs in adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D): • Sedentary: ≥1.0 to <1.4 • Low active: ≥1.4 to <1.6 • Active: ≥1.6 to <1.9 • Very active: ≥1.9 to <2.5 The Dietary Reference Physical Activity Levels represent the ratio of total energy expenditure to basal energy expenditure and are defined as sedentary, low active, active, or very active.	Consensus (imperative)
Recommendation 9: Nutrition intervention	
For adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D), the RDN should individualize energy intake, meeting total estimated energy needs RMR (measured or estimated), which is then multiplied by a physical activity factor for weight maintenance, the prevention of further weight gain or loss, and the prevention of catabolism. Research reports that MNT resulted in maintenance of body weight (a goal of MNT for heart failure) along with effective management of comorbid conditions, such as hypertension, disorders of lipid metabolism, diabetes mellitus, and obesity.	Strong (imperative)
Recommendation 10: Nutrition intervention	
For adults with heart failure (NYHA functional class I-IV/AHA stages B and C) who are also obese, once the patient is considered weight-stable and euvolemic (sodium, fluid, and medication adherent), the RDN may or may not consider intentional weight loss. Purposeful weight loss via healthy dietary intervention or physical activity for improving health-related quality of life or managing comorbidities such as diabetes mellitus, hypertension, or sleep apnea may be reasonable in obese patients with heart failure.	Weak (conditional)
Recommendation 11: Nutrition intervention	
For adults with heart failure (NYHA functional class I-IV/AHA stages B, C, and D), the RDN should individualize protein intake, prescribing at least 1.1 g protein/kg actual body weight to prevent catabolism. Research reports that in patients with heart failure who are either normally nourished or malnourished, reported protein intakes ranging from 1.1-1.4 g/kg actual body weight per day resulted in positive nitrogen balance, whereas protein intakes ranging from 1.0-1.1 g/kg actual body weight per day resulted in negative nitrogen balance.	Fair (imperative)
Recommendation 12: Nutrition intervention	
For adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D), the RDN should individualize sodium and fluid intake, within the ranges of 2,000-3,000 mg sodium/d and 1 to 2 L fluid/d. Research reports that a sodium intake of 2,000-3,000 mg/d and fluid intake of 1-2 L/d resulted in improvements in quality measures (readmissions rate, length of stay, and mortality rate), renal function, and clinical laboratory measures (eg, blood urea nitrogen, creatinine, brain natriuretic peptide, and serum sodium), symptom burden (shortness of breath, difficulty breathing when lying flat, swelling of legs or ankles, lack of energy, and lack of appetite), and body weight.	Fair (imperative)

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Figure 4. *(continued)* Recommendations of the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based nutrition practice guideline for the management of systolic heart failure (HFrEF) in adults.

Recommendation	Rating (classification)
Recommendation 13: Nutrition intervention	
Unless medically contraindicated, the RDN should encourage an individualized physical activity plan for adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D). Regular physical activity is recommended as safe and effective for patients with heart failure who are able to participate to improve functional status and cardiac rehabilitation can be useful in clinically stable patients with heart failure to improve functional capacity, exercise duration, health-related quality of life, and mortality.	Strong (conditional)
Recommendation 14: Nutrition intervention	
For adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D), the RDN should educate on self-care, on topics such as, but not limited to: • Appropriate eating plan based on stage and class of heart failure, as well as other comorbidities; • Energy and protein intake; • Sodium and fluid intake; • Physical activity; and • Self-monitoring of weight and symptoms. Adults with heart failure should receive specific education to facilitate heart failure self-care.	Fair (imperative)
Recommendation 15: Nutrition intervention	
For adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D), the RDN should implement MNT for heart failure and coordinate care as part of an interdisciplinary health care team. Every patient with heart failure should have a clear, detailed, and evidence-based plan of care that ensures the achievement of GDMT goals, effective management of comorbid conditions, timely follow-up with the health care team, appropriate dietary and physical activities, and compliance with secondary prevention guidelines for cardiovascular disease. This plan of care should be updated regularly and made readily available to all members of each patient's health care team.	
Recommendation 16: Nutrition intervention	
For adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D), the RDN should consult with others on the interdisciplinary health care team regarding vitamin, mineral, and herbal supplementation. Due to the many interactions between various supplements and common medications, it is unclear whether certain supplements, such as coenzyme Q10, n-3 fatty acids, vitamin D, iron, and thiamin, are appropriate for patients with heart failure.	Weak (imperative)
Recommendation 17: Nutrition intervention	
The RDN should monitor and evaluate the following in adults with heart failure (NYHA functional class I-IV/AHA stage B, C, and D), to determine the effectiveness of MNT: • NYHA functional classification, which describes the severity of symptoms and exercise intolerance; • Biochemical data, medical tests, and medication use, with special note of brain natriuretic peptide, creatinine, blood urea nitrogen, sodium, and potassium levels; • Nutrition-focused physical findings with emphasis on monitoring weight, edema, shortness of breath, and cachexia; • Client history; and	Strong (imperative)

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Figure 4. *(continued)* Recommendations of the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based nutrition practice guideline for the management of systolic heart failure (HFrEF) in adults.

