Micronutrient Deficiencies in Patients With Heart Failure: Relationships With Body Mass Index and Age

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ABSTRACT

Background: It is conceivable that lean patients (body mass index 18.5−24.9 kg/m^2) with heart failure (HF) have low body weight due to low food consumption and that this may contribute to micronutrient deficiencies and to their poorer prognosis compared with overweight/obese patients. We hypothesized that lean patients have a greater number of inadequate micronutrient intakes (<50% of recommendations) than overweight/obese patients and that this also depends on age.

Methods and Results: Lean (n = 15) and overweight/obese (n = 49) patients underwent 24-hour diet and physical activity recall interviews. Inadequate essential micronutrient intakes were ubiquitous (intakes of 13 ± 1 of 27 micronutrients were inadequate) and did not depend on race, status, or access to supermarkets. Younger (40−64 y) lean patients had inadequate intakes of 20 ± 2 micronutrients, which was more than the other weight/age subgroups (all $P < .01$). Physical activity levels did not differ across weight and age groups.

Conclusions: Patients with HF may be at risk of malnutrition due to numerous inadequate micronutrient intakes; younger lean patients may have an especially high risk. Future studies are needed to confirm these preliminary findings and to investigate the possibility that incorporating a micronutrient-dense meal plan will improve patient outcomes. (*J Cardiac Fail 2015;21:968−972*)

Key Words: Heart failure, nutrition, micronutrients.

Although obesity increases the risk of developing heart failure (HF), observational studies report that healthy-weight patients with HF have a poorer prognosis than their overweight and obese counterparts.[1−4] Because these findings come from epidemiologic studies, it is possible that factors other than body fat may be responsible. Lean patients may have low body weight by virtue of low food consumption resulting in inadequate micronutrient intakes. Given the possibility that micronutrients may be involved in the pathophysiology of HF,[5] inadequate nutritional intake may contribute to poorer prognosis and health status in lean patients. Therefore, we sought to compare micronutrient intakes with national recommendations and evaluate associations with weight and age. We also evaluated physical activity and inactivity, given their influence on energy balance and body weight.

Methods

Study Design and Participants

This study was a cross-sectional observation study of patients (40−90 years of age) with established symptomatic HF and reduced left ventricular ejection fraction (≤40%). Patients were recruited from outpatient cardiovascular clinics at a single institution and provided written consent to participate in the study, which was approved by the University's Institutional Review Board. Exclusion criteria included a history or clinical evidence of dementia or memory impairment, New York Heart Association (NYHA) functional class I, body mass index (BMI) <18.5 kg/m^2 or clinical evidence for cachexia, active cancer, active thyroid disease, solid organ transplant, dialysis, or restrictive renal diet.

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Data Collection

Data were collected via patient interviews, assessments, and medical chart review. Interviews included a 24-hour dietary recall[6,7] and Global Physical Activity Questionnaire (GPAQ).[8] A registered dietitian performed the dietary recalls; nutrient intakes were quantified with the use of nutrient analysis software (Food Processor SQL; ESHA Research, Salem, Oregon) and were compared with the recommended dietary allowances (RDAs) to identify inadequate intakes.[9,10] Adequate intake (AI) values were used as a surrogate for RDAs for nutrients that do not have RDAs. The GPAQ quantified sedentary time and time spent performing moderate and/or vigorous intensity physical activity; results were compared with recommendations for patients with HF.[11] Anthropometric data (height, weight, and mid-arm and waist circumferences) were measured with the use of standard methods.[12] The United States Department of Agriculture Economic Research Service online database was used to determine income status and distance from/access to supermarkets based on patient residential address.[13]

