Running Head: NUTRITIONAL KNOWLEDGE HEART FAILURE

The Effect of Nutritional Knowledge on Nutritional Intake in Individuals with Heart Failure

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Abstract

Background: The purpose of this study was to determine the nutritional knowledge of people diagnosed with heart failure (HF) and how it affects their diet adequacy. There are approximately 4.8 million people in the United States living with HF. Less than 15% of people diagnosed with HF survive more than 8 to 12 years, and 80% of males and 70% of females under the age of 65 die within 8 years of diagnosis. For an individual diagnosed with heart failure, the one-year mortality rate is one in five (Nicol, 2002). Adequate knowledge and understanding could play an essential role in improving nutritional status and delaying disease progression in heart failure.

Method: A convenience sample of 27 patients (also being used in a primary study) with heart failure (HF) due to coronary heart disease who met the specific inclusion criteria was studied. Sixteen of these individuals also completed the nutritional intake portion of the study. Their diets were analyzed by various valid tools including a detailed 4-day food diary, body weight history, body composition, body mass index (BMI), serum protein, and a questionnaire to assess levels of knowledge in general nutrition and nutritional issues specific to heart failure.

Results: Participants scored an average of 55.8% correct (SD= 11.3) on the nutritional knowledge questionnaire. Accuracy ranged from 30.8% to 83.8% on knowledge subscales, but 11 of 12 subscale scores were less than 70%. Various nutrient intake inadequacies were identified, such as greater than 50% of the participants were deficient in calcium, magnesium, and zinc. Also, nine out of the 10 selected nutrients in the study were shown to have some degree of deficiency. An interesting result was that there appeared to be no significant relationship between the important heart failure issue of sodium knowledge and patients' actual intake of sodium.

Conclusion: Heart failure is currently the only cardiovascular disease that is increasing in incidence, mortality, and prevalence. It is the single most common cause of hospital admissions

in people over the age of 65 (Nicol, 2002). The findings demonstrate that overall, nutritional knowledge in patients diagnosed with heart failure is below satisfactory. This is especially the case regarding application of sodium restriction intake in their daily lives, which has shown to delay HF disease progression and symptoms. More research needs to be completed to understand why patients diagnosed with heart failure who have some knowledge about foods high and low in sodium, are not choosing the lower sodium foods for their own diets.

Introduction

One of the most pervasive syndromes in medical practice is congestive heart failure. Heart failure (HF) is currently the only cardiovascular disease that is increasing in incidence, mortality, and prevalence (Nicol, 2002). The chronic progressive nature of this condition makes it a major contributor to the increasing numbers of cardiovascular morbidity and mortality (Murberg, 2001).

There are approximately 4.8 million people in the United States living with HF, with an estimated 550,000 new cases diagnosed in 2003. Less than 15% of people diagnosed with HF survive more than 8 to 12 years, and 80% of males and 70% of females under the age of 65 die within 8 years of diagnosis. For an individual diagnosed with heart failure, the one-year mortality rate is one in five (Nicol, 2002).

Heart failure is the single most common cause of hospital admissions in people over the age of 65. It also accounts for an estimated one million hospital discharges per year (an increase of 165% from 1979). The combined inpatient and outpatient costs are projected around 53 billion dollars a year, probably due to a readmission rate of 27 to 47 percent within 3 to 6 months of initial discharge (Nicol, 2002).

Adequate knowledge and understanding could play an essential role in improving nutritional status and delaying disease progression in heart failure. It was estimated that in 2001, 40% of the reasons for readmission of people with HF was due to diet and medication non-adherence. By educating patients and their families about the importance of diet and nutrition details specific to HF, disease symptoms and readmission rates could decrease.

The issue of nutritional knowledge specific to people with heart failure has yet to be studied by researchers. Several general studies have shown that nutrient intake in general is higher in individuals with better nutritional knowledge (Dallongeville, Marecaux, Cottel, Bingham, &

Amouyel, 2000). The anticipated goal of this study is to determine if those results also apply to persons diagnosed with heart failure.