Recommendation	Rating (classification)
• Food and nutrition-related history with emphasis on sodium and fluid adherence, early satiety, altered sense of taste, eating environment, access to healthy foods, and frequency of restaurant meals. Every patient with heart failure should have a clear, detailed, and continually updated evidence-based plan of care that ensures the achievement of GDMT goals, effective management of comorbid conditions, timely follow-up with the health care team, appropriate dietary and physical activities, and compliance with secondary prevention guidelines for cardiovascular disease.	

[a]MNT=medical nutrition therapy.

[b]NYHA=New York Heart Association.

[c]American Heart Association.

[d]RDN=registered dietitian nutritionist.

[e]GDMT=guideline-directed medical therapy.

[f]RMR=resting metabolic rate.

Figure 4. *(continued)* Recommendations of the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based nutrition practice guideline for the management of systolic heart failure (HFrEF) in adults.

Recommendation 3

Frequency and Duration of MNT in Advanced HF (NYHA Functional Class IV/AHA Stage D). For adults with advanced HF (NYHA functional class IV/AHA stage D), an RDN should provide an initial MNT encounter and additional follow-up encounters as often as every 2 weeks. Research reports that this frequency and duration of MNT resulted in increased exercise tolerance, higher physical component scores on quality of life measures, and decreased anxiety, as well as maintenance of body weight. **Rating: Fair; Conditional.**

Evidence Reviewed. Research showed that subjects in a multidisciplinary intervention group who received four individualized educational sessions from an RDN had increased exercise tolerance, higher physical component scores on quality of life measures, and decreased anxiety vs the control group. In addition, whereas intervention subjects maintained their weight, control subjects gained significantly more weight after 18 months. The RDN group received individualized dietary counseling interventions depending on the patient's body mass index, family's lifestyle, and nutritional status. Additional follow-up visits were via telephone as often as every 2 weeks. The control group only received standardized recommendations to stay on a healthy diet, to target the normal body mass index ranges, to improve physical fitness by exercising on a routine basis, and to seek psychosocial support when needed.[17]

NCP

The remaining 14 practice guideline recommendations are listed in the order of the NCP protocol: assessment, intervention, monitoring, and evaluation.

Recommendation 4

The RDN Should Assess the Following in Adults with HF (NYHA Functional Class I through IV/AHA Stage B, C, and D) to Formulate the Nutrition Care Plan. Assess NYHA functional classification, biochemical data, medical tests, and medication use; nutrition-focused physical exam findings; and client food and related history. **Rating: Strong; Imperative.**

Evidence Reviewed. The ACCF/AHA guideline[2] and the European Society of Cardiology (ESC) guideline[15] state that care should be provided for every patient with chronic HF that facilitates and ensures effective care designed to decrease the patient's signs and symptoms of HF and improve quality of life, improve metabolic profile, and prevent hospitalization and costly readmissions. The guideline also states that palliative and supportive care is effective for patients with symptomatic advanced HF to improve their quality of life.

Following the NCP,[12] when assessing a patient with HF, an RDN should specifically note the echocardiogram results. This result should indicate an LVEF <45%. An RDN should assess the patient's daily sodium and fluid intake, restaurant meal intake vs meals prepared at home, the use of fresh food vs processed food products, recorded daily weight, nutrition-focused physical findings, and current social support. In reviewing biochemical data, special attention should be given to blood urea nitrogen (BUN) and creatinine values. Values at the high end of normal often are associated with adherence with medication and MNT nutrition plan.

Assessing Energy Needs

Assessing energy needs is summarized in Figure 5 and includes the activity factor ranges.

Recommendation 5

Measure Resting Metabolic Rate in Adults with HF (NYHA Functional Class I through IV/AHA Stage B and C). If indirect calorimetry is available, an RDN should use a measured resting metabolic rate (RMR), which is then multiplied by a physical activity factor to estimate total energy needs in adults with HF (NYHA functional class I through IV/AHA stage B, C, and D). Measurement of RMR using indirect calorimetry is more accurate than

Indirect calorimetry	Adult heart failure group	Total energy needs equation	Rating
Available	New York Heart Association functional class I-IV/American Heart Association stages B, C, and D	Measured resting metabolic rate×activity factor[a]	Consensus, conditional
Not available	New York Heart Association functional class I-IV/American Heart Association stages B, C, and D	22-24 kcal/kg× activity factor[a]	Fair, conditional
	Advanced heart failure	18 kcal/kg×activity factor[a]	Consensus, imperative
[a]Sedentary range=1.0 to 1.4, low active range=1.4 to 1.6, active range=1.6 to 1.9, and very active range=1.9 to 2.5 (rating: consensus, imperative).			