Statistical Analyses

Previous studies have reported that lean patients (BMI 18.5−24.9 kg/m^2) have a poorer prognosis and shorter survival compared with overweight and obese patients (BMI ≥25.0 kg/m^2); therefore, data for the latter were pooled. Differences in patient characteristics between BMI groups were evaluated with the use of the Fisher exact test and independent-samples *t* test. Outcomes were evaluated with the use of analysis of covariance in which BMI group (lean vs overweight/obese) and age group (40−64 vs 65−90 years) were independent variables and sex was a covariate. Post hoc comparisons were performed with the use of the protected F-test principle and least significant difference test. Associations were evaluated with the use of Spearman correlations. Comparisons of correlation coefficients were performed with the use of Fisher r-to-z transformations. All tests were 2 tailed, with significance at $P \leq .05$. Data are presented as mean ± SE or n (%). Analyses were performed with the use of SAS (version 9.3; SAS Institute, Cary, North Carolina).

Results

Sixty-four patients were enrolled over 6 months. Overweight/obese patients were more likely than lean patients to reside in areas with limited access to a supermarket (ie, food deserts). No demographic characteristics differed between BMI groups. The prevalence of diagnoses, medical conditions, and medication use did not differ between BMI groups, except for mineralocorticoid receptor antagonist use, which was more common in lean patients. Most patients were in NYHA functional class II (61%) and III (25%); because NYHA functional classes IIIb and IV were less common, these groups were pooled. Ejection fraction was 28 ± 2%, with a tendency ($P = .07$) for lower values in lean patients.

Dietary Intakes

Inadequate nutrient intakes were prevalent, with 21 ± 1 nutrients (out of 27 nutrients evaluated) below the recommended intakes and 13 ± 1 below the stricter criterion of <50% of the RDA (Table 1). A significant interaction between BMI and age groups was observed ($P = .0003$). Young lean subjects had more inadequate micronutrient intakes compared with other age/weight subgroups (Table 2; Fig. 1). There was also a tendency ($P = .06$; Table 2) for lower energy (caloric) intakes in the young lean subgroup. Inclusion of energy intake as a covariate did not alter the micronutrient findings. Use of over-the-counter supplements did not differ among groups (Table 2). The number of micronutrient deficiencies was not associated with NYHA functional class ($r = -0.07$; $P = .56$), loop diuretic dose ($r = 0.13$; $P = .33$), or ejection fraction ($r = 0.04$; $P = .74$). The number of inadequate nutrient intakes did not differ by race ($P = .82$), access to a supermarket ($P = .98$), or income status ($P = .26$).

Physical Activity and Inactivity

Time spent performing moderate- and vigorous-intensity physical activity was (21 ± 4 min/wk), significantly ($P < .0001$) below the 150 min/wk (30 min × 5 d/wk) recommended for patients with HF.[11] Sedentary time was 10.3 ± 0.4 h/d. Physical activity and sedentary time did not differ across BMI and age groups (Table 2).

Discussion

Observational studies have reported that lean patients with HF have a poorer prognosis than their overweight and obese counterparts,[1−4] which raises the possibility that excess body fat is protective. However, confounding factors, such as malnutrition in lean patients, might be partly responsible for those findings. In the present study, we show that inadequate essential micronutrient intakes are ubiquitous in patients with HF despite differences in demographics, income status, and food access. Similar broad-spectrum nutritional deficiencies in both HF and control subjects have been reported elsewhere,[14] suggesting that these deficiencies may be attributable to a Western dietary pattern rather than HF per se. However, our findings also show that younger (40−64 y) lean patients are especially prone to nutritional deficiencies, with intakes for 20 out of 27 (74%) essential micronutrients falling ≥50% below recommendations. These findings for lean patients and for the group as a whole are especially concerning in light of the possibility that micronutrient needs may be higher in patients with HF due to factors such as greater urinary losses of water soluble nutrients (from diuretic use) and potential increased need for antioxidant nutrients due to oxidative stress. While it is not clear why micronutrient intakes are especially problematic in younger lean patients, lower food intake (evidenced by lower energy intake) may be partly responsible. However, it is also plausible that these individuals mainly consume foods with low micronutrient density, such as sugar-sweetened beverages.

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