Review of Literature

Cardiac cachexia is the end stage of a progressive wasting syndrome associated with altered nutritional intake and catabolism of adipose and protein-based tissues. Cachexia has been identified as an independent risk factor for mortality in persons with heart failure (Anker, Ponikowski, Varney,1997). Current evidence suggests that the anorexia and tissue catabolism associated with cardiac cachexia are due, in part, to the activity of proinflammatory cytokines, in particular tumor necrosis factor-alpha (TNFα) and interleukin-6 (IL-6) (Berry & Clark, 2000). These cytokines activate neuropathways that suppress eating and inhibit pathways that promote food intake. In addition, alterations in hedonic (appetite stimulating) factors such as dietary sodium restriction may compound these effects resulting in a further decrease in the desire to eat. In a person with heart failure and the accompanying appetite suppression and decreased desire for permitted foods, knowledge and understanding of adequate nutrition and permissible foods for restricted sodium diets are essential for improving nutritional status and intake.

Uric Acid and Inflammation

Elevated levels of uric acid have been reported in patients with heart failure independent of factors such as diuretics and renal impairment that can affect blood levels (Leyva, Anker, Godsland,Teixeira, 1997). This hyperuricemia has been hypothesized to be related to chronic inflammatory processes associated with heart failure (Leyva et al., 1998). Specifically, increased xanthine oxidase activity due to ischemia and other inflammatory stimuli result in increased formation of uric acid. Higher uric acid levels therefore, reflect an ongoing inflammatory process, particularly at the level of vascular epithelium. In a study of thirty-nine patients with documented heart failure for at least three months, serum uric acid levels were significantly higher in patients with heart failure compared to healthy controls. Moreover, uric acid was a strong predictor of serum TNFα, sTNFrI, sTNFrII, and IL-6 levels, independent of the effects of diuretics and renal status as indicated by serum creatinine levels.

Nutritional Intake

Despite the longstanding recognition of the importance of maintaining adequate nutrition in the treatment of heart failure, surprisingly little is known about nutrient intake of persons with heart failure. As noted by Berry and Clark (2000), the few studies that have examined nutritional status in persons with heart failure failed to quantify nutritional intake (Carr, Stevenson, Walden, Heber, 1989) or included only a small number of patients (Blomstrand, Kongstad, Broqvist, Dahlstrom, Wranne, 1994). Large-scale studies are needed to assess nutrient intake in patients with heart failure (Berry & Clark, 2000). Information about nutrient intake however, is of limited value unless data regarding factors that influence nutrient intake are also collected. These data include not only biologic (e.g. cytokines) factors, but also hedonic (appetite stimulating) factors. Sodium restriction is a prominent hedonic factor that may influence nutrient intake in persons with heart failure. Patients frequently report that low sodium diets are not palatable, which can result in diminished appetite leading to poor nutritional intake, or conversely, patients may choose palatable foods regardless of sodium content leading to failure to follow sodium restriction guidelines. To date, no studies have examined the effect of sodium restriction on nutrient intake or the effect of food choice on sodium intake in persons with heart failure.

<u>Nutritional Status</u>

There are no established criteria for defining altered nutritional status in persons with heart failure as only a few studies have examined nutritional status in this population. In a study by Carr et al. (1989), malnutrition was defined as decreased body fat (<15 percent in males and < 22 percent in females), body weight less than 90% of ideal, or low serum albumin (< 3.0 mg/dL). Serum albumin was a poor predictor of malnutrition in this population of 48 patients with heart failure in classes III to IV. Of the 24 patients identified as malnourished, only three patients exhibited low serum albumin. The remainder was identified by below normal anthropomorphic measurements. Transferrin, another serum protein used to identify malnutrition, was normal in the first 17 patients studied and was subsequently dropped as a variable.

Similar results regarding serum proteins were reported in a study by Schwengel, Gottlieb and Fisher (1994). Malnutrition was defined as either total body malnutrition (body weight < 80% of ideal, body fat < 15%, and/or marked muscle wasting) or protein-energy malnutrition (serum albumin < 3.5 g/dL, arm muscle area <5^{th} percentile, and/or 24-hour urinary creatinine excretion < 80% normal). Of the 81 patients screened, only 6% were identified as malnourished by serum albumin alone. The greatest percentage of patients (33%) were identified by creatinine excretion. Interestingly, nearly as many of the patients identified as malnourished by other criteria had body mass indexes (BMI) above normal (9%) as had BMI below normal (6%). A total of 37% of the patients met the criteria for both total body and protein-energy malnutrition.