Figure 5. Assessing energy needs.

estimating RMR using predictive equations. **Rating: Consensus; Conditional.**

Recommendation 6

Estimate RMR in Adults with HF (NYHA Functional Class I through IV/AHA Stage B and C). If indirect calorimetry is not available, an RDN should use 22 kcal/kg actual body weight (for normally nourished patients) to 24 kcal/kg actual body weight (for malnourished patients) to estimate RMR, which is then multiplied by a physical activity factor to estimate total energy needs in adults with HF (NYHA functional class I through IV/AHA stage B and C). In these patients measured RMR ranged from 22 kcal/kg actual body weight in normally nourished patients to 24 kcal/kg actual body weight in malnourished patients. **Rating: Fair; Conditional.**

Recommendation 7

Estimate RMR in Adults with Advanced HF (NYHA Functional Class IV/AHA Stage D). If indirect calorimetry is not available, an RDN should use 18 kcal/kg actual body weight to estimate RMR, which is then multiplied by a physical activity factor to estimate total energy needs in adults with advanced HF (NYHA functional class IV/AHA stage D). In these patients, the average measured RMR using indirect calorimetry was 1,610 kcal/day (17.69 kcal/kg actual body weight). **Rating: Consensus; Conditional.**

Recommendation 8

Estimate Total Energy Needs Using RMR and Activity Factors in Adults with HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). An RDN should multiply the RMR (measured or estimated) by one of the following physical activity factors to estimate total energy needs in adults with HF (NYHA functional class I through IV/AHA stage B, C, and D):

- Sedentary: ≥1.0 to <1.4,
- Low active: ≥1.4 to <1.6,
- Active: ≥1.6 to <1.9, or
- Very active: ≥1.9 to <2.5.

The Dietary Reference Intakes Physical Activity Levels represent the ratio of total energy expenditure to basal energy expenditure and are defined as sedentary, low active, active, or very active. **Rating: Consensus; Imperative.**

Evidence Reviewed. One positive-quality cross-sectional study was included in the evidence analysis supporting the recommendations. It was conducted in patients with HF (NYHA functional class I through IV/AHA stage B and C).[18] In this study, using indirect calorimetry, RMR ranged from 22 kcal/kg actual body weight in normally nourished patients to 24 kcal/kg actual body weight in malnourished patients.

No studies were available in patients with advanced HF (NYHA functional class IV/AHA stage D) during the search period. However, one study was published after our search was completed but within the guideline development time frame.

Research by Yost and colleagues,[19] patients with advanced HF, using indirect calorimetry, RMR of 18 kcal/kg actual body weight was observed. This retrospective study included demographic characteristics of mean resting energy expenditure of 1,610 kcal/day with mean weight of 91 kg and mean body mass index of 29.6. The study focused on comparing the results of 98 indirect calorimetry studies completed on advanced HF patients seeking a left ventricular device to various predictive equations, with the Brandi equation achieving the highest correlation and the lowest error of the estimate.

In assessing the activity factor, the expert work group reviewed the physical activity guidelines from the Physical Activity Guidelines Advisory Committee Report[20] and the National Academy of Sciences *Dietary DRI Reference Intakes: The Essential Guide to Nutrient Requirements*.[21]

Recommendation 9

Individualize Energy Intake in HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). For adults with HF (NYHA functional class I through IV/AHA stage B, C, and D), an RDN should individualize energy intake, meeting total estimated energy needs and RMR (measured or estimated), which is then multiplied by a physical activity factor for weight maintenance, the prevention of further weight gain or loss, and the prevention of catabolism. Research reports that MNT resulted in maintenance of body weight (a goal of MNT for HF) along with effective management of comorbid conditions such as hypertension, disorders of lipid metabolism, diabetes mellitus, and obesity. **Rating: Strong; Imperative.**

Recommendation 10

Intentional Weight Loss in Obesity and HF (NYHA Functional Class I through IV/AHA stage B and C). For adults with HF (NYHA functional class I through IV/AHA stage B and C) who are also obese, once a patient is considered weight-stable and euvolemic (ie, sodium, fluid, and medication adherent), the RDN may or may not consider intentional weight loss. Purposeful weight loss via healthy dietary intervention or physical activity for improving health-related quality of life or managing comorbidities such as diabetes mellitus, hypertension, or sleep apnea may be reasonable in obese patients with HF. **Rating: Weak; Conditional.**

Evidence Reviewed. One positive-quality, cross-sectional study, Aquilani and colleagues[18] evaluated total energy expenditure and energy intake in 57 nonobese, free-living patients with HF and 49 healthy subjects. In the patients with HF, total energy expenditure was estimated as resting energy expenditure (measured by indirect calorimetry) times 1.3 as a physical activity factor. A total of 54.4% of patients with HF were malnourished (nine had combined protein-calorie malnutrition and 22 had protein malnutrition despite normal body weight). In the normally nourished patients with HF, resting energy expenditure was measured at 1,609±256 kcal/day (21.9±2.4 kcal/kg). However, in malnourished patients with HF, resting energy expenditure was measured at 1,461±192 kcal/day (23.9±2.3 kcal/kg).

