

Georgia State University

ScholarWorks @ Georgia State University

Nutrition Theses

Department of Nutrition

Winter 12-14-2011

The Relationship between Diet Quality and the Comorbidity of Diabetes in Adults with Heart Failure

Jessica M. Hill

Byrdine F. Lewis School of Nursing & Health Professions

Follow this and additional works at: https://scholarworks.gsu.edu/nutrition_theses

Recommended Citation

Hill, Jessica M., "The Relationship between Diet Quality and the Comorbidity of Diabetes in Adults with Heart Failure." Thesis, Georgia State University, 2011.

doi: <https://doi.org/10.57709/2383507>

This Thesis is brought to you for free and open access by the Department of Nutrition at ScholarWorks @ Georgia State University. It has been accepted for inclusion in Nutrition Theses by an authorized administrator of ScholarWorks @ Georgia State University. For more information, please contact scholarworks@gsu.edu.

ACCEPTANCE

This thesis, THE RELATIONSHIP BETWEEN DIET QUALITY AND THE COMORBIDITY OF DIABETES IN ADULTS WITH HEART FAILURE, by Jessica Hill was prepared under the direction of the Master's Thesis Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Master of Science in the Byrdine F. Lewis School of Nursing & Health Professions, Georgia State University. The Master's Thesis Advisory Committee, as representatives of the faculty, certify that this thesis has met all standards of excellence and scholarship as determined by the faculty.

Anita M. Nucci, PhD, RD, LD

Committee Chair

Jennifer Frediani, MS, RD, LD

Committee Member

Barbara Hopkins, MMSc, RD, LD

Committee Member

Date

AUTHOR'S STATEMENT

In presenting this thesis as a partial fulfillment of the requirements for the advanced degree from Georgia State University, I agree that the library of Georgia State University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote, to copy from, or to publish this thesis may be granted by the professor under whose direction it was written, by the Byrdine F. Lewis School of Nursing & Health Professions director of graduate studies and research, or by me. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve potential financial gain. It is understood that any copying from or publication of this thesis which involves potential financial gain will not be allowed without my written permission.

Signature of Author

NOTICE TO BORROWERS

All theses deposited in the Georgia State University library must be used in accordance with the stipulations prescribed by the author in the preceding statement. The author of this thesis is:

Jessica Hill

2992 Glenrock Drive

Macon, GA 31204

The director of this thesis is:

Anita M. Nucci, PhD, RD, LD

Assistant Professor and Division Head

Division of Nutrition

Byrdine F. Lewis School of Nursing & Health Professions

Georgia State University

Atlanta, Georgia 30302

VITA

Jessica Hill

ADDRESS: 2992 Glenrock Drive

Macon, GA 31204

EDUCATION: M.S. 2011 Georgia State University

Health Sciences

B.S.F.C.S 2010 The University of Georgia

Dietetics

PROFESSIONAL EXPERIENCE:

- August 2008 - May 2010: University of Georgia's Cooperative Extension Expanded Foods and Nutrition Education Program (EFNEP).
Athens, GA
- January 2011-May 2011: Georgia State University Graduate Assistantship with After School All-Stars
Atlanta, GA
- July 2011-Present: The Coca Cola Company
Atlanta, GA

AWARDS AND PUBLICATIONS:

- Pam McIntyre Thompson, R.D. Scholarship 2009-2010
- Educational Curriculum Package Award-2009
- Educational Curriculum Package, First Place, Southern Region Winner-2009
- Undergraduate Research Grant from the College of Family and Consumer Sciences at The University of Georgia- 2009

ABSTRACT

THE RELATIONSHIP BETWEEN DIET QUALITY AND THE COMORBIDITY OF DIABETES IN ADULTS WITH HEART FAILURE

by

Jessica Hill

Background: Heart failure and diabetes are common coexisting diseases. Elevated levels of glucose in the blood caused by insulin resistance can damage blood vessels and nerves, and eventually lead to heart disease. A poor diet and obesity can also contribute to the progression of diabetes and heart disease.

Objective: The purpose of this study was to determine if diet and lifestyle factors between adult heart failure patients with and without diabetes who are participating in the EducationN, and Supportive Partners Improving Self-CaRE (ENSPIRE) study are associated with comorbidities such as diabetes, and if so then how current dietary recommendations in this population should be modified based on diabetes status.

Methods: Using data collected from the EducationN and Supportive Partners Improving Self-CaRE (ENSPIRE) study from 2006 to 2009 which was a prospective, randomized, controlled clinical trial, a secondary data analysis was conducted. Daily dietary intake of calories, sodium, carbohydrate, fat, sugar, and fiber was assessed via a 3-day food record. Differences in anthropometric measures, smoking history, education level and health literacy score between the two groups were also assessed. 117 heart failure patients were included in the analysis. Of these, 39% had diabetes.

Statistical analysis: Statistical analyses included the t-test, Chi-square analysis, and Mann Whitney U test used to compare anthropometric data, lifestyle factors, and disease states.

Results: Weight was higher in heart failure patients with vs. without diabetes (104.9 vs. 92.6 kg, respectively; $P < 0.05$). Total daily sugar intake was lower in men with diabetes than in those without (49 vs. 89 g/day, respectively; $P < 0.01$). Other anthropometric values, lifestyle characteristics and nutrient variables were not significantly different between the two groups.

Conclusion: Weight was significantly higher in heart failure patients with diabetes and they consumed fewer carbohydrates than their non-diabetic counterparts. We recommend encouraging these individuals to closely monitor their macronutrient intake, specifically limiting fat in the diet. Meeting with a dietitian to ensure adequate nutrient intake is strongly recommended.

THE RELATIONSHIP BETWEEN DIET QUALITY AND THE COMORBIDITY OF
DIABETES IN ADULTS WITH HEART FAILURE

by
Jessica Hill

A Thesis

Presented in Partial Fulfillment of Requirements for the Degree of
Master of Science in Health Sciences

Byrdine F. Lewis School of Nursing & Health Professions

Division of Nutrition

Georgia State University

Atlanta, Georgia

2011

ACKNOWLEDGMENTS

I would like to thank Dr. Anita Nucci for her guidance throughout this process. I have learned so much from her and am very grateful. I would also like to thank Emory University Nell Hodgson Woodruff School of Nursing for the use of their data in my analysis. Georgia State University and the faculty in the nutrition program have been amazing through this Master's program as well. Finally, I would like to thank my parents, Doug and Nan Hill for their unwavering support throughout this experience.

TABLE OF CONTENTS

List of Tables	iv
Abbreviations	v
Chapter	
I. INTRODUCTION	1
II. LITERATURE REVIEW	3
Diabetes and Heart Disease	3
Hypertension and Heart Disease	7
Diet Recommendations	10
Pharmacology and Nutrient Loss	11
Nutrition Intake Methodology	12
References	15
III. MANUSCRIPT IN STYLE OF JOURNAL	20
Author's Page	21
Abstract	23
Introduction	24
Methods	25
Results	29
Discussion	32
Conclusion	34
Tables	36
References	44

LIST OF TABLES

Table	Page
1. Outcome variables measured and tests/instruments used in the ENSPIRE* study....	28
2. Demographic Variables by Gender of Heart Failure Patients in the ENSPIRE Study	36
3. Anthropometric Characteristics by Gender and Diabetes Status of Heart Failure Patients in the ENSPIRE Study	37
4. Lifestyle Characteristics of Male Heart Failure Patients in the ENSPIRE Study	38
5. Lifestyle Characteristics of Female Heart Failure Patients in the ENSPIRE Study	39
6. Smoking History and Diabetes Status of Male Heart Failure Patients in the ENSPIRE Study	40
7. Smoking History and Diabetes Status of Female Heart Failure Patients in the ENSPIRE Study.....	40
8. Hypertension and Diabetes of Male Heart Failure Patients in the ENSPIRE Study	41
9. Hypertension and Diabetes of Female Heart Failure Patients in the ENSPIRE Study.....	41
10. Nutrient Intakes for Male Heart Failure Patients in the ENSPIRE study ^a	42
11. Nutrient Intakes for Female Heart Failure Patients in the ENSPIRE study ^a	43