Based on extensive clinical experience, Anker and Coats (1999) argue that cardiac cachexia should be recognized as a process that can be identified only by documented weight loss measured in a nonedematous state. The authors defined severe cachexia as >15% weight loss or > 7.5% weight loss and < 85% of ideal body weight. Early or moderate cachexia was defined as > 7.5% to ≤ 15% weight loss or > 7.5% weight loss but still within 85% or more of ideal body weight. Combined, these results demonstrate that multiple measures are necessary to detect malnutrition in persons with heart failure as each has its own limitations. For example, serum albumin is negatively affected by inflammation and liver disease; body weight, body mass index, as well as anthropometric measures can be altered by body water content; while creatinine excretion and creatinine height index are affected by renal status. In the parent study, a combination of indicators will be used to determine nutritional status. Assessment and control of factors that can influence each indicator will be done on a case-by-case basis in analysis and interpretation.

Nutritional Knowledge

The issue of nutritional knowledge specific to people with heart failure has yet to be studied by researchers. Several studies have shown that nutrient intake in general is higher in individuals with better nutritional knowledge (Dallongeville, Marecaux, Cottel, Bingham, & Amouyel, 2000). Adequate knowledge and understanding could play an essential role in improving nutritional status and delaying disease progression. Nutritional knowledge should continue to be an important target for health promotion and education and has the potential to contribute to improving dietary quality (Wardle, Parmenter, & Waller, 2000). If a higher nutritional knowledge does not correlate with a more adequate diet, then perhaps the emphasis of patient education could be more geared to nutritional intake rather than knowledge. Regardless, a sufficient diet is at the fundamental level of improving quality of life and decreasing and/or preventing any type of disease incidence.

Method

Purpose

The purpose of this secondary analysis is to evaluate the effect of nutritional knowledge on nutritional intake in individuals with heart failure.

<u>Research Questions</u>

Research questions for this project include: 1) What is the nutritional knowledge of people diagnosed with heart failure? 2) What is the nutritional adequacy of of the diets of persons with diagnosed heart failure?

<u>Hypothesis</u>

1) Nutritional knowledge will have a positive effect on nutritional adequacy of the diets of people with heart failure.

<u>Design</u>

A cross-sectional descriptive design will be used to examine the relationships among variables.

<u>Sample</u>

A convenience sample of 27 was used. Ten participants were male (37%), twelve were female (44%), and five did not respond to the gender question. All were diagnosed with heart failure (HF) due to coronary heart disease and those who met the following inclusion criteria were recruited for the study: a) diagnosis of heart failure with left ventricular dysfunction as evidenced by an ejection fraction of less than 40%, b) NYHA functional class II or III, c) stability on medication regimen for at least three months, d) no history of a myocardial infarction within the last 3 months, e) no history of hospitalization within the previous three months, f) no cognitive impairment, g) ability to read and speak English, h) access to a telephone, and g) ability to travel to the Clinical Research Center. Patients with well-controlled comorbidities of diabetes, or thyroid, liver, and renal dysfunction were included in the study. Patients with any concurrent illness known to alter food intake such as cancer, end stage renal disease, and gastrointestinal diseases were excluded from the study.

Patient Recruitment

Patients were recruited for the primary study from the Heart Failure Service of the Department of Cardiology at The Ohio State University and from the Heart Failure Clinic of the University of Kentucky, with which the investigators have pre-existing relationships. The cardiologist and nurse practitioners referred patients who met the inclusion criteria to the investigators. Referred patients were contacted by telephone or in person at the time of their clinic visit to explain the study and were then invited to participate. Informed consent was obtained after the patients had an opportunity to ask questions. IRB approval was obtained from both research facilities. After agreeing to participate, a chart review was conducted on each patient to obtain demographic and pertinent medical data regarding medications, disease history, and to determine the New York Heart Association (NYHA) class.