The ACCF/AHA guideline states that purposeful weight loss via healthy dietary intervention or physical activity for the purposes of improving health-related quality of life or managing comorbidities such as diabetes mellitus, hypertension, or sleep apnea may be reasonable in obese patients with HF. Because of reports of the development of cardiomyopathy, sibutramine or ephedra weight loss preparations are contraindicated.[2]

The ACCF/AHA guideline also references a suggested *U*-shaped distribution curve that indicates that mortality is greatest in cachectic patients, lower in normal, overweight, and mildly obese patients and higher in more severely obese patients.

Large-scale clinical trials on the role of weight loss in patients with HF with obesity have not been performed.[2]

Recommendation 11

Individualize Protein Intake in HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). For adults with HF (NYHA functional class I through IV/AHA stage B, C, and D), an RDN should individualize protein intake, prescribing at least 1.1 g protein/kg actual body weight to prevent catabolism. Research reports that in patients with HF who are either normally nourished or malnourished, reported daily protein intakes ranging from 1.1 to 1.4 g/kg actual body weight resulted in positive nitrogen balance, whereas daily protein intakes ranging from 1.0 to 1.1 g/kg actual body weight resulted in negative nitrogen balance. **Rating: Fair; Imperative.**

Evidence Reviewed. In Aquilani and colleagues[18] protein intake and nitrogen balance were evaluated in 57 nonobese, free-living patients with HF and 49 healthy subjects. A total of 54.4% of HF patients were malnourished (nine had combined protein-calorie malnutrition and 22 had protein malnutrition despite normal body weight). In the normally nourished patients with HF, protein intake was 1±0.1 g/kg/day, resulting in a negative nitrogen balance of −1.5±2.9 g/day, and in the malnourished patients, protein intake was 1.1±0.1 g/kg, also resulting in a negative nitrogen balance of −1.9±3.3 g/day.

In another research study from Aquilani and colleagues[22] 38 muscle-depleted, normal-weight patients with HF consuming adequate energy-protein intake (energy >30 kcal/kg, protein >1.1 g/kg) were randomized to receive amino acid supplementation (70 kcal/day, 8 g/day protein) or no supplementation for 2 months. At baseline, protein intake was 78±11 g/day (1.4±0.2 g/kg) in supplemented patients and 68±9.6 g/day (1.12±0.16 g/kg) in the control subjects. After 2 months, protein intake was 76±27 g/day (1.3±0.5 g/kg) in the supplemented patients and 67±9.1 g/day (1.1±0.15 g/kg) in the control subjects. Both groups had similar positive nitrogen balance at baseline and after 2 months.

Recommendation 12

Individualize Sodium and Fluid Intake in HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). For adults with HF (NYHA functional class I through IV/AHA stage B, C, and D), an RDN should individualize sodium and fluid intake within the ranges of 2,000 to 3,000 mg/day sodium and 1 to 2 L/day fluid. Research reports that a sodium intake of 2,000 to 3,00 mg/day and fluid intake of 1 to 2 L/day resulted in improvements in quality measures (eg, readmissions rate, length of stay, and mortality rate), renal function, and clinical laboratory measures (eg, BUN, creatinine, brain-type natriuretic peptide [BNP], and serum sodium), symptom burden (eg, shortness of breath, difficulty breathing when lying flat, swelling of legs or ankles, lack of energy, and lack of appetite) and body weight. **Rating: Fair; Imperative.**

Evidence Reviewed. Three studies reported on sodium and fluid intake in patients with HF (NYHA functional class I through IV/AHA stage B, C, and D). One positive-quality 7-year randomized controlled trial using food records[5] reported that among subjects receiving 1 L fluid/day and consuming 2,800 mg sodium/day had significantly reduced BUN and creatinine levels than those consuming 1,800 mg sodium/day. In addition, subjects consuming 2,800 mg sodium/day had serum sodium levels that were increased and maintained within normal limits, whereas subjects consuming 1,800 mg sodium/day had a gradual reduction in serum sodium to below normal limits.[5]

Concerning sodium and fluid intake on quality measures, Paterna[5] reported that among subjects receiving 1 L fluid/day and consuming 2,800 mg sodium/day, significant reductions were achieved in readmissions rate, length of stay, and mortality rate when compared with those consuming 1,800 mg sodium/day. However, one positive-quality prospective cohort study in patients with HF (NYHA functional class I through IV/AHA stage B and C), reported on subjects receiving 2.0 to 2.4 L fluid/day and consuming ≥2,800 mg sodium/day had significantly higher mortality rates than the subjects consuming ≤1,900 mg sodium/day. No patient death was

observed in the middle tertile of 2,000 to 2,700 mg sodium/day.[4]

Two studies noted the effect of sodium and/or fluid intake on quality of life, signs, and symptoms. Paterna[5] reported that among subjects receiving 1 L fluid/day and consuming 2,800 mg/day sodium had significant and sustained reductions in body weight and improvements in NYHA functional class compared with those consuming 1,800 mg/day sodium. In a positive-quality prospective cohort study, Son and colleagues[6] reported that a sodium intake <3,000 mg/day resulted in reduced symptom burden (in terms of frequency and severity of shortness of breath, difficulty breathing when lying flat, swelling of legs or ankles, lack of energy, and lack of appetite) when compared with a sodium intake level >3,000 mg/day. Fluid intake was not reported in this research.[6]