ABBREVIATIONS

ACE-I	Angiotensin-Converting Enzyme Inhibitors
AHA	American Heart Association
AI	Adequate Intake
AMI	Acute Myocardial Infarction
ARB	Angiotensin II Receptor Blockers
BMI	Body Mass Index
CHO	Carbohydrate
cm	centimeter
ENSPIRE	EducatioN and Supportive Partners Improving Self-CaRE
FPI	Family Partnership Intervention
HbA1c	Glycated Hemoglobin
HDL	High Density Lipoprotein
ht	height
HTN	Hypertension
in	inch
Kcals	Kilocalories
kg	kilogram
lbs	pounds
LDL	Low Density Lipoprotein
m	meter
Na	sodium

NHANES	National Health and Nutrition Examination Survey
NYHA	New York Heart Association
REALM	Rapid Estimate of Adult Literacy in Medicine
VAMC	Veterans Administration Medical Center
wt	weight

CHAPTER I

THE RELATIONSHIP BETWEEN DIET QUALITY AND THE COMORBIDITY OF DIABETES IN ADULTS WITH HEART FAILURE

Introduction

Heart failure and diabetes are common coexisting diseases in the population. The order in which these diseases occur is individualized. Diabetes is a metabolic disorder characterized by the body's misuse of glucose for energy (1). The body uses insulin to increase glucose uptake in cells (1). In diabetes, the pancreas either does not produce enough insulin or the cells sensitive to insulin do not respond, resulting in hyperglycemia (1). There are two main types of diabetes, type 1 and type 2. Type 1 diabetes accounts for about five to ten percent of all diagnosed cases of diabetes (1). People with type 1 diabetes do not produce any insulin and are dependent on exogenous insulin for survival (1). Type 2 diabetes accounts for about 90 to 95 percent of diabetes cases and is characterized by insulin resistance. Although the exact etiology is unclear, obesity, specifically abdominal obesity, contributes to the insulin resistance present in type 2 diabetes (1). Treatment of hyperglycemia in type 2 diabetes involves oral medications and sometimes exogenous insulin (1). Type 2 diabetes is not typically detected immediately because of the slow progression of the disease (1). Elevated levels of glucose in the blood can damage blood vessels and nerves, and eventually lead to heart disease and stroke if left untreated (1).

Over time, diabetes, high blood pressure, and obesity cause damage and narrowing of the blood vessels (2). Heart failure and diabetes eventually lead to kidney damage, heart valve problems, liver damage, heart attack, or stroke (2).

Dietitians are integrally involved in the care of patients with heart failure and diabetes, primarily through diet planning, education, and counseling of patients and their families. One of the issues faced is how to adequately educate these patients with regard to their diets (3,4). We are investigating whether there is a difference in diet quality between heart failure patients with and without diabetes on parameters of daily intake of calories, sodium, carbohydrate, fat, and fiber. We are also investigating differences between the two groups in gender, age, ethnicity, education level, and health literacy scores. We plan to use this information to identify where further nutrition education is needed.

The **E**ducatio**N** and **S**upportive **P**artners **I**mproving **S**elf-**C**a**R**E (ENSPIRE) study was a prospective randomized controlled clinical trial that compared the effect of a Family Partnership Intervention (FPI) over patient and family education and usual heart failure care on physical and mental health outcomes over an 8-month period. Adults, who participated in ENPSIRE, had heart failure with or without diabetes. The purpose of the secondary data analysis of data from the ENSPIRE study is to determine if diet and lifestyle factors are associated with comorbidities such as diabetes, and if so then how current dietary recommendations in this population should be modified based on diabetes status. We hypothesize that sodium consumption in adults with heart failure will be higher in those with diabetes than those without diabetes.

CHAPTER II

Literature Review

Diabetes and Heart Disease

Heart disease and stroke are the leading causes of death for someone with diabetes (5). High blood glucose levels over time damage blood vessel walls, leaving areas where fatty material can deposit (6). This results in a narrowing of the blood vessels, which increases the risk of plaque formation in the arteries, also known as atherosclerosis (5). Hyperglycemia, insulin resistance, and diabetes accelerate the process of atherosclerosis (6). Impaired glucose tolerance among other pre-diabetes and diabetes indicators is associated with impaired cardiovascular conditions such as carotid intima media thickness, high blood pressure, hypercholesterolemia, and smoking status (6). Elevated blood glucose levels can also cause irreversible damage to the heart muscle and irregular beats (7). It has been shown that a 0.7% reduction in the glycated hemoglobin level (HbA1c), a measure used to assess the average blood glucose level over the previous three months, is expected to decrease macrovascular events by one sixth (8). Common risk factors of heart disease and heart failure in people with diabetes include a family history of heart disease, high dietary cholesterol intake, elevated serum cholesterol levels, hypertension, atherosclerosis, smoking status, and abdominal obesity (6).

Abdominal obesity has been shown to be directly related to an increase in the development of hypertension and heart disease (9). Independent of other risk factors of heart disease, abdominal obesity has been shown to diminish vascular response, playing a dangerous role in the development of atherosclerosis (9). Abdominal obesity lowers the

response of blood vessels to vasodilators such as acetylcholine and increases the contractile response to vasoconstrictors such as angiotensinogen II, which can cause damage to blood vessels (9). Management of abdominal obesity and excess weight gain is important in prolonging or preventing the development of comorbidities such as heart disease.

Excess weight gain and a resulting increased BMI were shown to be significantly associated with an increased prevalence of type 2 diabetes and hypertension in a study conducted using data from the 1999-2004 National Health and Nutrition Examination Survey (NHANES) (10). The study showed that as obesity increased so did the risk of developing hypertension and diabetes (10). Certain ethnicities and age groups were also shown to have an increased risk of these diseases. With increasing obesity, the largest increase in prevalence of hypertension was in Caucasian men and Mexican-American women aged 18-29 years (10). The largest increase in prevalence of diabetes was in Caucasian men and women, and Mexican-American women aged 30-49 years (10). Since Caucasian men and women and Mexican-American women are the most at risk for these diseases as weight increases, efforts to reduce weight and abdominal obesity should be emphasized.

In a review on the role gender plays in patients with heart failure with normal left ventricular ejection fraction, women were found to have a higher prevalence of this disease because of the presence of two major comorbidities: diabetes and hypertension (11). Women have been shown to be at a higher risk for hypertension because they have increased vascular wall thickness and smaller heart chambers (11). Diabetes and obesity

were also both shown to have a greater effect in women compared to men because of the greater roles they play in the progression of atherosclerosis in women (11). Postmenopausal women also lose the beneficial effects of estrogen on the heart after menopause (11).

Lifestyle and self-care behaviors also differ between genders and are directly related to management and disease progression in heart failure patients. A cross-sectional, correlational study of patients with heart failure by Heo et al., found that heart failure patients routinely did not participate in self-care behaviors (12). Self-care behaviors included following a low sodium diet, participating in regular exercise, and controlling body weight (12). Different factors affected self-care behaviors in men and women. In men, behaviors related to better self-care were better perceived control of taking care of one's self and heart failure management knowledge (12). For women, having a higher self-care confidence level and oddly a poorer functional status were related to better self-care behaviors (12). Women with a better functional status simply did not engage in as many self-care behaviors. Overall, self-care confidence was the most influential characteristic that affected self-care behaviors in heart failure patients (12). It seemed that when the patients were confident in taking care of themselves they had better results regardless of gender (12).