Measurement of Variables

Nutrient Intake. Participants were provided with a 4-day food diary form and instructions on how to measure and record type and amount of all food eaten over 4 consecutive days. Because eating patterns have been reported to differ on weekdays versus weekends (Mattes & Donnelly 1990), the four-day food diary included one weekend day. To assist with recording of food intake, participants were provided with a digital electronic scale, a set of rubber models of generic portion sizes (Nasco), and a one page handout depicting seven ways to estimate portion size (©National Dairy Council). The Nutrition Data System (NDS) software (NCC, University of Minnesota), housed in The Ohio State University General Clinical Research unit was used to analyze the diets. The NDS software provides output for over 102 nutrient and nutrient ratios derived from the food intake data. The database contains over 19,000 foods with over 160,000 variants differing in preparation method or ingredients. The database also contains diet supplements, medications containing sodium, and over 7,800 name brand foods.

Nutritional Status. Body weight history, body composition, body mass index (BMI), and serum proteins were used to determine nutritional status and estimate degree of cachexia. Patients weighed themselves at the same time daily in the same clothing for 30 days including the four-day food intake period. Determination of whether body weights reflected “dry weight” was based on stability of weight over time, fluid status, and other clinical evidence such as dependent edema and nocturnal dyspnea. Body composition was determined by an experienced, Ph.D-prepared dietician using anthropomorphic measurements obtained from Lange calipers and linen tape measurements. BMI was calculated according to the Quetelet index as weight (kg) divided by height (m^2). Serum was sent to the ancillary laboratory services of The Ohio State University Hospital for measurement of total protein and albumin as markers of serum protein status.

Nutritional Knowledge. Participants in the study were given a questionnaire to assess levels of knowledge in general nutrition and nutritional issues specific to heart failure. The instrument consisted of 26 multiple choice questions which was modified from the general nutrition knowledge survey developed by Parmenter and Wardle (1999) to relate more specifically to heart failure patients. A panel of nurses with expertise in caring for patients with heart failure established content validity. It assessed twelve subscales, such as health problems related to various food groups, recommended food and nutrient groups, and knowledge of food groups high or low in a specific content area (e.g. fat) (Appendix A).

Procedure Patients completed a Daily Symptom Severity rating instrument (DSS) at baseline and recorded body weight for 30 days. At the end of this period, patients recorded the four-day food intake data starting on Sunday (Day 1) and running through Wednesday (Day 4). A research assistant visited patients in their home to deliver equipment (scale, handout, rubber models of food portions, and urine collection bottle) and provided detailed instructions on how to measure and record food intake and collect the 24-hour urine for creatine levels. Briefly, patients were instructed to begin urine collection with the first morning void on Day 4 (Wednesday) and end with the last nocturnal void of the 24-hour period. The first morning void is defined as the void that corresponds with the person getting up for the day. By 10 AM that morning of Day 5, participants came to the GCRC to a) deliver urine samples, b) have fasting blood drawn, c) fill out the nutritional knowledge questionnaire, and d) have anthropomorphic measurements taken for body composition determination. The 24-hour urine was sent for analysis of sodium and creatinine clearance to assess renal function. Clotted blood was spun down and the serum placed in aliquots for measurement of serum proteins. Patients were paid $125 for completing the entire study: $50 for completing 30 days of body weight measurement, a one-page symptom checklist, and a four-day food diary, plus $75 for the visit to the CRC.

Data Analysis

Research Question 1) "What is the nutritional knowledge of people diagnosed with heart failure?"

Level of knowledge was determined by calculating the percentages of correct answers to questions on the Nutritional Knowledge Questionnaire. The answers on the questionnaire were subdivided into level of knowledge related to the following nutritional categories: dietary fat, dietary protein, dietary sodium, dietary sugar, dietary fiber, vitamins, calcium, and magnesium.

Research Question 2) "What is the nutritional adequacy of persons with heart failure?