In patients with advanced HF (NYHA functional class IV/AHA stage D), one study reported on biochemical results, mortality, and quality of life. Sparderna[3] reported hyponatremia (<130 mg/dL [3.38 mmol/L]) was associated with fluid intake >2 L/day, an increased risk of deterioration and/or death was associated with frequent consumption of salty foods and/or an increase ratio of fluids to cardiac index, and patients who consumed salty foods were more often likely to be symptomatic as indicated by NYHA functional class IV. No studies were identified that reported on quality measures (eg, readmission rate, length of stay, and mortality rate) or renal function for adults with AHA stage D HF.

A review of the ACCF/AHA guideline for the nonpharmacologic treatment of stated that sodium restriction is reasonable for patients with symptomatic HF to reduce symptom burden. Regarding fluid restriction, the guideline stated that limiting daily fluid intake to 1.5 to 2 L is reasonable in AHA stage D, especially in patients with hyponatremia to reduce congestive symptoms.

Recommendation 13

Encourage Individualized Physical Activity Plan for Adults with HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). Unless medically contraindicated, an RDN should encourage an individualized physical activity plan for adults with HF (NYHA functional class I through IV/AHA stage B, C, and D). Regular physical activity is recommended as safe and effective for patients with HF who are able to participate to improve functional status and cardiac rehabilitation can be useful in clinically stable patients with HF to improve functional capacity, exercise duration, health-related quality of life, and mortality. **Rating: Strong**; **Conditional.**

Evidence Reviewed. The ACCF/AHA guideline for the nonpharmacologic treatment of patients with HF recommends exercise training (or regular physical activity) as safe and effective for patients with HF who are able to participate to improve functional status. In addition, the guideline promotes cardiac rehabilitation programs as useful in clinically stable patients with HF to improve functional capacity, exercise duration, quality of life, and mortality.[2]

The ESC guideline recommends regular aerobic exercise for stable patients with HFrEF to improve functional capacity, symptoms, and to reduce the risk of HF hospitalizations.[15]

Both guidelines recommend a multidiscipline approach to the treatment of HF. Thus, consulting with a physician before beginning an exercise program is recommended.[2,15]

Recommendation 14

Educate on Self-Care for Adults with HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). For adults with HF (NYHA functional class I through IV/AHA stage B, C, and D), an RDN should educate on self-care, especially topics such as but not limited to:

- appropriate eating plan based on stage and functional class of HF, as well as other comorbidities,
- energy and protein intake,
- sodium and fluid intake,
- physical activity, and
- self-monitoring of weight and symptoms.

Adults with HF should receive specific education to facilitate HF self-care. **Rating: Fair**; **Imperative.**

Evidence Reviewed. Both the ACCF/AHA and the ESC guidelines recommend that patients with HF should receive specific education to facilitate HF self-care.[2,15] The NCP model of care (assess, diagnose, intervene/educate, monitor, and evaluate) used by RDNs addresses different barriers to behavior change.[12] The goal of self-care is to reduce the risk of subsequent hospitalizations for HF and to improve the patient's quality of life.[2,15]

Recommendation 15

Coordination of Care for Adults with HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). For adults with HF (NYHA functional class I through IV/AHA stage B, C, and D), an RDN should implement MNT for HF and coordinate care as part of an interdisciplinary health care team. Every patient with HF should have a clear, detailed, and evidence-based plan of care that ensures the achievement of GDMT goals, effective management of comorbid conditions, timely follow-up with the health care team, appropriate dietary and physical activities, and compliance with secondary prevention guidelines for cardiovascular disease. This plan of care should be updated regularly and made readily available to all members of each patient's health care team.

Evidence Reviewed. Both the ACCF/AHA and ESC guidelines strongly encourage the use of multidisciplinary teams during hospitalization and postdischarge in outpatient settings. Follow-up is most important to assess adjustment to HF medical therapy, to evaluate renal function and electrolyte balance; and to reinforce HF education self-care, emergency plans, and the need for adherence to medical and diet therapies. Palliative and supportive care is to be considered for patients with symptomatic advanced HF to improve their quality of life.[2,15]

Recommendation 16

Consult with Interdisciplinary Health Care Team Regarding Vitamin, Mineral, and Herbal Supplementation in HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). For adults with HF (NYHA functional class I through IV/AHA

stage B, C, and D), an RDN should consult with others on the interdisciplinary health care team regarding vitamin, mineral, and herbal supplementation. Due to the many interactions between various supplements and common medications, it is unclear whether certain supplements, such as coenzyme Q10, n-3 fatty acids, vitamin D, iron, and thiamin, are appropriate for patients with heart failure. **Rating: Weak; Imperative.**