Although the evidence linking the benefits of following a healthy lifestyle and the reduction of the risk of developing heart failure and other cardiovascular diseases is strong, the amount of people following a healthy lifestyle is decreasing (13). Results of a study analyzing the number of adults who follow healthy lifestyle habits showed that over the last 16 years body mass indices (BMI) and moderate alcohol use increased,

physical activity and eating fresh fruits and vegetables decreased, and smoking rates did not change (13). Men have a greater decrease in healthy habits than women overall (13). The gender of the patient with heart failure is important in treatment and in management behavior and must be taken into account as well as family history.

Genetics play a strong role in heart disease and diabetes. In a study conducted on non-diabetic first degree relatives of a population of persons with diabetes, the relatives showed an increased whole body insulin resistance in skeletal muscle and adipose tissue (14). They also showed a higher intima media thickness of the internal carotid artery, which is a risk factor for atherosclerosis and heart disease (6,14). Pre-screening for diabetes and heart disease in people with a family history of diabetes is important in early prevention and detection of developing associated comorbidities (14).

A diet rich in fruits and vegetables and consequently lower in sodium has been shown to prevent heart disease, which is the leading cause of death in people with diabetes (15). A study by Vitolins et al., which analyzed the diets of 2,757 Americans with diabetes, found that 93 percent of the subjects exceeded recommended intakes of sodium, calories from fat, and saturated fat (15). Participants consumed 44 percent of energy from carbohydrates, 40 percent from fat, and 17 percent from protein (15). Adherence to diet recommendations given by healthcare providers and a reduction in sodium intake might delay the progression and complications of these diseases.

Hypertension and Heart Disease

Hypertension is a leading cause of cardiovascular disease and heart failure and a contributing factor to complications related to diabetes. High sodium diets have been shown to raise blood pressure, increase the risk of hypertension, heart disease, stroke, and heart failure in healthy populations (16,17). The average American consumes approximately 3,400 milligrams of sodium per day (16). The American Heart Association recommends that Americans consume 1,500 milligrams a day (16); the Dietary Guidelines for Americans recommend 1,500 milligrams a day for people over 50 years of age, African Americans, or those with hypertension, diabetes, or chronic kidney disease; and the adequate intake (AI) set for Americans is 1,500 milligrams a day, 1,300 milligrams per day for adults age 50-70, and 1,200 milligrams a day for adults over 70 years of age (16,18,19). Many Americans are consuming twice the recommended amount and should reduce their sodium intake (16).

A secondary data analysis was conducted using the National Health and Nutrition Examination Survey (NHANES) from 1999-2006 to evaluate the dietary quality of people with heart failure that were age 50 years and older (20). The results of the study showed that most people with heart failure had poor quality diets with a mean sodium intake of 2,719 milligrams (20). At the time of this survey, the American College of Cardiology and the American Heart Association recommended that people with heart failure follow a low-sodium diet defined as less than 2,000 milligrams of sodium per day (20). Only 34 percent of the heart failure population surveyed consumed less than this amount (20).

A study by Arcand et al., compared results of a lower, middle, and high sodium diet in medically stable heart failure patients to assess whether a high sodium diet was related to acute decompensated heart failure (17). The study showed that heart failure patients consuming a high sodium diet, which was defined as $\geq 2,800$ milligrams of sodium a day, were 2.5 times more likely to have early acute decompensated heart failure than heart failure patients consuming a lower sodium diet (17). Furthermore, patients with a higher dietary sodium intake had an elevated risk of going to the hospital for any cause and a higher mortality risk (17).

High sodium diets have been shown to increase risk factors for and conditions associated with heart failure, including hypertension, atherosclerosis, and heart disease while low sodium diets have been shown to result in significant decreases in body weight, blood pressure and creatinine clearance (20,21). In addition, a decreased sodium intake and increased potassium intake have been shown to lower blood pressure and decrease the risk of hypertension. A recent study by Cook et al. examined this relationship by measuring the urinary sodium to potassium excretion ratio (22). Increased risk of cardiovascular disease, coronary heart disease, and stroke was associated with increased urinary sodium excretion; reduction of these diseases occurred with increased urinary potassium excretion (22,23).

In addition to excessive sodium in the diet of heart failure patients, there are data suggesting that, as a group, heart failure patients are typically malnourished (3,4). Contributing factors include digestive disturbances, early satiety, and not having the energy to shop for food or prepare meals (3,4). Along with dietary counseling on reducing sodium intake, dietitians should focus on patients meeting estimated daily

calorie intake through a well-balanced diet and individualize meal plans to specific patients with regards to their medication regimens, comorbidities, and overall nutritional status (4).

Sodium intake should be controlled to reduce the risk of hypertension and the resulting comorbidities of heart failure and diabetes. According to a study by Bibbins-Domingo et al, a national effort to reduce individual sodium consumption by 1,190 milligrams per day is estimated to reduce annual new cases of coronary heart disease by up to 120,000, stroke by 66,000, myocardial infarction by 99,000, and reduce the annual number of deaths from any cause by 92,000 (24). Reduction of sodium by 1,190 milligrams a day is also predicted to reduce health care costs by \$10 billion to \$24 billion dollars (24). The predicted benefits of an anticipated national sodium reduction effort are shown to have a greater benefit for African Americans than other racial groups and a greater benefit for women over men (24).

Cardiovascular disease causes over 900,000 deaths a year and remains the leading cause of death among Caucasians and African Americans (25). African Americans have a lower long-term survival rate compared to Caucasians (25). African Americans diagnosed with cardiovascular disease when compared to Caucasians were more often female, younger, had higher BMI measurements, and had a higher prevalence of medical comorbidities including hypertension and diabetes (25). Hypertension was a strong predictor of cardiovascular disease among both African American and Caucasian patients, but diabetes was more predictive in Caucasians (25). Overall, African American women had the lowest survival rate and Caucasian men had the highest (25). African

American race remains an independent predictor of increased mortality in cardiovascular disease (25).

Diet Recommendations

There are three main diet recommendations that are available for heart failure patients with diabetes to follow. They are the Dietary Guidelines for Americans 2010, The American Heart Association's Diet and Lifestyle Recommendations 2006, and the American Diabetes Association's Standards of Medical Care in Diabetes 2011.

According to the Dietary Guidelines for Americans 2010, the consumption of fruit and vegetables, whole grains, and low-fat or fat-free dairy should be increased (26). The Dietary Guidelines recommend choosing a variety of protein sources including seafood and beans, limiting the amount of protein sources high in solid fats and choosing foods high in calcium, dietary fiber, potassium, and vitamin D which include fruits, vegetables, and dairy products (26). The Dietary Guidelines for Americans also state that saturated fat intake should be less than ten percent of total daily calories, consumption of dietary cholesterol should be less than 300 milligrams per day, and trans fatty acid consumption should be kept to a minimum or completely avoided if possible (26). Intake of solid fats, sugars, and refined grains should be reduced, and alcohol should be consumed in moderation (26). Moderate alcohol consumption is considered one drink a day for women and two drinks a day for men (26).

The American Heart Association (AHA) Diet and Lifestyle Recommendations 2006 emphasize maintaining a healthy body weight by balancing caloric intake with exercise (27). The AHA recommends consuming a diet high in fruits, vegetables, whole

grains, high-fiber foods, and oily fish and limiting intake of saturated fat to seven percent of total daily calories, trans fat to one percent of total daily calories, and cholesterol to 300 milligrams per day (27). The AHA suggests doing this by consuming lean meats and vegetarian options, consuming fat-free and low-fat dairy products, and reducing the intake of partially hydrogenated fats (27). The AHA also recommends reducing the intake of added sugars, using little to no salt, and consuming alcohol in moderation (27).