Diet adequacy was determined by comparing averaged 4-day intake of nutrients in the diet to the Dietary Reference Intakes (DRI) established by the Food and Nutrition Board of the Institute of Medicine. Adequacy of each nutrient was determined by calculating a z-score based on the difference between the individual's 4-day average intake of the nutrient minus the DRI divided by the square root of pooled variance of the population based on standard deviation in daily intake of nutrient plus the standard deviation of the individual's 4-day variance in intake of nutrient. A z-score less than –1 indicates that the individual's diet is deficient in that nutrient, a z-score greater than 1 indicates that the individual's diet is adequate in that nutrient. z-scores between –1 and +1 indicate insufficient data to determine adequacy or inadequacy of nutrient in diet. Percentages of type and number of diet inadequacies were calculated to determine nutritional adequacy of the diet.

Hypothesis 1) Nutritional knowledge will have a positive effect on nutritional adequacy of the diets of people with heart failure.

For the purposes of this question, incorrect and "not sure" answers on the Nutrition Knowledge Questionnaire were combined to indicate lack of knowledge regarding that nutrient. Participants were grouped into high vs. low levels of nutritional knowledge. If possible, groupings were determined by a natural (bimodal) distribution of scores. If not, groups were divided by a median split of number correct vs. number incorrect plus not sure. The independent variable was knowledge-level group and the dependent variable was the number of nutritional deficiencies.

Results

Sample Characteristics

The results of this descriptive study were based on the findings of a sample of 27 people completing the nutritional knowledge questionnaire. Sixteen of these individuals also completed the nutritional intake portion of the study. For the sample of 27, ten participants were male (37%), twelve were female (44%), and five did not respond to the gender question. The yearly income for the participants ranged from $839 to $192,000. Twelve of the participants were married or cohabitated (75%), and four were divorced or separated (25%). The ethnicity was coded into three groups—White, African-American, and Other. Eleven of the participants were White (68.8%), four African-American (25%), and one person identified her/himself as “Other” (6.3%). Twenty-one of the participants reported their age, with the oldest as 79. The youngest was 37 years old, and the average age was 59.8 years, with a standard deviation of 12.7.

Nutritional Knowledge

There was a wide range of information regarding the first research question: what is the nutritional knowledge of people diagnosed with heart failure? Scores on the total questionnaire ranged from 34% to 72% correct responses (Table 1), while the subscale with the highest average percentage (83.8%) of nutritional knowledge resulted from the first subscale on the survey: “Do you think nutrition experts recommend that, in general, most people should be eating more, the same amount, or less of these foods?” The items in this subscale included food groups such as: meat, vegetables, fruit, high-fiber foods, starchy foods, fatty foods, sugary foods, and salty foods.

In contrast, the subscale on which participants received the lowest average score (30.8%) was “Which of the following health problems or disease are related to a low intake of fiber?” The health problems from which they could choose included: two correct responses (colon cancer and increased cholesterol) and four incorrect responses (liver disease, heart failure, high blood pressure, and diabetes).

The widest distribution of scores (SD=31.4 and mean of 43.9%) occurred on the subscale regarding foods high and low in trans-fatty acids. Food selections of skim milk, vanilla milkshake (both correct for low levels), microwave popcorn, vanilla wafer cookies, frozen french fries, margarine, salad dressing (all correct for high levels) were listed. Participants responded with either a high or low content, or not sure. Table 1 provides detail on each of the content areas of nutritional knowledge with subscale scores in descending order from highest to lowest percentage correct.

Table 1. Percentage correct for nutrition knowledge on specific areas (range, mean, standard deviation). N=27.

These are all in percentages—(e.g. range of 38-100% with mean of 83.8%, etc.).