Evidence Reviewed: Coenzyme Q10 in HF. In patients with HF (NYHA functional class I through IV/AHA stage B and C), two studies reported on the effect of coenzyme Q10 supplementation on signs and symptoms. One positive-quality RCT selected 55 patients with HF. Twenty-seven patients were placed in the control group receiving 200 mg coenzyme Q10 daily for 6 months and 28 in the placebo group without supplementation. Khatta and colleagues[23] reported that almost three-quarters of patients in their control group classified themselves as neither improved nor worse after 6 months, whereas 6 patients receiving 200 mg/day coenzyme Q10 believed that their symptoms had improved minimally, and one patient believed symptoms had deteriorated. In the placebo group, two patients reported improvement in symptoms and three patients reported increased severity of symptoms. Khatta and colleagues[23] did not report on quality of life improvement.

In the second study reviewed, Keogh and colleagues[24] enrolled 39 patients with HF in a neutral-quality RCT. Nineteen received 150 mg coenzyme Q10 for 3 months and 20 patients were placed in the placebo group. They reported that the control group receiving 150 mg/day oral coenzyme Q10 had a significant improvement of 0.5 units in NYHA function class (P=0.0001) after 3 months, compared with the placebo group, which had no significant change. They did not report on quality of life.

Regarding hospital readmissions, Keogh and colleagues[24] reported no hospital admissions or deaths during the 3-month intervention period within or between groups receiving either 150 mg/day oral coenzyme Q10 or placebo. Research is needed regarding the effect of coenzyme Q10 supplementation on quality measures in patients with HF.

Regarding biochemical results, Keogh and colleagues[24] reported no significant differences in creatinine levels after 3 months within or between control or placebo groups (0.1±0.01 vs 0.1±0.006).

In patients with advanced HF (NYHA functional class IV/AHA stage D), one neutral-quality RCT of 32 patients with advanced HF reported that patients with end-stage HF awaiting cardiac transplantation receiving 60 mg/day Ultrasome-CoQ10 (Herbamed Ltd/New Products Plus [NPP]) for 3 months had improved quality of life and significant decreases in frequency of nocturia, severity of fatigue, severity of dyspnea, and NYHA functional classification, compared with those receiving placebo.[25]

No studies were identified that reported on the effect of coenzyme Q10 supplementation on quality measures (eg, readmission rate, length of stay, and mortality rate) or renal/clinical biochemical results for patients with advanced HF.

However, due to the interactions between coenzyme Q10 and some common HF medications (eg, warfarin, statins, and beta blockers), it is unclear whether coenzyme Q10 is appropriate for patients with stable or advanced HF.[2]

Evidence Reviewed: n-3 Fatty Acid in HF. In patients with HF (NYHA functional class I through IV/AHA stage B and C), three studies were identified concerning the influence of n-3 fatty acid on quality measures and biochemical results. One study was identified on quality of life, signs, and symptoms.

In one neutral-quality RCT involving 70 patients with stable HF, Kojuri and colleagues[26] reported no significant differences in hospitalization or mortality rates during the 6-month study between the control group receiving 2 g/day n-3 polyunsaturated fatty acids or the placebo group. In another positive-quality RCT involving 1,203 patients with stable HF, Masson and colleagues[27] reported no significant differences in mortality rates during the 3-month trial between groups receiving 1 g/day n-3 polyunsaturated fatty acids or placebo. In another positive-quality RCT involving 123 patients with stable HF, Nodari and colleagues[28] reported significantly fewer HF-related hospitalizations during 1 year between groups receiving 2 g/day n-3 polyunsaturated fatty acids compared with placebo (6% vs 30%; P=0.0002).

Three studies evaluated the role of n-3 fatty acids effect on BNP. BNP is a hormone produced by the heart and indicates how well the heart is working. In a patient with HF, BNP ≥100 pg/mL means an increased amount of fluid or high pressure inside the heart. Kojuri and colleagues[26] reported a significant decrease in BNP level after 6 months in the group receiving 2 g/day n-3 polyunsaturated fatty acids (from 1,766.2±1,978.1 pg/mL to 1,159.4±1,430.9 pg/mL; P=0.005), compared with placebo, but the change between groups was not significant. Masson and colleagues[27] reported no significant differences in BNP levels after 3 months within or between groups receiving 1 g/day n-3 polyunsaturated fatty acids or placebo. In a neutral-quality RCT involving 76 patients for 3 months, Zhao and colleagues[29] reported significant decrease in BNP levels after 3 months in the control group receiving 2 g/day n-3 polyunsaturated fatty acids (from 812±296 pg/mL to 674±216 pg/mL; P=0.024), compared with placebo, and the change between groups was also significant (P<0.001).

One study was identified regarding quality of life, signs, and symptoms. Nodari and colleagues[28] stated that the group receiving 2 g/day n-3 polyunsaturated fatty acids for 1 year had a significant decrease in NYHA functional class (from 1.88±0.33 to 1.61±0.49 units) compared with an increase in the placebo group (1.83±0.38 to 2.14±0.65 units; P<0.001 between groups).