The American Diabetes Association's Standard of Medical Care in Diabetes 2011 outlines the recommended diet for patients with diabetes (28). Carbohydrate intake is very important in diabetes management (28). Saturated fat intake should be no more than seven percent of total daily calories, trans fatty acid intake should be kept at a minimum to reduce LDL cholesterol and increase HDL cholesterol, and alcohol should be consumed in moderation (28). The American Diabetes Association also recommends that individuals with diabetes consume 14 grams of fiber for every 1,000 kilocalories consumed and that one-half of all grains consumed be whole grains (28).

According to the Dietary Reference Intakes, acceptable macronutrient distribution ranges for adults are 45-65 percent of total energy from carbohydrate, 10-35 percent of total energy from protein, and 25-35 percent of total energy from fat (29). Approximately 10 percent of total energy from fat can come from *n*-3 or *n*-6 fatty acids (29).

Pharmacology and Nutrient Loss

Common medications used in the management of heart failure and diabetes have micronutrient interactions that further exacerbate pre-existing diets of poor quality.

Furosemide, a loop diuretic commonly used by heart failure patients, has been shown to increase thiamin excretion (30). Thiamin deficiency is a known cause of heart failure (31). Magnesium, calcium, and potassium are other micronutrients lost with the use of loop and thiazide diuretics (4). A magnesium deficiency may reduce energy availability and increase symptoms of fatigue (4).

Metformin, a drug regularly used in controlling blood glucose levels in type 2 diabetes, has been shown to reduce serum folate and vitamin B₁₂ levels and increase serum homocysteine levels (32,33). Increased blood levels of homocysteine are a cardiovascular risk factor in persons with diabetes and may be a cause of diabetic retinopathy (33). Although dietary intake of these nutrients may not be sufficient to account for these deficiencies, consuming an adequate diet is important in persons with heart failure and diabetes because of these drug-nutrient interactions. Avoiding micronutrient deficiencies is essential in managing these disease states.

Nutrition Intake Methodology

There are several assessment methods for nutrient intake. The most commonly used methods are the 24 hour diet recall, food frequency questionnaire, and the food record. Each has its benefits and limitations.

The 24-hour diet recall records everything a person ate from the previous 24 hours. These data are recorded in an interview with a trained professional (34). Benefits of the 24-hour diet recall are the quickness and ease of completion for the participant; one drawback is that it is not a good measure of usual intake. The 24-hour diet recall provides only a snapshot of intake. Another commonly used method is the food

frequency questionnaire, which records frequency of intake of typically consumed foods over a period of time (35). Food frequency questionnaires provide a better report of habitual intake compared to the 24-hour recall, and the person is usually able to take the questionnaire without the help of an interviewer. The food frequency questionnaire has limitations: it requires the recorder to be literate; certain foods that a person usually eats could be missing from the questionnaire; and the person could have problems quantifying his usual intake.

The food record is another method used to assess dietary intake. The food record requires the participant to record food items and amounts they eat and drink for a period of time (34). A three day food record has been determined to be the optimum amount of days to determine average calories consumed (35). The food record was used in the ENSPIRE study.

A benefit of the food record is that it does not rely on memory. The participants record everything they eat and drink as they consume the food or beverage. The food record is also useful in helping participants become more aware of what they are consuming, and it is more valid than a single 24 hour recall. A possible limitation of the food record is that the time period when dietary intake is recorded may not be typical. Another shortcoming is that the participant might change what is typically consumed or chooses to not record everything he eats. Furthermore, eating habits might have recently changed.

Assessment of sodium intake is an important measure for heart failure patients. With the increase of convenience and pre-packaged foods in the diet, sodium consumption has increased dramatically for heart failure patients and healthy Americans

alike. Research has shown that a 24-hour urine collection is the gold standard to assess sodium intake, but this measure is not accurate for heart failure patients on loop diuretic therapy, nor does it take into account day to day variation in sodium intake (36). Due to the challenge of collecting urine specimens over several days, food records have been shown to be the best method in the assessment of sodium intake long-term and in heart failure patients who are taking loop diuretics (36).

References

1. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care*. 2009;33(suppl 1):S62-S69.
2. Mayo Foundation for Medical Education and Research. Heart failure - MayoClinic.com. *Heart failure: definition*. 2009.
<http://www.mayoclinic.com/health/heart-failure/DS00061>. Accessed April 19, 2011.
3. Aquilani R, Opasich C, Verri M, et al. Is nutritional intake adequate in chronic heart failure patients? *J. Am. Coll. Cardiol.* 2003;42(7):1218-1223.
4. Grossniklaus DA, O'Brien MC, Clark PC, Dunbar SB. Nutrient intake in heart failure patients. *J Cardiovasc Nurs.* 2008;23(4):357-363.
5. National Institutes of Health of the U.S. Department of Health and Human Services, National Institute of Diabetes and Digestive and Kidney Diseases. Prevent diabetes problems: Keep your heart and blood vessels healthy. 2009.
http://diabetes.niddk.nih.gov/dm/pubs/complications_heart/. Accessed April 19, 2011.
6. Faeh D, William J, Yerly P, Paccaud F, Bovet P. Diabetes and pre-diabetes are associated with cardiovascular risk factors and carotid/femoral intima-media thickness independently of markers of insulin resistance and adiposity. *Cardiovasc Diabetol.* 2007;6:32.
7. National Institutes of Health of the U.S. Department of Health and Human Services, National Institute of Diabetes and Digestive and Kidney Diseases. Diagnosis of Diabetes. 2008. <http://diabetes.niddk.nih.gov/dm/pubs/diagnosis/>. Accessed April 19, 2011.
8. Patel A, MacMahon S, Chalmers J, et al. Intensive blood glucose control and vascular outcomes in patients with type 2 diabetes. *N. Engl. J. Med.* 2008;358(24):2560-2572.

9. Rueda-Clausen CF, Lahera V, Calderón J, et al. The presence of abdominal obesity is associated with changes in vascular function independently of other cardiovascular risk factors. *Int. J. Cardiol.* 2010;139(1):32-41.
10. Nguyen NT, Magno CP, Lane KT, Hinojosa MW, Lane JS. Association of hypertension, diabetes, dyslipidemia, and metabolic syndrome with obesity: findings from the National Health and Nutrition Examination Survey, 1999 to 2004. *J. Am. Coll. Surg.* 2008;207(6):928-934.
11. Regitz-Zagrosek V, Brokat S, Tschope C. Role of gender in heart failure with normal left ventricular ejection fraction. *Prog Cardiovasc Dis.* 2007;49(4):241-251.
12. Heo S, Moser DK, Lennie TA, Riegel B, Chung ML. Gender differences in and factors related to self-care behaviors: a cross-sectional, correlational study of patients with heart failure. *Int J Nurs Stud.* 2008;45(12):1807-1815.
13. King DE, Mainous AG 3rd, Carnemolla M, Everett CJ. Adherence to healthy lifestyle habits in US adults, 1988-2006. *Am. J. Med.* 2009;122(6):528-534.
14. Anderwald C, Pfeiler G, Nowotny P, et al. Glucose turnover and intima media thickness of internal carotid artery in type 2 diabetes offspring. *Eur. J. Clin. Invest.* 2008;38(4):227-237.
15. Vitolins MZ, Anderson AM, Delahanty L, et al. Action for Health in Diabetes (Look AHEAD) trial: baseline evaluation of selected nutrients and food group intake. *J Am Diet Assoc.* 2009;109(8):1367-1375.
16. American Heart Association. Sodium (Salt or Sodium Chloride). *Sodium (Salt or Sodium Chloride)*. 2011.

http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Sodium-Salt-or-Sodium-Chloride_UCM_303290_Article.jsp. Accessed April 20, 2011.

17. Arcand J, Ivanov J, Sasson A, et al. A high-sodium diet is associated with acute decompensated heart failure in ambulatory heart failure patients: a prospective follow-up study. *Am. J. Clin. Nutr.* 2011;93(2):332-337.