Subscale Topic	Minimum	Maximum	Mean	Std. Deviation
Recommended food amounts	38	100	83.8	16.6
Nutrients recommended	0	100	66.1	27.8
Foods high or low in Fat	33	100	65.8	17.9
Foods high or low in Salt	0	85	65.8	19.4
Foods high or low in Protein	0	88	59.3	20.4
Healthy alternative foods	0	100	56.2	27.8
Total questions correct	34	72	55.8	11.3
Health problems related to Salt	0	100	49.4	29.7
Foods high or low in Sugar	13	75	47.7	16.9
Health problems related to Fat	0	83	44.4	23.6
Health problems related to Trans Fat	0	86	43.9	31.4
Health problems related to Sugar	0	83	42.6	23.7
Health problems related to Fiber	0	83	30.8	26.0

Nutritional Adequacy

Results for the second research question regarding the nutritional adequacy of diets of people diagnosed with heart failure was obtained during the data collection period as described in the methods section. Four-day food diaries were analyzed by using the Data Systems-R software. The dietary adequacy of 18 nutrients was determined by using dietary reference intakes (DRI) according to the recommendations outlined by the Institute of Medicine (2000). Estimated Average Requirement (EAR) gave information to determine the probability that an individual's diet was deficient in those nutrients (z-score of individual's intake vs. EAR). The EAR is the median usual intake value estimated to meet the requirement of half the population in a life stage and gender group. It currently is the best estimate available of an individual's actual requirement.

Recommended daily allowances (RDAs) were also used for some nutrients as broader indices intended to cover the needs of 98% of individuals. Those whose intake exceeded 80% of a RDA were defined as having adequate intake of the nutrient, while those whose diets contained less than 80% of a RDA were defined as being at risk for developing a deficiency in that nutrient. Both EARs and RDAs were adjusted according to each individual's age and sex.

Upon examining the results, the quality of the participants' diets was clearly evident. The participants were deficient in many nutrients, ranging from 94% deficient in Calcium to no deficiency in Riboflavin. Most of the participants were shown to be deficient in Zinc, Magnesium, and Folate. Less than half were deficient in Niacin, vitamin B6, Thiamine, and Phosphorous (Table 2). Not included in Table 2, was the amount of sodium present in the diet. Participant's sodium content of the diet was calculated using the Food and Nutrition Board (FNB) formula for assessing excessive dietary nutrient intake. Approximately 25% of the participants exceeded the RDA for sodium.

Table 2. Percentage of sample with diets deficient in selected nutrients. (n=16)

Nutrient	Percent Deficient
Calcium	94%
Magnesium	88%
Zinc	69%
Folate	44%
Protein (macronutrient)	31%
Vitamin B6	13%
Phosphorous	13%
Niacin	13%
Thiamine	13%
Riboflavin	0%

Other important aspects that were analyzed in the participant's diets were dietary fat, carbohydrates, protein, and saturated fats. The percentage of fat for a diet should be less than 30% of daily intake. The participants' diet fat intake ranged from 23 to 51%, with an average of 34% (Table 3). Carbohydrates are recommended to be approximately 50% of the daily diet.

Participants' dietary carbohydrate intake ranged from 23% to 61%, with an average of 50%. The percentage that is recommended for protein in a daily diet is 12-15%.The study participants' percentage of diet from protein ranged from 11 to 26%, with an average of 18%. Finally, recommended amount of saturated fat in a diet is 10%. The participant's percentage of diet from saturated fat ranged from 7 to 18%, with a mean of 12%. Thus, when examining the average percentage of diet, participants exceeded the recommended level of fat, and were less than the recommended percentage of protein and approximately the desired level of carbohydrates. (www.fda.gov, United States Food and Drug Administration).

Table 3. Proportion of dietary intake by major categories and the recommended level. (n=16).

Dietary Factor	Minimum	Maximum	Mean	Percentage recommended
Fat	23%	51%	34%	<30% of diet
Carbohydrates	23%	61%	50%	50% of diet
Protein	11%	26%	18%	12-15% of diet
Saturated Fat	7%	18%	12%	10%

<u>Relationships between nutritional knowledge and adequacy</u>

Various significant relationships were found between nutritional knowledge subscales and intake. For example, the higher percentage correct a participant received on the subscale; "Do you think these foods are high or low in added sugar?"' the higher the fat intake and carbohydrate intake a person had. The more a participant knew about which foods are high or low in protein correlated significantly with a higher magnesium intake. Accurately identifying foods high or low in salt was significantly related to calcium, carbohydrate, and protein intake, but interestingly it was not correlated to with actual sodium intake. Knowledge involving what foods contain fiber was positively correlated with vitamin D, thiamine, riboflavin, vitamin B6, B12, iron, and zinc intake. The question “Which of the following health problems or diseases are related to how much sugar people eat?” was positively correlated with the amount of protein intake.