The ACCF/AHA HF guideline[2] states that n-3 polyunsaturated fatty acid supplementation is reasonable to use as adjunctive therapy in patients with NYHA functional class II through IV symptoms, unless contraindicated, to reduce mortality and hospitalizations. It is important to note that because n-3 fatty acid supplementation may increase the effects of blood-thinning agents such as warfarin, aspirin, clopidogrel, and vitamin E, the appropriate dose and duration of n-3 fatty acids is a coordination of care decision.[2]

No studies were identified for patients with advanced failure concerning the effects of n-3 fatty acids on quality measures (eg, readmission rate, length of stay, and mortality rate), signs and symptoms, or biochemical results.

Evidence Reviewed: Vitamin D in HF. In patients with HF (NYHA functional class II through V/AHA stage B and C), one positive-quality RCT involving 101 patients with stable HF was identified. Schroten and colleagues reported on the effect of vitamin D supplementation on quality measures and biochemical results. In patients with HF (NYHA functional class I through IV/AHA stage B and C), this research stated that among patients randomized to either the intervention group receiving 2,000 IU oral vitamin D-3 daily for 6 weeks or the control group, the two adverse events that occurred during the study (one death and one hospitalization) were not associated with the vitamin D supplementation.

Regarding biochemical results, Schroten and colleagues[30] reported that in patients randomized to either the intervention group receiving 2,000 IU oral vitamin D-3 daily for 6 weeks or the control group, there were no significant differences within or between groups in regard to BNP results. However, due to the interactions between vitamin D and some common medications (eg, oral corticosteroids, thyroxin, antiepileptics, tetracyclines, and quinolones), it is unclear whether this dose and duration of vitamin D would be appropriate for patients with HF.

No studies were identified concerning vitamin D supplementation with patients with advanced HF.

Evidence Reviewed: Iron and Thiamin in HF. No studies were identified concerning iron or thiamin supplementation with stable HF or advanced HF.

Recommendation 17

Monitor and Evaluate Effectiveness of MNT in HF (NYHA Functional Class I through IV/AHA Stage B, C, and D). An RDN should monitor and evaluate the following in adults with HF (NYHA functional class I through IV/AHA stage B, C, and D), to determine the effectiveness of MNT:

- NYHA functional classification, which describes the severity of symptoms and exercise intolerance;
- biochemical data, medical tests, and medication use, with special note of BNP, creatinine, BUN, sodium, and potassium levels;
- nutrition-focused physical findings with emphasis on monitoring weight, edema, shortness of breath, and cachexia;
- client history; and
- food and nutrition-related history with emphasis on sodium and fluid adherence, early satiety, altered sense of taste, eating environment, access to healthy foods, and frequency of restaurant meals.

Every patient with HF should have a clear, detailed, and continually updated evidence-based plan of care that ensures the achievement of GDMT goals, effective management of comorbid conditions, timely follow-up with the health care team, appropriate dietary and physical activities, and compliance with secondary prevention guidelines for cardiovascular disease. **Rating: Strong**; **Imperative.**

Evidence Reviewed. Both the ACCF/AHA and the ESC guidelines recommend that patients with HF should receive specific education to facilitate HF self-care.[2,15] The NCP model of care (assess, diagnose, intervene/educate, monitor, and evaluate) used by RDNs addresses different barriers to behavior change.[12] The goal of self-care is to reduce the risk of subsequent hospitalizations for HF and to improve a patient's quality of life.[2,15]

Strengths and Limitations

The strength of this update is the Academy's rigorous methodology used to conduct the systematic review and develop the guideline recommendations.[13,14] New to this update is the stratification of patients with HFrEF into two groups: patients with chronic HF (ACCF/AHA stage A, B, and C/NYHA functional class I through IV) and those with advanced HF (ACCF/AHA stage D/NYHA functional class IV). This guideline is an excellent reference for practitioners to use in daily practice. However, for more specific background information on the disease, including medications and risk factors, the practitioner is referred to the ACCF/AHA and the ESC guidelines for HF.[2,15]

A limitation to this systematic review is the lack of RCTs, especially for patients with advanced HF. More research is needed indicating the effectiveness of nutrition interventions by RDNs.

CONCLUSIONS

The purpose of this guideline is to provide an update to the HF evidence-based nutrition practice guideline originally published in 2008. It is an evidence-based summary of the effective practice of nutrition management and treatment of HF in adults with HFrEF. Seventeen recommendations are provided in the guideline. All recommendations focus on MNT's effectiveness as indicated by reduced HF signs and symptoms and improved quality of life for the patient, maintaining optimal nutritional status as evidenced by the patient's renal and biochemical outcomes, and in quality measures (eg, reducing readmissions, length of stay, and mortality). Our recommendations were integrated into the NCP model of nutrition assessment, nutrition intervention, and nutrition monitoring and evaluation.