18. U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2010. 2010. <http://www.cnpp.usda.gov/DGAs2010-PolicyDocument.htm>. Accessed April 20, 2011.

19. Institute of Medicine of the National Academies. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. 2011.

<http://www.iom.edu/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx>. Accessed April 19, 2011.

20. Lemon SC, Olendzki B, Magner R, et al. The dietary quality of persons with heart failure in NHANES 1999-2006. *J Gen Intern Med.* 2010;25(2):135-140.

21. Alvelos M, Ferreira A, Bettencourt P, et al. The effect of dietary sodium restriction on neurohumoral activity and renal dopaminergic response in patients with heart failure. *Eur. J. Heart Fail.* 2004;6(5):593-599.

22. Cook NR, Obarzanek E, Cutler JA, et al. Joint effects of sodium and potassium intake on subsequent cardiovascular disease: the Trials of Hypertension Prevention follow-up study. *Arch. Intern. Med.* 2009;169(1):32-40.

23. Woo J, Kwok T, Leung J, Tang N. Dietary intake, blood pressure and osteoporosis. *J Hum Hypertens.* 2009;23(7):451-455.

24. Bibbins-Domingo K, Chertow GM, Coxson PG, et al. Projected effect of dietary salt reductions on future cardiovascular disease. *N. Engl. J. Med.* 2010;362(7):590-599.
25. Thomas KL, Honeycutt E, Shaw LK, Peterson ED. Racial differences in long-term survival among patients with coronary artery disease. *Am. Heart J.* 2010;160(4):744-751.
26. U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2010. www.dietaryguidelines.gov. Accessed July 14, 2011.
27. Lichtenstein AH, Appel LJ, Brands M, et al. Diet and Lifestyle Recommendations Revision 2006. *Circulation.* 2006;114(1):82 -96.
28. American Diabetes Association. Standards of Medical Care in Diabetes--2011. *Diabetes Care.* 2010;34(suppl 1):S11-S61.
29. Institute of Medicine of the National Academies. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients) 2005. http://www.nal.usda.gov/fnic/DRI/DRI_Energy/107-264.pdf. Accessed November 1, 2011.
30. Suter PM, Vetter W. Diuretics and vitamin B1: are diuretics a risk factor for thiamin malnutrition? *Nutr. Rev.* 2000;58(10):319-323.
31. Witte KA, Nikitin NP, Parker AC, et al. The effect of micronutrient supplementation on quality-of-life and left ventricular function in elderly patients with chronic heart failure. *Eur. Heart J.* 2005;26(21):2238-2244.
32. Sahin M, Tutuncu NB, Ertugrul D, Tanaci N, Guvener ND. Effects of metformin or rosiglitazone on serum concentrations of homocysteine, folate, and vitamin B12 in patients with type 2 diabetes mellitus. *J. Diabetes Complicat.* 2007;21(2):118-123.

33. Wulffelé MG, Kooy A, Lehert P, et al. Effects of short-term treatment with metformin on serum concentrations of homocysteine, folate and vitamin B12 in type 2 diabetes mellitus: a randomized, placebo-controlled trial. *J. Intern. Med.* 2003;254(5):455-463.
34. Mahan LK, Escott-Stump S. *Krause's Food & Nutrition Therapy*. 12th ed. St. Louis, MS: Saunders Elsevier; 2007: 395-397.
35. Basiotis PP, Welsh SO, Cronin FJ, Kelsay JL, Mertz W. Number of days of food intake records required to estimate individual and group nutrient intakes with defined confidence. *J. Nutr.* 1987;117(9):1638-1641.
36. Arcand J, Floras JS, Azvedo E, Mak S, Newton GE, Allard JP. Evaluation of 2 methods for sodium intake assessment in cardiac patients with and without heart failure: the confounding effect of loop diuretics. *Am. J. Clin. Nutr.* 2011;93(3):535-541.

CHAPTER III

Manuscript in Style of Journal

1 **AUTHOR'S PAGE**

2 The Relationship between Diet Quality and the Comorbidity of Diabetes in Adults with
3 Heart Failure

4 Key Words: Heart Failure, Diabetes, Nutrition, Diet

5 Word Count – Abstract: 238

6 Word Count – Text: 2597

7

8 Jessica Hill, MS; 2992 Glenrock Drive, Macon, GA 31204; Phone: 478-997-1268;

9 jmhill1187@gmail.com

10

11 Anita M. Nucci, PhD, RD, LD; Assistant Professor and Graduate Program Director;

12 Division of Nutrition, School of Health Professions, College of Health and Human

13 Sciences, Georgia State University; P.O. Box 3995, Atlanta, GA, 30302-3995; Phone:

14 (404) 413-1234; Fax: (404) 413-1228; anucci@gsu.edu

15

16 Jennifer Frediani, MS, RD, LD, ACSM-CES; Bionutrition Research Director, ACTSI-

17 CIN; Emory University; Phone: 404-712-7239; JFREDIA@emory.edu

18

19 Barbara Hopkins, MMSc, RD, LD; Clinical Instructor and Didactic Program in Dietetics

20 Director; Division of Nutrition, School of Health Professions, College of Health and

21 Human Sciences, Georgia State University; P.O. Box 3995, Atlanta, GA, 30302-3995;

22 Phone: (404) 413-1238; Fax: (404) 413-1228; bhopkins@gsu.edu

23 Dr. Sandra Dunbar, RN, DSN, FAAN, FAHA; Associate Dean for Academic
24 Advancement; Emory University's Nell Hodgson Woodruff School of Nursing, 201
25 Downman Drive. Atlanta, GA 30322; Phone: 404-727-6939; sbdunba@emory.edu

26

27 Corresponding Author: Anita M. Nucci

28 Author for Reader Requests for Reprints: Anita M. Nucci

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46 **ABSTRACT**

47 Heart failure and diabetes are common coexisting diseases. Elevated levels of
48 glucose in the blood caused by insulin resistance can damage blood vessels and nerves,
49 and eventually lead to heart disease. A poor diet and obesity can also contribute to the
50 progression of heart disease and macrovascular complications related to diabetes.

51 The purpose of this study was to determine a difference in diet quality between
52 adult heart failure patients with and without diabetes who are participating in the
53 EducationN, and Supportive Partners Improving Self-CaRE (ENSPIRE) study. Daily
54 dietary intake of calories, sodium, carbohydrate, fat, sugar, and fiber was assessed via a
55 3-day food record. Differences in anthropometric measures, smoking history, education
56 level and health literacy score between the two groups were also assessed. 117 heart
57 failure patients were included in the analysis. Of these, 39% had diabetes.

58 The study population was predominantly male (62%) and African American
59 (58%) with mean age being 56.1 ± 10.4 years. Weight was higher in heart failure
60 patients with vs. without diabetes (104.9 vs. 92.6 kg, respectively; $P < 0.05$). Total daily
61 sugar intake was lower in men with diabetes than in those without (49 vs. 89 g/day,
62 respectively; $P < 0.01$). Other anthropometric values, lifestyle characteristics and nutrient
63 variables were not significantly different between the two groups. We recommend
64 encouraging these individuals to closely monitor their macronutrient intake, specifically
65 limiting fat in the diet. Meeting with a dietitian to ensure adequate nutrient intake is
66 strongly recommended.