In synopsis, the total amount of sodium intake was not significantly correlated to accurately identifying what foods were high or low in sodium. The results show in this study that the participants, who have been diagnosed with heart failure and have been recommended to follow low sodium diets, are not accurately following them. In comparison, the more correct answers a participant gave for identifying what foods are high or low in sugar, the more this information was found to correlate with sugar intake in their diets. The same was true regarding the question involving nutrient knowledge--the more correct answers; the less the participant was deficient in nutrients.

Discussion

In this study, participants scored an average of 55.8% correct (SD= 11.3) on the nutritional knowledge questionnaire. The instrument is a 26 multiple-choice questionnaire modified from the general nutrition knowledge survey developed by Parmenter and Wardle (Wardle, 1999) to relate more specifically to heart failure patients. A panel of nurses with expertise in caring for patients with heart failure established content validity.

As predicted in the research hypothesis, “Nutritional knowledge will have a positive effect on nutritional adequacy of the diets of people with heart failure.” Many of the results did show this to be true. For example, a person with higher nutritional knowledge had a better than average—or at least an adequate--intake of recommended levels within a selected food group. This was especially the case in the intake of sugars and nutrients. It was, however, not the case in sodium intake correlation, as increased knowledge was not associated with reduced sodium intake. One-fourth of the sample exceeded the recommended level of sodium intake.

When people are diagnosed with heart failure, many dietary recommendations are made in response to their chronic disease. Arguably, perhaps, the most important recommendation is sodium restriction. Patients frequently report, however, that low sodium diets are not as appetizing and good tasting as the typical unrestricted diet. This can result in diminished appetite, often leading to poor nutritional intake. Conversely, patients may choose better-tasting foods regardless of sodium content, which will surely lead to failure to follow the recommended sodium restricted diet.

In this study, for whatever the reason, the heart failure-diagnosed participants' knowledge of foods high and low in sodium did not correlate with their intake of sodium. So, if these participants knew in general what foods are high in salt, why did they still choose to eat them? Perhaps the importance of sodium restriction was not stressed enough to the participants when they were first taught about the importance and benefits of diet in controlling their disease, nor were they shown the probable negative effects of a high-sodium diet. It could also be that taste preference primarily influences dietary selections, regardless of nutritional knowledge.

Behavior change is complex and not always predicted by a subject's knowledge. One such theoretical framework that has been applied is the Health Belief Model (HBM). The HBM was developed in the 1950s to explain health behavior associated with the failure of people to participate in programs that would reduce disease risk. The HBM implies that health behaviors are determined by health beliefs and readiness to take action. The inclusion of self-efficacy in the HBM assumes that the likelihood of taking action is not only a function of beliefs related to outcomes but also a function of a person's belief that he or she is behaviorally capable of achieving the desired outcome. Interventions that also emphasize self-efficacy may increase the likelihood that positive behavioral changes will be executed. (Abood, Black, Feral, 2003).

Elevated sodium intake was not the only negative finding in this study. The majority of the participants were found to be deficient in many nutrients, especially calcium, magnesium, and zinc. Which are all important in many physiologic processes dealing with muscular, neurological, and immune systems. But the main dietary factors considered in this study (Fat, Protein, Carbohydrates, and Saturated Fat), were overall found to be at average recommended levels or slightly increased. It is clear that based on the results of the mean score of the nutritional knowledge questionnaire (55.8%), better nutritional knowledge education needs to be supplemented in some form for patients diagnosed with heart failure.

Conclusion

This study is a reference point for heart failure patients and their current knowledge and status related to nutritional issues. The nutritional knowledge questionnaire could continue to be a useful tool for demonstrating understanding of diet for patients diagnosed with congestive heart failure by assessing their comprehension level of nutrition. Future research addressing the essence of why patients with adequate sodium-restriction dietary knowledge are not applying this important information into their own lives and diets is warranted. The current study provides preliminary information upon which to build numerous other studies in the advancement of optimal care for the congestive heart failure patient.

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