From medical records, an RDN should note the LVEF and the NYHA/AHA HF classification. LVEF <45% indicates a patient with HFrEF. NYHA class II through IV/AHA stage B, C, or D indicates a patient's current symptom burden.[2] A comprehensive nutrition assessment should include the patient's daily sodium and fluid intake, restaurant meal intake vs meals prepared at home, the use of fresh food vs processed food products, recorded daily weights, nutrition-focused physical findings, and current social support. In reviewing biochemical data, special attention should be given to BUN and creatinine values. Values at the high end of normal often are associated with adherence with medication and MNT nutrition plan.[12]

Research has shown that MNT provided by an RDN will increase a patient's nutrition knowledge, maintain body weight, and decrease sodium intake.[16,17] The recommendations for energy intake (Figure 5) indicate the need for an RDN's expertise both in assessing

current intake and for an MNT intervention to prevent malnutrition and/or cachexia. Concerning protein intake, patients with HF who were either normally nourished or malnourished, protein intakes ranging from 1.1 g to 1.4 g/kg actual body weight per day resulted in positive nitrogen balance.[18,19,22]

Research indicates a sodium range of 2 to 3 g/day and fluid intake of 1 to 2 L/day results in improvements in quality measures (eg, readmissions rate, length of stay, and mortality rate), renal function and clinical laboratory measures (eg, BUN, creatinine, BNP, and serum sodium), symptom burden (eg, shortness of breath, difficulty breathing when lying flat, swelling of legs or ankles, lack of energy, and lack of appetite), and body weight.[5,6] These ranges serve to individualize an MNT plan, increase adherence, and improve quality of life.[3-6] It is important to note that a sodium intake <2 g may not improve clinical outcomes.[4,5]

Both the ACCF/AHA and the ESC guidelines recommend that patients with HF should receive specific education to facilitate HF self-care.[2,15] The NCP model of care used by RDNs addresses different barriers to behavior change.[12] The goal of self-care is to reduce the risk of subsequent hospitalizations for HF and to improve a patient's quality of life.[2,15]

Coordination of care is best provided by an interdisciplinary team.[2,15] An RDN should consult with others on the interdisciplinary health care team regarding vitamin, mineral, and herbal supplementation. Due to the many interactions between various supplements and common medications, it is unclear whether certain supplements, such as coenzyme Q10, n-3 fatty acids, vitamin D, iron, and thiamin, are appropriate for patients with HF.[2] Physical activity should be encouraged, when appropriate, by a physician and/or HF team.

Concerning monitoring and evaluation, an RDN should consider the NYHA functional classification, biochemical data, medication use, medical tests, nutrition-focused physical findings (especially weight, edema, dyspnea, and cachexia). Food and nutrition-related history with emphasis on sodium and fluid adherence, protein and calorie intake, early satiety, altered sense of taste, access to healthy foods, and frequency of restaurant meals are areas to monitor to improve patient outcomes, quality of life, and reduce hospitalizations.[12]

APPLICATIONS FOR PRACTICE

RDNs who see patients with HF*r*EF in outpatient clinics or as part of a multidisciplinary HF team should consider nutrition assessment, intervention, and monitoring that include patients recording daily weight, sodium intake in the range of 2 to 3 g, guide the patient through goal setting that includes a nutrient-rich diet with emphasis on protein and calorie intake to prevent catabolism, and encourage daily activity at an appropriate level for the patient's NYHA functional class. Adults with advanced HF may need more monitoring of fluid limits in the range of 1 to 2 L/day. Individualization of the nutrition plan is the key to improve adherence.

RDNs also should consider using the Academy Health Informatics Infrastructure for monitoring and evaluating nutrition outcomes for patients with HF*r*EF.[12] The Academy Health Informatics Infrastructure is the vehicle to investigate the influence of evidence-based nutrition guidelines for systolic HF provided by RDNs nationwide.

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AUTHOR INFORMATION

T. Kuehneman is a cardiac dietitian/consultant, Papillion, NE. M. Gregory is a clinical dietitian, Advocate Christ Medical Center, Oak Brook, IL. D. de Waal is a renal dietitian, University of Vermont Medical Center, Burlington. P. Davidson is an assistant professor of nutrition, Sturzebecker Health Science Center, West Chester University of Pennsylvania, West Chester. R. Frickel is a clinical dietitian, CHI Creighton Bergan Medical Center, Omaha, NE. C. King is an associate professor, University of Alaska, Anchorage. E. Gradwell is an independent contractor and lead analyst, Academy of Nutrition and Dietetics, Arvada, CO. D. Handu is a lead analysts/project manager, Academy of Nutrition and Dietetics, Chicago, IL.

Address correspondence to: Deepa Handu, PhD, RDN, Academy of Nutrition and Dietetics, 120 S Riverside Plaza, Ste 2190, Chicago, IL 60606-6995. E-mail: dhandu@eatright.org

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

None to report.

AUTHOR CONTRIBUTIONS

T. Kuehneman wrote the first draft of the manuscript with contributions from M. Gregory, D. deWaal, and P. Davidson. All authors reviewed and commented on subsequent drafts of the manuscript. All authors were involved in data collection/evidences synthesis.