67

68

69 THE RELATIONSHIP BETWEEN DIET QUALITY AND THE COMORBIDITY OF
70 DIABETES IN ADULTS WITH HEART FAILURE

71

72 **INTRODUCTION**

73 Heart failure and diabetes are common coexisting diseases in the population. The
74 order in which these diseases occur is individualized. Diabetes is a metabolic disorder
75 characterized by the body's misuse of glucose for energy (1). There are two main types
76 of diabetes, type 1 and type 2. Type 1 diabetes accounts for about five to ten percent of
77 all diagnosed cases of diabetes (1). People with type 1 diabetes do not produce any
78 insulin and are dependent on exogenous insulin for survival (1). Type 2 diabetes
79 accounts for about 90 to 95 percent of diabetes cases and is characterized by insulin
80 resistance. Although the exact etiology is unclear, obesity, specifically abdominal
81 obesity, contributes to the insulin resistance (1).

82 Type 2 diabetes is not typically detected immediately because of the slow
83 progression of the disease (1). Elevated levels of glucose in the blood can damage blood
84 vessels and nerves, and eventually lead to heart disease and stroke if left untreated (1).
85 Once diabetes is diagnosed it is important to keep blood glucose levels under control. It
86 has been shown that even a 0.7% reduction in the glycated hemoglobin level (HbA1c), a
87 measure used to assess blood glucose levels over the past three months, is expected to
88 decrease macrovascular events by one sixth (2). Common risk factors of heart disease
89 and heart failure in people with diabetes include a family history of heart disease, high
90 dietary cholesterol, high plasma cholesterol, hypertension, atherosclerosis, smoking
91 status, and abdominal obesity (3).

92 Dietitians are integrally involved in the care of patients with heart failure and
93 diabetes, primarily through dietary planning, education, and counseling of patients and
94 their families. One of the issues faced is how to adequately educate these patients with
95 regard to their diets (4,5). We are investigating whether there is a difference in diet
96 quality between heart failure patients with and without diabetes on parameters of daily
97 intake of calories, sodium, carbohydrate, fat, sugar, and fiber. We are also investigating
98 differences between the two groups in gender, age, ethnicity, education level, and health
99 literacy scores. We hypothesize that sodium consumption in adults with heart failure will
100 be higher in those with diabetes than those without diabetes. We plan to use this
101 information to identify where further nutrition education is needed.

102

103 **METHODS**

104 Using data collected from the ENSPIRE study, a prospective, randomized,
105 controlled clinical trial, a secondary data analysis will be conducted comparing nutrition
106 outcome variables between heart failure patients with and without diabetes.

107

108 **Study Population**

109

110 The ENSPIRE study was conducted by the Emory University Nell Hodgson
111 Woodruff School of Nursing. Participants were recruited from the Emory Clinic at
112 Emory University Hospital, Veterans Administration Medical Center (VAMC), Emory
113 University Hospital Midtown, the General Clinical Research Center at Emory University,
114 and Grady Memorial Hospital. One of the inclusion criteria included having a

115 documented diagnosis of heart failure categorized as class II or III by the New York
116 Heart Association (NYHA) functional classification criteria for heart failure. In addition,
117 participants had to be between the ages of 30-79 years, ambulatory, literate, able to write
118 and speak English, have telephone access, have no contraindications to a low sodium diet
119 as indicated by their primary care provider, have a glomerular filtration rate >30
120 mL/min/1.73 m², and be on a medication regimen that included angiotensin-converting
121 enzyme inhibitors (ACE-I) or angiotensin II receptor blockers (ARB) and diuretics or
122 documented contraindications to these drugs. Participants had to have an eligible family
123 member in a caregiver relationship defined as a spouse, partner, or other adult (≥ 19 years)
124 that lived in the same house or was in contact with the heart failure patient at least 2 times
125 per week.

126 Participants were excluded from the study if they met criteria for NYHA class I or
127 IV, had suffered from an acute myocardial infarction (AMI) in the past six months, had
128 significant angina pectoris, renal failure, heart failure secondary to an untreated medical
129 condition (e.g. hyperthyroidism), planned cardiac surgery, impaired cognition due to
130 neurological comorbidity, psychiatrist diagnosis or an uncorrected visual or hearing
131 problem. The primary study enrolled 262 participants. For the secondary analysis, we
132 aim for a sample of >100 participants, at least 50 with diabetes and 50 without diabetes.

133

134 **Research Design**

135 The research design was an exploratory, cross-sectional, cohort study. We
136 will be analyzing relationships between dietary and lifestyle factors of heart failure
137 patients, specifically between those participants with diabetes and those without diabetes.

138 We will be analyzing data from the cohort of heart failure patients at baseline.

139

140 **Data Collection**

141 Data to be analyzed include dietary intake of kilocalories, sodium,
142 carbohydrate, fat, sugar, and fiber recorded from a 3-day food record at baseline.

143 Demographic data recorded at baseline included gender, age, ethnicity, education level,
144 and health literacy score, which assessed the participant's understanding of prior health
145 education and information received. Baseline data are shown in Table 1.

146

147

148

149

150

151

152

153

154

155

156

157

158

159

160

161 Table 1. Outcome variables measured and tests/instruments used in the ENSPIRE* study

Variable	Test/Instrument
Weight (kg)	Scale-Tronix 5005
Height (cm)	Stadiometer
BMI (kg/m ²)	Calculated
Presence of diabetes	Charlson Comorbidity Index
Presence of HTN**	Survey
Dietary kilocalories	3-day food record
Dietary sodium intake	3-day food record
Dietary carbohydrate intake	3-day food record
Dietary fat intake	3-day food record
Dietary sugar intake	3-day food record
Dietary fiber intake	3-day food record
Gender	Survey
Age	Survey
Ethnicity	Survey
Education level	Survey
Health literacy score- REALM	Survey
Smoking Status	Survey

162 *ENSPIRE - Education and Supportive Partners Improving Self-Care

163 **HTN – hypertension

164

165 **Data Analysis**

166 Demographic and anthropometric characteristics, nutrient intake and lifestyle
167 behaviors between heart failure patients with and without diabetes were described and
168 compared using frequency statistics. Outliers in the data were identified and removed.
169 Anthropometric data was described using the t-test for height and weight and the Mann
170 Whitney U test for BMI. After stratifying for gender and diabetes status, the Chi-square
171 analysis was used to compare education level, health literacy score, smoking status, and
172 hypertension status. The Chi-square analysis was also used to compare smoking and
173 diabetes, hypertension and diabetes, education and diabetes, and smoking and diabetes.
174 The Mann Whitney U test was used to assess nutrient intake when comparing males and
175 females with and without diabetes. All analyses were conducted using SPSS v.18
176 software.

177

178 **RESULTS**

179 The demographic characteristics of heart failure patients with and without
180 diabetes are listed in Table 2. Of the 117 heart failure patients in the ENSPIRE study,
181 forty-six (39%) had diabetes and eighty-six (74%) had HTN. Diabetes and hypertension
182 were more common in males than females. The study population was predominantly
183 male (62%) and the mean age of the population was 56.1 ± 10.4 years. A higher
184 percentage of the population was African American (58%). Anthropometric
185 characteristics of the population by gender and diabetes status are shown in Table 3. The
186 weight and BMI measurements reported in this study are based on the dry weight of the
187 participants. Height and weight data were normally distributed while BMI data was

188 skewed. Height and weight differed by gender with males being significantly taller and
189 heavier than females ($P < 0.05$). Weight and BMI were significantly higher for those
190 with diabetes than those without diabetes ($P < 0.05$).

191 Lifestyle characteristics including education level and health literacy score of
192 heart failure patients are shown for males and females in Tables 4 and 5, respectively.
193 The majority of male participants had a high school education or less (55%) while more
194 than half of female participants had a college education (52%). When stratified by
195 diabetes status, 53% of males with diabetes had a college education compared to only
196 39% of those without diabetes. Of female heart failure patients with diabetes, 43% had a
197 college education compared to 57% of those without diabetes (57%). These reported
198 differences in education level for males and females by diabetes status were not
199 statistically significant.

200 Of male heart failure patients with diabetes, 74% had a health literacy score
201 equal to a 12th grade education compared to 62% of males without diabetes. Sixty-four
202 and 75% of female heart failure patients with and without diabetes, respectively had
203 health literacy scores equal to a 12th grade education. The differences in health literacy
204 scores for males and females by diabetes status were not statistically significant.

205 The smoking history of the population by diabetes status and gender is
206 shown in Table 6 for males and Table 7 for females. Of the male heart failure patients
207 with diabetes, nineteen (61%) were either current or former smokers, and twelve (39%)
208 never smoked. Of males without diabetes, the number of current or former smokers was
209 slightly higher at 63%. Of the 14 female heart failure patients with diabetes, only two
210 (14%) smoked. Of females without diabetes, 30% were current or former smokers.

211 These reported differences in smoking status were not statistically significant for either
212 males or females.

213 The comorbidities of hypertension and diabetes in heart failure patients are shown
214 in Table 8 and Table 9 for males and females, respectively. Of the 73 male heart failure
215 patients, fifty-five (75%) have hypertension. Of these, approximately half (n=26, 47%)
216 also have diabetes. No significant association between HTN and diabetes status was
217 found in males. Of the 44 female heart failure patients, thirty-one (70%) have
218 hypertension. Of these women, thirteen (42%) also have diabetes. A significant
219 association was found between hypertension and diabetes in female heart failure patients
220 ($P < 0.05$).

221 The distributions of reported nutrient intake values were skewed. Therefore,
222 median intakes for males and females with and without diabetes are shown in Tables 10
223 and 11, respectively. Male heart failure patients with diabetes reportedly consumed 49
224 grams of sugar per day, 40 fewer grams of sugar than male heart failure patients without
225 diabetes ($P < 0.01$). Also shown in Tables 10 and 11 is fat as a percentage of total
226 calories. Men with diabetes consumed more fat as a percentage of total calories than men
227 without diabetes at 38 and 35 percent respectively. Women consumed slightly less fat as
228 a percentage of total calories. Women with diabetes consumed 33 percent and women
229 without diabetes consumed 36 percent. No other significant differences in nutrient intake
230 were found in males or females by diabetes status. No significant differences in nutrient
231 intake were found by gender or diabetes status after subdividing the cohort by ethnicity
232 (data not shown).

233

234 **DISCUSSION**

235 We evaluated characteristics of heart failure patients, including demographics, the
236 existence of concomitant diseases of hypertension and diabetes, anthropometrics, and
237 lifestyle characteristics. We found that height and weight were significantly greater in
238 males than in females, which was not unexpected. Weight was significantly higher in
239 heart failure patients with diabetes, which is consistent with current literature stating that
240 82 percent of Americans with diabetes are considered overweight, with 46 percent
241 classified as obese (6,7). This is a concern since excess weight contributes to insulin
242 resistance in individuals and can contribute to the progression of many diseases. We also
243 found an association between hypertension and diabetes in females. Women have
244 smaller heart chambers and a thicker vascular wall, which causes them to have a higher
245 risk of hypertension than men (8). Diabetes and obesity also affect women differently
246 than men causing a more rapid progression of atherosclerosis (8). The only dietary factor
247 found to be different between heart failure patients with and without diabetes was total
248 grams of daily sugar intake in men. The observation reflects the expected avoidance of
249 foods with a high amount of sugar in people with diabetes. Despite the fact that less
250 sugar was consumed by both men and women with diabetes, they both weighed
251 significantly more on average than those without diabetes. A possible explanation is that
252 this population obtains calories from another energy source such as fat or complex
253 carbohydrates. A study by Vitolins et al., which analyzed the diets of 2,757 Americans
254 with diabetes, found that 93 percent of the subjects exceeded recommended intakes of
255 sodium, calories from fat, and saturated fat (6). Participants consumed 44 percent of
256 energy from carbohydrates, 40 percent from fat, and 17 percent from protein (6).

257 Vitolins et al. pointed out the lower contribution of carbohydrates and higher contribution
258 of fat to their diets which is similar to the participants with diabetes in our study (6).
259 Men with diabetes are exceeding the dietary guidelines recommendation of 25 to 35
260 percent of calories from fat consuming 38 percent of total calories from fat. Women are
261 consuming a percentage of calories from fat that is closer to the dietary guidelines goal.
262 All groups in the ENSPIRE study consumed more sodium than recommended. Although
263 those with diabetes consumed more daily sodium on average than those without diabetes,
264 the difference was not statistically significant.

265 Our results are consistent with a recent study that compared the diets of
266 Americans with chronic diseases to those without chronic diseases (9). Chen et al. found
267 that patients with diabetes consumed significantly less sugar than those without diabetes
268 (9). This study also showed that compared with healthy individuals, patients with
269 chronic diseases including heart disease and diabetes had lower energy intake (9). As
270 with our study, the authors hypothesized that people with chronic diseases, especially
271 more than one chronic disease, were more aware of healthy eating habits and nutrition
272 information although this was not always apparent in their diet (9). Nelson et al.
273 demonstrated this in a study that analyzed data from the third National Health and
274 Nutrition Examination Survey (NHANES III) (7). They reported that 62 percent of
275 individuals with diabetes consumed fewer than five servings of fruit and vegetables per
276 day. In addition, 42 percent consumed 30 to 40 percent of their daily calories from fat
277 and 26 percent consumed >40 percent of their daily calories from fat (7). Although
278 patients with diabetes may be aware of healthy eating habits, compliance remains a
279 problem. This is a rising trend in the United States as the prevalence of overweight and

280 obesity continues to grow along with the number of Americans with diabetes and other
281 concomitant diseases.

282 There are several limitations to our study. Smoking data were divided into three
283 categories of current smokers, recent smokers, and people that have never smoked. The
284 amount of time that had elapsed since the recent smokers had smoked was not disclosed,
285 which makes our conclusion that there is no difference in smoking by diabetes status
286 questionable. Much of the data collected from the heart failure patients in this study were
287 self-reported, which could introduce reporting biases. The respondents could have
288 purposely under-reported or over-reported the amounts of food they were consuming.
289 Another limitation of this study is its cross-sectional design. External variables including
290 cohort effects, or differences in the heart failure patients' time of birth or generation, and
291 life choices made by the heart failure patient, such as drug and alcohol use, exercise and
292 eating habits, and the frequency of doctor's visits can affect this study design.

293

294 **CONCLUSION**

295 As we hypothesized, the lifestyle characteristics and reported dietary intakes of
296 heart failure patients with and without diabetes in this study were not significantly
297 different with the exception of sugar intake in males. We accept the null hypothesis
298 because there was no statistically significant difference in sodium intake between heart
299 failure patients with and without diabetes. However, since weight was significantly
300 higher in heart failure patients with diabetes and they consumed fewer carbohydrates than
301 their non-diabetic counterparts, we recommend encouraging these individuals to closely
302 monitor their macronutrient intake, specifically limiting fat in the diet. Nutrition

303 education with a dietitian to ensure adequate nutrient intake is strongly recommended.
304 We also recommend education to promote a healthy lifestyle. If proper nutrition and
305 healthy cooking methods are taught early in life, the risk of developing chronic diseases
306 is reduced.

307 In the future, lifestyle factors of patients with heart failure and with diabetes
308 should be analyzed more critically. The more we know about the behaviors that are
309 linked to these diseases, the better we can counsel patients and develop methods of
310 preventive treatment. Although the ENSPIRE study was a randomized clinical trial, our
311 secondary analysis was cross-sectional. Instead of using a cross-sectional design
312 assessing only one point in time, we recommend for future studies to use a longitudinal
313 design and assess nutrient intake over an extended period to understand if nutrition
314 education is effective in changing dietary habits in this population.

315

316

317

318

319

320

321

322

323

324

325 **TABLES**

326 Table 2. Demographic Variables by Gender of Heart Failure Patients in the ENSPIRE Study

	Total (%) N=117	Males (%) N=73	Females (%) N=44
Diabetes	46 (39)	32 (44)	14 (32)
HTN	86 (74)	55 (75)	31 (70)
Race			
Black	68 (58)	38 (52)	30 (68)
White	49 (42)	35 (48)	14 (32)
Mean age ^a	56.1 ± 10.4	57.5 ± 9.9	53.8 ± 10.9

327 Abbreviations: HTN – hypertension

328 ^aMean ± SD

329

330

331

332

333

334

335

336

337

338

339

340

341 Table 3. Anthropometric Characteristics by Gender and Diabetes Status of Heart Failure

342 Patients in the ENSPIRE Study

	Height (in) ^a	Weight (lbs) ^a	BMI (ht/wt ²) ^b
Total Population	67.1 ± 4.1	214.9 ± 51.2	32.4 (27.2, 39.0)
Males	68.9 ± 3.9 ^c	223.5 ± 46.3 ^c	32.4 (27.3, 38.5)
Females	64.2 ± 2.4	200.5 ± 56.0	33.0 (27.1, 40.2)
Diabetes Status			
Diabetes	67.5 ± 3.6	231.3 ± 48.6 ^d	35.3 (30.0, 40.2) ^d
No Diabetes	66.9 ± 4.4	204.2 ± 50.3	32.0 (25.6, 36.7)

343 Abbreviations: in – inches; lbs – pounds; BMI – body mass index

344 ^aMean ± SD345 ^bMedian (25%, 75%)346 ^cP < 0.05 (comparison by gender)347 ^dP < 0.05 (comparison by diabetes status)

348

349

350

351

352

353

354

355

356

357

358

359 Table 4. Lifestyle Characteristics of Male Heart Failure Patients in the ENSPIRE Study

	Total (%) N=73	Diabetes (%) N=32	No Diabetes (%) N=41
Education			
High school or less	40 (55)	15 (47)	25 (61)
College or higher	33 (45)	17 (53)	16 (39)
Health literacy score			
≤8 th grade	23 (32)	8 (26)	15 (38)
12 th grade	48 (68)	23 (74)	25 (62)

360

361

362

363

364

365

366

367

368

369

370

371

372

373

374 Table 5. Lifestyle Characteristics of Female Heart Failure Patients in the ENSPIRE Study

	Total (%) N=44	Diabetes (%) N=14	No Diabetes (%) N=30
Education			
High school or less	21 (48)	8 (57)	13 (43)
College or higher	23 (52)	6 (43)	17 (57)
Health literacy score			
$\leq 8^{\text{th}}$ grade	12 (29)	5 (36)	7 (25)
12 th grade	30 (71)	9 (64)	21 (75)

375

376

377

378

379

380

381

382

383

384

385

386

387

388

389 Table 6. Smoking History and Diabetes Status of Male Heart Failure Patients in the ENSPIRE
 390 Study

	Total (%)	Diabetes (%)	No Diabetes (%)
Smoking			
Yes	64 (62)	19 (61)	26 (63)
No	39 (38)	12 (39)	15 (37)

391

392

393

394

395 Table 7. Smoking History and Diabetes Status of Female Heart Failure Patients in the
 396 ENSPIRE Study

	Total (%)	Diabetes (%)	No Diabetes (%)
Smoking			
Yes	11 (25)	2 (14)	9 (30)
No	33 (75)	12 (86)	21 (70)

397

398

399

400

401

402

403

404 Table 8. Hypertension and Diabetes of Male Heart Failure Patients in the ENSPIRE Study

	Total (%) N=73	Diabetes N=32	No Diabetes N=41
HTN No	18 (25)	6	12
Yes	55 (75)	26	29

405

406

407

408

409

410

411 Table 9. Hypertension and Diabetes of Female Heart Failure Patients in the ENSPIRE Study

	Total (%) N=44	Diabetes N=14	No Diabetes N=30
HTN No	13 (30)	1	12
Yes	31 (70)	13	18

412

413

414

415

416

417

418

419 Table 10. Nutrient Intakes for Male Heart Failure Patients in the ENSPIRE study^a

	Diabetes	No Diabetes
Kcals ^a	1570 (1379, 1934)	1666 (1394, 2065)
CHO (g) ^a	178 (149, 206)	220 (139, 273)
Fat (g) ^a	66 (57, 75)	70 (47, 80)
Na (mg) ^a	2726 (2105, 4230)	2645 (1955, 3366)
Fiber (g) ^a	17 (13, 20)	14 (9, 18)
Sugar (g) ^a	49 (37, 83) ^c	89 (45, 128)
Fat (%) ^b	38	35

420 Abbreviations: Kcals – kilocalories, CHO – carbohydrate, Na - sodium

421 ^aMedian (25%, 75%)422 ^bPercentage of total calories423 ^cP < 0.01 (comparison by diabetes status)

424

425

426

427

428

429

430

431

432

433

434

435

436 Table 11. Nutrient Intakes for Female Heart Failure Patients in the ENSPIRE study^a

	Diabetes	No Diabetes
Kcals ^a	1112 (1018, 1783)	1482 (1009, 1823)
CHO (g) ^a	126 (103, 223)	208 (135, 241)
Fat (g) ^a	43 (33, 60)	57 (34, 78)
Na (mg) ^a	2039 (1291, 2461)	1933 (1093, 2694)
Fiber (g) ^a	12 (8, 16)	13 (9, 21)
Sugar (g) ^a	46 (35, 103)	87 (59, 123)
Fat (%) ^b	33	36

437 Abbreviations: Kcals – kilocalories, CHO – carbohydrate, Na - sodium

438 ^aMedian (25%, 75%)439 ^bPercentage of total calories440 ^cP < 0.01 (comparison by diabetes status)

441

442

443

444

445

446

447

448

449

450 **REFERENCES**

- 451 1. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus.
452 *Diabetes Care*. 2009;33(suppl 1):S62-S69.
- 453 2. Patel A, MacMahon S, Chalmers J, et al. Intensive blood glucose control and vascular
454 outcomes in patients with type 2 diabetes. *N. Engl. J. Med.* 2008;358(24):2560-2572.
- 455 3. Faeh D, William J, Yerly P, Paccaud F, Bovet P. Diabetes and pre-diabetes are
456 associated with cardiovascular risk factors and carotid/femoral intima-media thickness
457 independently of markers of insulin resistance and adiposity. *Cardiovasc Diabetol.*
458 2007;6:32.
- 459 4. Aquilani R, Opasich C, Verri M, et al. Is nutritional intake adequate in chronic heart
460 failure patients? *J. Am. Coll. Cardiol.* 2003;42(7):1218-1223.
- 461 5. Grossniklaus DA, O'Brien MC, Clark PC, Dunbar SB. Nutrient intake in heart failure
462 patients. *J Cardiovasc Nurs.* 2008;23(4):357-363.
- 463 6. Vitolins MZ, Anderson AM, Delahanty L, et al. Action for Health in Diabetes (Look
464 AHEAD) trial: baseline evaluation of selected nutrients and food group intake. *J Am Diet*
465 *Assoc.* 2009;109(8):1367-1375.
- 466 7. Nelson KM, Reiber G, Boyko EJ. Diet and exercise among adults with type 2 diabetes:
467 findings from the third national health and nutrition examination survey (NHANES III).
468 *Diabetes Care.* 2002;25:1722-1728.
- 469 8. Regitz-Zagrosek V, Brokat S, Tschope C. Role of gender in heart failure with normal
470 left ventricular ejection fraction. *Prog Cardiovasc Dis.* 2007;49(4):241-251.
- 471 9. Chen X, Cheskin LJ, Shi L, Wang Y. Americans with diet-related chronic diseases
472 report higher diet quality than those without these diseases. *J. Nutr.* 2011;141:1543-1551.